



A Crowdsourcing Study of Perceived Credibility of Reddit Content Based on a Novel Data Scraping Tool

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Abstract

The internet is a forever growing trove of information. It is well known, both in the public and in academia that in the last years the unhindered access to the internet gave everyone more opportunities to post fake or misleading content. Furthermore, the growing interest in artificial intelligence and large language models showed how easy it is for people to be provided, possibly by mistake, with misleading content through AI tools. These tools are trained on content from the world wide web, but one might wonder, how might these AI tools know which content is believable and which is not?

The current thesis aims to contribute to the credibility literature of online media through a crowdsourcing survey based on content gathered – through a tool designed and build for the purposes of this thesis – from the Reddit social media platform. The data gathering tool was designed to scrape Reddit and store historical data from Reddit posts, something that no other tool has done before, and using the scraped data it offers the possibility of creating surveys for assessing credibility of Reddit posts.

The thesis aimed to find what features of Reddit posts affect credibility. Once the survey participants assessed the credibility of multiple Reddit posts, both a quantitative and a qualitative analysis were conducted on the results. Findings show that popularity does not affect perceived credibility, however topic familiarity and experience of using Reddit have a weak positive affect on credibility. Furthermore, agreeable and content that is easy to understand were also affecting credibility positively, however content that contained jargon or that participants disagreed with or found offensive impacted credibility negatively. Among other findings, this thesis defines three types of credibility evaluation, "shallow evaluation", "in-depth evaluation" and "experience-based evaluation", that can help future research in understanding and designing credibility studies.

The thesis brings several contributions to the literature. Firstly, it both complements and challenges past findings in credibility research of online media. Furthermore, the research puts forward the three levels of credibility evaluation, which can be used in future research and analyzed more thoroughly. Finally, the artifact that was built for the study, the open-source data gathering tool, offers a new way for researchers to gather data from Reddit, but it also gives the possibility to store historical data of a post, something that no other tool does, and enables possible new avenues for research in this direction.

Keywords

content credibility, artifact, web scraping, reddit

Supervisor

Post-doctoral researcher Miikka Kuutila

Foreword

This thesis has been a very enlightening experience personally, and I hope I will be able to continue working, alone or otherwise, on the data scraping tool developed during the work on the thesis on an open-source basis in the future. I firstly want to thank my supervisor, post-doctoral researcher Miikka Kuutila, he gave me some really honest and helpful feedback and helped improve the quality of this thesis, in my opinion, a great amount. I also want to thank my significant other Gloria, who has been really helpful in times of need during some rougher times during the year. Lastly, I am very grateful for my parents who have actually motivated me throughout my education to be perseverant and give my best.

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List of Abbreviations

JSON	JavaScript Object Notation
RPC	Remote Procedure Call
API	Application Programming Interface
CSV	Comma-separated values

1. Introduction

The internet is a vast trove of information, ranging from scientific publications to personal opinions and video logs. The low barrier to entry means that anyone, from anywhere, can distribute information with almost no resistance and it can be seen or read by everyone who can access it. On one hand, this freedom means that anyone's voice can be heard, regardless of their social or financial status, but on the other hand, especially in the recent years, the spread of fake or misleading information captured the web, making it difficult for the average internet user to find reliable and trustworthy information.

This phenomenon took the name of "fake news", and is described by experts as fabricated information made to mimic news-like content but containing false or misleading information (Lazer et al., 2018). Fake news is by no means a new term, it's actual first use dates back to the 19th century, however recent years amplified this term on the whole web ("The Real Story of 'Fake News'," n.d.).

Contrary to how books, newspapers or magazines work, where factual verification is part of the process of publishing, web information does not undergo the same editorial process, if any process at all (Metzger et al., 2003). This means that it's much easier to publish content on the web that is either false or contains misleading information, and research calls for "*A new system of safeguards*" (Lazer et al., 2018) that would help reducing the influence of fake news. Maybe another useful application of the detection of information credibility online is in that of automated analysis of online content and media to be consumed in decision related matters. For example, a group of researchers in Romania recently announced an initiative to build an "AI government advisor" which analyzes data from social media to find important topics to be communicated to authorities to take action ("Romania PM unveils AI 'adviser' to tell him what people think in real time," 2023). Evidently, a problem with this approach is, how do you choose which messages to believe?

Previous research found that people are less likely to pay attention to media that they find less credible (Johnson and Kaye, 1998). Until now, research has mostly focused on reviewing credibility of communication done on Twitter, even building corpuses of data for assessing credibility of twitter posts (e.g. Mitra and Gilbert, 2021; Jenkins et al., 2020; Bhuiyan et al., 2021). Reddit, another popular social media website¹, has been target to increasing research in the last few years (Proferes et al., 2021). Reddit was found to be a good source of high-quality research data (Jamnik and Lane, 2017). It was also proved to be better than Twitter in terms of amount of content added through comments as context to events, or as the reaction to events is much quicker on Reddit in the incipient phases, when compared to Twitter (Priya et al., 2019). Research has been published regarding credibility on Reddit as well, but less so than on Twitter (e.g. A. Hubner et al., 2021; Hartzell et al., 2021). As such, the current thesis aims to contribute to the current literature by studying what affects perceived credibility of online media posted to *Reddit.com*.

With the objective of identifying the factors influencing the perceived credibility of Reddit posts, the current thesis aims to use crowdsourcing as a survey methodology. Primarily, a custom tool was developed to extract and evaluate the credibility of Reddit data. Through web scraping, this tool enables the extraction of data, capturing of screenshots, and preserving the historical information of a given Reddit post.

¹ <https://www.businessofapps.com/data/reddit-statistics/>

Additionally, it facilitates the creation of simple surveys for credibility assessments, using the data scraped from Reddit and chosen by researchers. The research seeks to address the following research questions and fulfill a design objective:

- **RQ1:** As Reddit posts gain popularity through votes, is the credibility of a Reddit post influenced by its popularity? And if yes, in what way?
- **RQ2:** What other factors contribute to the perceived credibility of Reddit posts?
- **Design objective:** Design and use a web-based tool that gathers Reddit data for credibility-focused research and surveys.

The following sections describe, firstly, past research conducted in regards to credibility of social media, fake news, crowdsourcing and Reddit, then an overview of the methods and structure of the tool used for conducting the research is presented, followed by the experimental results that continues with a discussion explaining the results and limitations, and finally concluding and providing possible future research directions.

2. Literature review

In order to have a better overview of the problem of credibility, the current section will describe in more detail what credibility and perceived credibility mean, as well as past research. Furthermore, an overview about crowdsourcing is presented, followed by implementations and results of research regarding perceived credibility on social media.

2.1 Credibility

According to Tseng and Fogg (1999) the research of credibility dates back to the 1950s, mainly found in the fields of psychology and communication. In their view, *believability* is the best synonym to credibility, and in most cases, these can be used interchangeably. They identify four main ways that can explain how people experience credibility. *Presumed credibility* refers to the credibility judgement of a perceiver about something or someone else, based on their own personal assumptions, for example based on stereotypes or familiarity. *Reputed credibility* describes the perceivers credibility assessment based on third-party reports, for example awards or titles that make someone appear more credible. Thirdly, they describe *Surface credibility*, which they simply explain through the phrase "judging a book by its cover" or in other words, the assessment of credibility is done based solely on first impressions. Lastly, *Experienced credibility* refers to the credibility gained based on past first-hand interactions or experiences.

Fogg (2003) also coined the Prominence-Interpretation theory of web credibility. In fact, the theory defines a simple relationship that, if broken, results in credibility assessments to break, that is, when assessing credibility, users notice something (prominence) and then make a judgement (interpretation). Both of these phases need to happen in order for credibility assessments to exist.

The credibility literature also defines the Source Credibility Theory. Hovland and Weiss (1951) put forward the idea that receivers of information are more likely to be persuaded when the source of the information is perceived as credible. This theory has been applied not only on textual content such as news, but also in advertising, politics, religion, graphic and website design, in reputation systems for e-commerce websites and so on (Umeogu, 2012; Lowry et al., 2014; Cho et al., 2009) These findings show how important credibility is, not only in online media, but in all aspects of our society.

The web is vast and content can be created, shared by virtually anyone, and be seen by everyone. Therefore, the issue of how credible a piece of information arises. Flanagin and Metzger (2000) found that less experienced users of the web are less likely to verify the actual information they are reading, while more experienced users generally tend to verify information more rigorously and at the same time view the web as a credible source of information.

Furthermore, Wathen and Burkell (2002) exemplified a list of factors that affect credibility, which can be seen in more detail in Table 1. They categorized the factors based, firstly, on the findings of Treacy and Wiersema (1993) who found three types of effects that have an influence on credibility: effects from the manipulation of the source of media, effects due to the messaging or the issue being messaged, and effects caused by the medium in which the message is propagated. Furthermore, Petty and Cacioppo (1990) augment the findings, mentioning that credibility is also affected by

receiver-related factors, such as their involvement in the topic or attitudes towards it. Lastly, Wathen and Burkell (2002) mention that messages aimed to specific contexts or audiences can also lead to improved perception of credibility.

Moreover, a large-scale study, involving over 1400 people from the United States and Europe, regarding credibility of websites found that elements such as real-world feel, ease of use, expertise, trustworthiness and tailoring were affecting perceived credibility positively. On the other hand, amateurism and commercial implications had a negative effect on perceived credibility (Fogg et al., 2001).

Table 1. Examples of factors influencing credibility (Wathen and Burkell, 2002)

Source	Receiver	Message	Medium	Context
Expertise/ Knowledge	Issue relevance	Topic/ content	Organization	Distraction / “noise”
Trustworthiness	Motivation (i.e., need for the information)	Internal validity/ consistency	Usability	Time since message encountered
Credentials	Prior knowledge of the issue	Plausibility of arguments	Presentation	
Attractiveness	Issue involvement	Supported by data or examples	Vividness	
Similarity to receiver beliefs/context	Values/ beliefs/ situation	Framing (loss or gain)		
	Stereotypes about source or topic	Repetition/ familiarity		
	“Social location”	Ordering		

Other researchers defined three stages of credibility through which users go when assessing online media (Hartzell et al., 2021). With a basis on Hsieh and Li (2020) findings, Hartzell et al. (2021) define the three stages as follows:

Initial credibility is the first phase and the credibility is first established. The user makes assumptions based on content or others’ opinions. If the source or author of the content is unknown to the user, the initial credibility is low. This phase can be associated with the presumed, surface or reputed credibility types.

Transactional credibility marks the second phase of credibility. In this phase the credibility is assessed during the engagement with the target material (e.g., website, social-media post). Credibility increases if the author maintains credible messaging and intent during the whole engagement process.

Terminal credibility represents the last phase of credibility and is defined by the credibility of the user at the end of the interaction. To maintain a high credibility in this phase means that the whole interaction was credible, however, a low credibility in this phase will affect future interactions and the overall credibility of the author for the user - we can associated this with the experienced credibility type.

2.2 Crowdsourcing

Crowdsourcing, as described by Hopkins (2011) is the act of outsourcing jobs to a large number of people in the form of an open call, jobs that were before done by an employee of a company or other designated person. It was first coined by Howe (2006) in an online article, and in his book, he compared crowdsourcing to open-source, suggesting that the open-source movement was a blueprint that crowdsourcing was building upon (Howe, 2009, p. 71). Howe also defined a taxonomy of crowdsourcing, defining how crowdsourcing can be used for different goals:

- *Collective intelligence* is a form of crowdsourcing to gather knowledge from a crowd. Examples of such activities include internet-wide brainstorming sessions, employee suggestion boxes, or recruiting users with specific knowledge to help improve products or build new ones.
- *Crowd creation* can be associated with co-creation, a crowdsourcing activity where users are actually creating a product or a service by doing small tasks part of a whole, for example through crowdsourcing applications such as Amazon Mechanical Turk, developing open-source software, posting images on stock photo websites and so on.
- *Crowd voting* permits the gathering and organization of large quantities of information. Google's algorithm is given as an example of this, where websites are ranked based on popularity, thus the users accessing a website can count as a crowdsourced vote.
- *Crowdfunding* is a form of micro-lending - people lending small amounts of money to help others start a business or aid in humanitarian efforts.

Crowdsourcing is increasingly being used in research as well (Hossain and Kauranen, 2015). It is also described as type of open innovation. *Microtasking* is a form of crowdsourcing, it is defined as the process in which users (also referred to as *microworkers*) are rewarded for completing small tasks, such as filling in a survey (Kittur et al., 2008). As found by Hossain and Kauranen (2015), microtasking is a good way to generate extra income for those in need. It is also a good way to gather large amounts of data. There are, however, some problems identified. For instance, organizers of crowdfunding can refrain from awarding microtaskers on grounds of non-satisfactory work, and no possible solutions were found yet for avoiding such situations. Furthermore, the quality of results can be a concern, thus researchers must take into consideration when designing their research, however more research is suggested in this area.

2.3 The Reddit platform

Reddit is one of the largest online social platforms, boasting over 57 million daily unique users, more than 100 thousand communities (also referred to as subreddits), and with a staggering amount of content: over 13 billion posts and comments (Reddit, n.d.). Reddit users can join communities that are based on particular topics, such as /r/WorldNews or /r/Science. Content on Reddit is represented by posts and comments. A post can be any type of media, from text to video to external links, and each post can be discussed through comments. Each post and comment can also be "upvoted", "downvoted", or given various "awards", so that the most popular content rises to the top.

As Proferes et al. (2021) mentions, Reddit is becoming an increasingly popular medium for research, especially because of the benefits that Reddit offers compared to Twitter. For instance, Reddit is divided into topical subreddits, so research can easily find content

based on a specific theme. Also, while Twitter limits the number of characters a post can contain, Reddit has no such problem (technically, a post can contain up to 40000 characters, however that is much larger than Twitter's limit), so there is opportunity for finding more qualitative research material.

Scholars are already using Reddit as a data source. Proferes et al. (2021) conducted a systematic review of papers using Reddit as a data source that were published between 2010 and 2020. They found that the most prominent subreddits analyzed are politics-, mental health- and drug-related. They argue that researchers targeting these types of subreddits generally focus on analyzing Reddit-specific phenomena and social phenomena. They also discuss some of the potential problems with using Reddit as a data source. The argument they bring up is, firstly, that models built on Reddit content will also present signs of the inherent Reddit structure and culture which differs from that of traditional social media. Secondly, they also raise the problem of the algorithm that Reddit uses to rank posts and comments, suggesting that scraping all comments from a Reddit post will show that most comments interacted with only the top ones voted, possibly painting an unrepresentative picture.

Jamnik and Lane (2017) tested Reddit's ability to replace other crowdsourcing platforms, such as MTurk, with a much more affordable solution: Reddit users. The researchers compared the responses to an online survey from Reddit users and undergraduate students. They found that Reddit offers a more diverse sample of participants while retaining validity and measurability of the data. Furthermore, they explain that, compared to classic crowdsourcing platforms, Reddit offers a more diverse user base in terms of location, as crowdsourcing platforms, such as MTurk, require a bank account in a specific country which results in the user pool coming from a select set of countries. One particular limitation to note is that of compensation, which may indeed be a problem when using Reddit as the source of study participants. MTurk or student participants are rewarded for their participation, while the participants from Reddit completed the survey on a voluntary basis.

Credibility is also studied in regards to Reddit. For instance, Hartzell et al. (2021) studied source credibility on Reddit. They found that Reddit is unique in the way source credibility is established. For instance, popularity of a subreddit and the way it's managed and the culture around it can affect initial credibility. Transactional credibility was determined by how content is ranked based on upvotes and downvotes, but also on awards given to comments and posts. A. Y. Hubner and Bond (2022) studied the differences between male and female scientists in the Ask Me Anything subreddit, and found that male scientists on general receive more comments on their posts, but vote scores don't differ from gender to gender. Another study on the Science subreddit found that credibility, in the case of scientists hosting "ask me anything" sessions, is established through rigorous vetting procedures by the subreddit's moderators. For instance, the rules for such discussions require the scientists to have the papers they wish to answer questions about to have been already peer reviewed by other experts in their fields. Also, custom "flairs" assigned by the moderators of the subreddit offer the community higher levels of credibility as they see the scientist is actually verified by leader members of the community.

2.4 Credibility of online media

Sun (2021) suggests three main factors that affect the evaluation of credibility of online information: *topic credibility*, *source credibility* and *content credibility*. They suggest that

choosing an appropriate topic when evaluating perceived credibility is important, as some topics are perceived inherently as more credible, such as scientific communication, while other topics can be guided by a publisher's opinions or emotions, such as entertainment or emotional topics. Additionally, they suggest that the source where the information comes from can have an impact on credibility. Thus, because of the reputation of said source, social-media reactions or other forms of engagement don't affect credibility as much. Lastly, content credibility is also a factor, but this factor can prove difficult in automated contexts, as information can be distributed in multiple mediums, such as an image, audio or a video recording, but as well as text, that may be more complex or harder to analyze.

A literature review conducted by Keshavarz (2021) proposes a conceptual framework for the evaluation of social media information. They extracted multiple components of social media and categorized them into multiple key dimensions that can be used as theoretical frameworks for evaluating social media information:

- *Information source* - described by components User profile - evaluated through the user's reliability, frequency of posts, age of account, engagement, etc. - and Authority - evaluated through educational background, credentials, contact information, etc.;
- *Information presentation* - described by components Content, evaluated through readability, comprehensiveness, consistency, etc.; Links, evaluated through PageRank, ratio of inbound/outbound links, network metrics, etc.; Layout, evaluated through visual aspect, purpose of profile, logo, etc. and Writing, evaluated through vocabulary usage, errors in writing, sentiment, etc.;
- *Information credibility* - described by components of Objectivity, evaluated through honesty, bias, fairness, ethics, etc.; Currency, evaluated through recency and frequency of postings events, etc.; Accuracy, evaluated through relevancy of content, references, discussion depth, etc.; and Usability, evaluated through ease of use, accessibility, search capabilities, etc.;
- *Decision-related* - described by components Risks, evaluated through information type, security protocols, system policies, etc.; Benefits, evaluated through technical qualifications, attitudes towards work and life, documentation, etc.; Trust, evaluated through prior cooperation, psychological aspects, and Organizational issues, evaluated through management styles and policies, attitudes, centralization, and so on.

While the theoretical model proposed by Keshavarz (2021) provides a good ground layer to start when evaluating social media information as well as its credibility, it has not been rigorously tested yet to find patterns and relationships between dimensions, thus they suggest more research in the area.

There is considerable research in the realm of credibility and truthfulness regarding online media. Kolluri and Murthy (2021) built a tool to assess the credibility and fact-check Covid related articles using crowdsourcing and publicly available datasets to train an automated classifier for detecting fake news related to Covid, but also other types of news.

Popat et al. (2016) tried to assess truthfulness using a machine learning-based classifier that, based on linguistic features of text, coupled with the reliability of sources based on Alexa ranking and Page ranking, was tested on a Wikipedia dataset of hoaxes to assess their truthfulness. Their model has different limitations, such as the fact that its ability to detect fake claims is limited because of different text semantics and negations that it is not able to handle. Other researchers incorporated the level objectivity of online news

articles to assess the truthfulness of said articles (Nakashole and Mitchell, 2014). Through the use of crowdsourcing on the Amazon Mechanical Turk (MTurk) platform a survey was conducted for assessing, based on human opinion, whether news articles were trustworthy and objective. The results showed that, most of the time, trustworthy articles were also objective, while untrustworthy articles were often subjective.

Others have implemented techniques for flagging misleading or fake news. Achimescu and Chachev (2020) demonstrated the use of rule engines and natural language processing. They manually built a language model that checks Reddit comments for keywords such as "fake", "misleading" or similar phrases that call out the post as possibly fake. The claim that their model is more performant than other machine learning techniques, and can be used even on other platforms, as it does not depend on Reddit exclusively. Limitations to their method include the fact that, for the model to work, a post must have at least one comment, and additionally users may have different agendas, knowledge or opinions, leading to false positives in measurements. Terminal credibility is measured through the accumulation over time of votes, but also of the way the subreddit is seen by the public based on public media appearances (A. Hubner et al., 2021).

Alrubaian et al. (2019) surveyed the literature of credibility evaluation, mainly for Twitter. They found that credibility evaluation research generally employs one or more of three main levels of evaluation. *Post level* evaluations include the analysis of various features of social media posts, such as the number of likes, number of words and characters, metadata from multimedia posts such as video or audio duration or sentimental features that induce positive or negative sentiment. Credibility can also be assessed at the *topic level*, meaning that a topic can be seen as more credible than another, however a limitation with this method is that people can post fake or misleading content regarding that topic. *User level* evaluation has also been conducted, where credibility of the author was analyzed. Finally, Alrubaian et al. (2019) add that hybrid assessments can also be conducted and are recommended, as each singular method comes with advantages and disadvantages, thus creating a holistic assessment can overcome limitations of singular methods. Another finding in the study showed that features such as the number of followers, following, retweets, the URL, mentions and hashtags, were among the most important used in research. Interestingly, verification status of users on Twitter was not as important, and neither was the source of information. Another interesting finding is the observation by Castillo et al. (2011). They found that long time users of Twitter generally post more credible messages.

Other researchers tried finding what features of a Twitter and Reddit post have the most influence on the perceived credibility of a post (Kang et al., 2015). They conducted a survey with users on MTurk and found that the most influential features for perceived credibility are metadata, ratings, retweets, hashtags. One key difference between the two platforms that they found is that textual content is more influential on Reddit than on Twitter. Morris et al. (2012) also conducted a crowdsourcing study on Twitter, and their findings showed that the author of a tweet was one of the most influential features contributing to credibility. They also noticed that there is a high correlation between the credibility of a tweet's contents and the author of the tweet. In other words, if an author is found credible, then their tweets might also seem credible as well. This is interesting in this thesis as Reddit users use aliases and they don't have profile pictures, nor verification marks to show their identification status, thus the credibility of a Reddit post might not be affected by the author. They also found that scientific tweets seem more credible to respondents when compared to entertainment or politics.

Past research around the credibility of Reddit showed interesting findings. One finding showed that, on the subreddit */r/science*—a heavily moderated Reddit community dedicated to discussion of scientific research and publications—found that posts from users with expertise claims (through the use of an author flair, e.g. "PhD Physics" that is written alongside their username) generally see higher number of upvotes, thus can be seen as more credible (A. Hubner et al., 2021). This finding goes in line with Tseng and Fogg (1999) type of credibility entitled "*reputed credibility*", which describes how credible something, or someone, is perceived based on third-party reports. In Reddit's case, moderators assign user flairs based on manual verification. Examples of such verifications include subreddits such as *r/IAmA* (abbreviation for "I am ... ask me anything"), where public personalities, scientists or others with remarkable achievements go through a verification process before they can answer questions from the public².

A. Hubner et al. (2021) conducted a quantitative social network and content analysis of posts and comments on Reddit. They analyzed the data posted on the */r/science* subreddit in 2016, which resulted in data set of more than five-hundred-thousand comments and more than one-hundred-fifty-thousand unique users. One of their findings showed that more complex language was rated higher, showing that complexity or the use of jargon can be a marker of credibility. These findings complement what Morris et al. (2012) found regarding Twitter. The authors admit to the limitation that even if the content is highly regarded, the level of truthfulness of the posts or comments is uncertain.

While there is considerable research regarding perceived credibility of online content, this study aims to contribute to the current pool of knowledge by studying how Reddit content credibility is perceived, what methods to evaluate people use and what factors influence the credibility.

² https://www.Reddit.com/r/IAmA/wiki/index/#wiki_3_what_constitutes_.22proof.22.3f

3. Artifact design

The research conducted during the current thesis is based on Reddit data. To gather the Reddit data necessary for a credibility survey of Reddit posts a software tool was designed and built for scraping data from the Reddit platform. The design, development and usage of the artifact comprises the design objective of the thesis.

Based on the guidelines for Design Science research described by Hevner et al. (2004), the artifact was designed based on identified research needs and evaluated. While most research on Reddit uses PushShift, certain recent events forced PushShift to shut down³(Baumgartner et al., 2020). Furthermore, Reddit is seen as a good source of research data, as previous literature reviews show (Proferes et al., 2021). There were no other similar tools found during this thesis that could fill the hole PushShift could leave if it is shut down. Therefore, the idea to build the data gathering tool arised.

The data gathering tool has two main roles. Firstly, it uses web scraping methods to gather data from Reddit and save it into a database for later analysis, and secondly it can create surveys for perceived credibility assessment that can be used with crowdsourcing platforms. Web scraping is a method of web data extraction through automated methods and saving the extracted data to a database (Zhao, 2017).

The tool aims to allow a researcher to gather data from any communities on Reddit and the changes of the data in time. In other words, as seen in online statistics⁴, there is a lot of activity on Reddit and people submit new posts, rate posts, leave comments and rate comments all the time. As such, one of the functionalities of the data gathering tool was to record not only basic information about a Reddit post, but also the changes in time to it. Additionally, the tool is also designed to attach a screenshot of the post every time it is scraped. Using this approach people filling in our survey will see a post in isolation, almost as if they would see it if they were browsing Reddit themselves. Figure 1 presents an example of such screenshot.

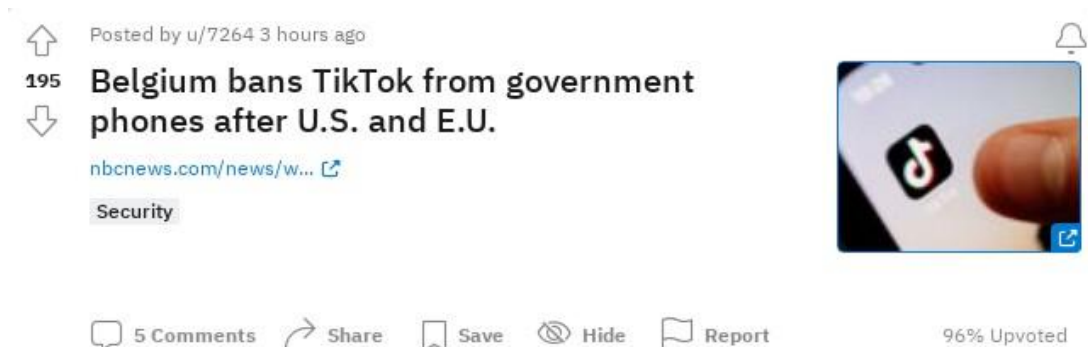


Figure 1. Example of a Reddit post screenshot

³ https://www.reddit.com/r/pushshift/comments/13mhuzq/api_has_been_taken_down/

⁴ <https://subredditsstats.com/>

Multiple features that construct the Reddit post can be observed, every one of them, and others, being recorded by the tool. A complete list of all features recorded and their explanation is presented in table 2.

Table 2. List of features of a Reddit post recorded by the data gathering tool

Feature name	Description
Post ID	The unique post ID created by Reddit's systems
Title	The title of the post. When the post is a link to an external article, the post's text is most often the title of the article.
Author	The username of the author. Importantly, users on Reddit rarely use their real names.
Date posted	Self explanatory.
Score	Also known as "upvotes". These are given by the users of the platform.
Upvote ratio	Stored as a percentage, represents the ratio of upvotes to downvotes of a post.
Post Flair	Added manually by posters or moderators, usually representing the type or category of information.
User Flair	Not seen in table 2. Depending on subreddits, this is an accompanying text next to a users name. For example, the r/science community moderators give verified researchers a Flair representing their field of expertise.
No. comments	The number of comments.
Source Link	If the post is a link to an outside website, the link to that website is also stored.
Post Permalink	The unique link of the post.
Comments	A machine readable version of the top comments of a post, stored in a JSON format
Awards	Other users can award posts if their content is remarkable, these awards are also recorded.
Screenshot	The screenshot itself of the post.
Title sentiment	Based on an automated detection of sentiment on a scale from -1 to 1.

From an architectural standpoint, the tool is designed with 3 main components. A graphical representation of the architecture can be observed in figure 2.

The first main component is the web interface. The web interface is built using state-of-the art technologies with a focus on ease of use and performance. The interface is

built using the SolidJS⁴ web framework, accompanied by the TypeScript⁵ programming language.

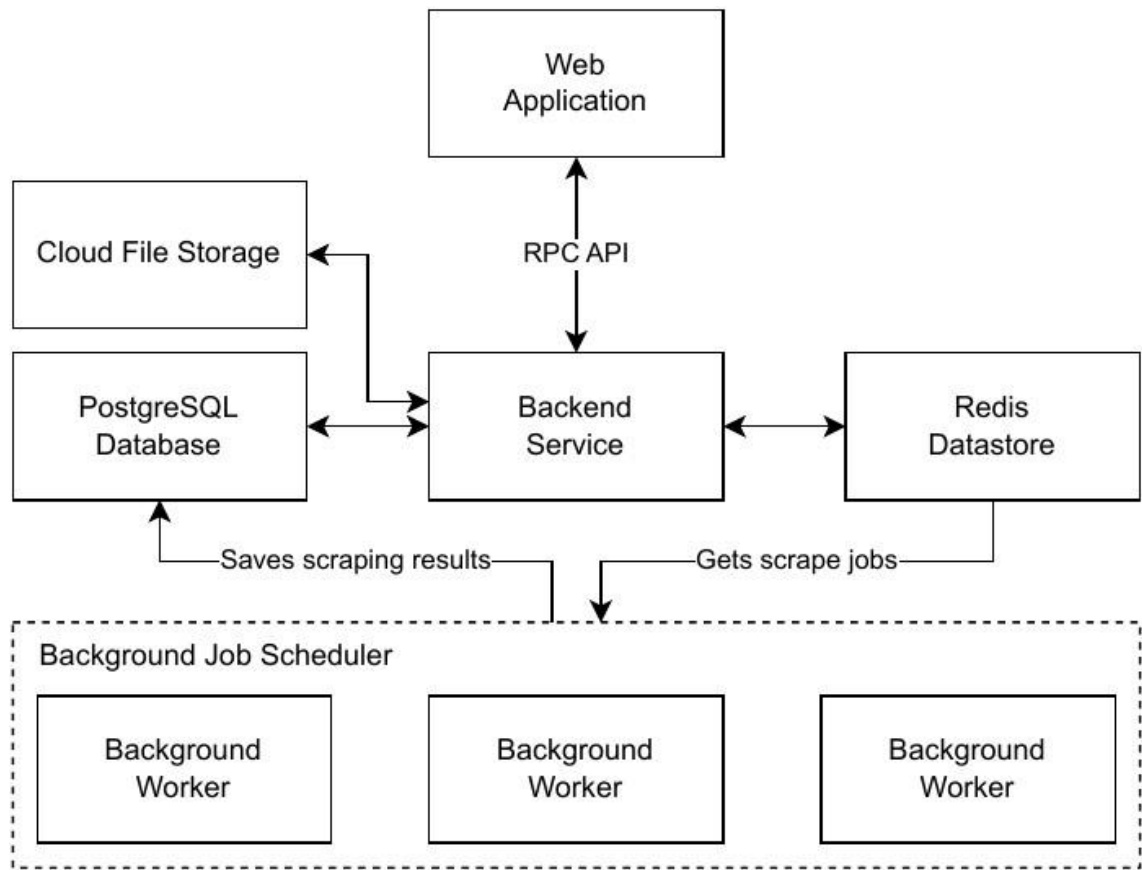


Figure 2. Architectural overview of the data gathering tool

Credee

Any Any Search by title Clear

This page contains aggregated data of the dataset. The posts are grouped by their ID. (4494 results)

POST	FEATURES	POSTED AT	FLAIR	SCORE HISTORY
/worknews/15.7bce08 Ukraine rebounds from Russian barrage, restores power supply AP News	↑ 404 ↓ 92% □ 6 % 0 ⚡ 0.27 ⚡ 32	10 Mar 2023, 14:50		
/worknews/15.7bce08 Iran, Saudi Arabia agree to resume relations after tensions	↑ 36 ↓ 74% □ 7 % 0 ⚡ 0.00 ⚡ 21	10 Mar 2023, 14:41		
/worknews/15.7bce08 3 wounded, including 1 critically, in central Tel Aviv terror shooting	↑ 28 ↓ 73% □ 1 % 0 ⚡ 0.36 ⚡ 23	10 Mar 2023, 14:35		
/worknews/15.7bce08 Exclusive: Tesla taps Asian partners to address 4680 battery concerns	↑ 1 ↓ 50.99999999999999 □ 0 % 0 ⚡ 0.20 ⚡ 20	10 Mar 2023, 14:28	Transportation	
/worknews/15.7bce08 Exclusive: Tesla taps Asian partners to address 4680 battery concerns	↑ 0 ↓ 100% □ 0 % 0 ⚡ 0.20 ⚡ 1	10 Mar 2023, 14:28	Transportation	
/worknews/15.7bce08 Wagner boss says the Kremlin won't talk to him anymore after he complained that Russia isn't giving his troops enough ammo	↑ 34346 ↓ 94% □ 2097 % 0 ⚡ 0.10 ⚡ 23	10 Mar 2023, 14:21		
/worknews/15.7bce08 Iran and Saudi Arabia 'agree to restore relations'	↑ 2862 ↓ 95% □ 812 % 0 ⚡ 0.03 ⚡ 21	10 Mar 2023, 14:17		
/worknews/15.7bce08 Engineers have developed a new, unusually thought, material made from numerous interconnected microscale knots (each knot is around 70 micrometers) that may find applications in biomedicine and aerospace applications	↑ 32 ↓ 76% □ 11 % 0 ⚡ 0.00 ⚡ 23	10 Mar 2023, 14:15		
/worknews/15.7bce08 China is developing a quantum communications satellite network	↑ 0 ↓ 40% □ 9 % 0 ⚡ 0.00 ⚡ 23	10 Mar 2023, 14:03	Networking/Telecom	
/worknews/15.7bce08 Apple and Foxconn efforts win labour reforms to advance Indian production plans	↑ 5 ↓ 67% □ 4 % 0 ⚡ 0.42 ⚡ 23	10 Mar 2023, 14:01	Business	
/worknews/15.7bce08 Apple and Foxconn efforts win labour reforms to advance Indian production plans	↑ 0 ↓ 100% □ 0 % 0 ⚡ 0.42 ⚡ 1	10 Mar 2023, 14:01	Politics	
/worknews/15.7bce08 Russia Raises Doubts About Grain Deal as Deadline Looms	↑ 28 ↓ 74% □ 4 % 0 ⚡ 0.22 ⚡ 19	10 Mar 2023, 13:53		
/worknews/15.7bce08 Valentine's Day asteroid? NASA says asteroid as wide as a football field could hit Earth in 2046	↑ 22 ↓ 63% □ 46 % 0 ⚡ 0.00 ⚡ 27	10 Mar 2023, 13:43		

Figure 3. Overview of the tool's graphical interface

⁴ <https://www.solidjs.com/>

⁵ <https://www.typescriptlang.org/>

Figure 3 shows an overview of the graphical interface. There are four different pages that can be observed in the application, surveys, detailed data, scrape jobs and scrape results. The surveys page shows all surveys created. The detailed data page shows aggregated data for each scraped post, with specific features show, including: the title and subreddit, author, posted date, current score, upvote ratio, title sentiment, awards, flair, history of the features as a line graph and gives options for filtering data based on subreddit, flair and a search by title option. The scrape jobs lists current running web scrapers and when they run, as well as allows adding and deleting them. Lastly, the scrape results page shows the raw scrape results with no aggregation.

The second and third components of the represent the Remote Procedure Call (RPC) Application Programming Interface (API) service and the Background Worker service respectively (together referred to as *backend services*). The RPC API service is used by the web interface to communicate with the database and to schedule scrape jobs. The Background Worker on the other hand is used to run the web scrapers on a schedule set by the researcher. Both backend services are built using the NodeJS⁶ runtime and the TypeScript programming language. Additionally, storing the saved data is managed through a persistent PostgreSQL⁷ database - storing for all scraped data, survey data and survey responses - and a Redis⁸ database - used for scheduling the background workers. Finally, the screenshots of the Reddit posts are stored on public cloud servers.

3.1 Data gathering tool features and usage

As the main goals of the tool are to gather Reddit data and generate surveys for analyzing perceived credibility, the tools must have accompanying features for easily achieving these tasks. Therefore, the main capabilities and features of the tool are described next.

Scraping Reddit data. Achieved through the scheduling of "scrape jobs". Each job can be scheduled using three separate variables. First variable is the subreddit name, so, depending on the need, a researcher can scrape a specific subreddit. Second variable is the number of posts to scrape at one time (referred to as *scrape limit*), and the third variables is the time interval, expressed in minutes, at which the job should run. As each subreddit has varying levels of activity each job can be adjusted to scrape the subreddit in the most efficient manner possible. Once sufficient data is gathered, a job can be removed for reducing redundant executions of workers.

Two types of workers were implemented for optimization purposes and consistency. At first, only one worker was used that ran based on the job-level defined schedule and scraped only the newest posts on the subreddit sequentially. However, this approach revealed that after some time, depending on how many posts were newly added, a specific post stopped being scraped as the scrape limit did not reach it anymore. In other words, if the scrape limit is set as 25 then the 26th post in the list is no longer scraped. Therefore, a new background worker was implemented that re-scrapes every post added into the database. This worker is executed at a fixed interval of 1 hour and re-scrapes all posts that were scraped less than 36 times (i.e. posted 1.5 days ago) or if they are older than 2 days,

⁶ <https://nodejs.org/en/>

⁷ <https://www.postgresql.org>

⁸ <https://redis.io>

as it was observed that posts no longer receive a significant amount of interaction 1-2 days after they were posted.

There were also other optimization opportunities that were observed and also implemented. For instance, it was noticed that posts sometimes get removed by moderators, therefore when a scraper finds a deleted post, it also deletes all past scrapes if any, and the screenshots to save space. Additionally, if a post has received no new activity on subsequent scrapes, then it is also ignored to reduce space.

Analysis of scraped data. Achieved manually and supported by filtering features for Reddit posts. Currently the interface supports filtering by subreddit name, post flair or searching by text, or any combination of the previously mentioned. Future iterations could improve this feature and allow the users to query the data in more complex ways, however, for the purposes of this survey it was kept simple.

Creation of surveys. When creating a survey the researcher can choose a title, a deadline for submissions and assign any number of Reddit posts as a data set to be used for the survey credibility questions. At the moment of writing, all surveys use hardcoded question formats, but the data set used for credibility evaluation is dynamic. More details about the survey are presented in the next section.

View of survey responses. The data gathering tool also allows viewing the responses of microtaskers regarding the perceived credibility of the Reddit posts selected for a survey, as well as the pre-survey answers. A researcher can also download the responses in an excel format for further analysis or usage in statistical tools. In the future, the tool could implement smarter ways to analyze the data in real time or test hypotheses.

3.2 Evaluation

As part of the evaluation process, as described by Hevner et al. (2004), the tool was used in two distinct processes. Firstly, the data gathering process took approximately four months, during which the tool scraped a total of 16,484 Reddit posts. As each post was scraped more than once, the final data set of historical data for all posts yields a total of 573,068 items. The data set is also available publicly, stored in a Comma-separated values (CSV) format, in the GitHub repository⁹.

The second descriptive evaluation consisted of using the tool to conduct a credibility survey in which participants would each receive a set of Reddit posts to rate for credibility. The actual survey is described in more detail in chapter 4. A total of 14 Reddit posts were selected for the credibility survey using the tool, and the total number of credibility evaluations using the tool resulted in 952 credibility ratings.

⁹<https://github.com/arpadgabor/credee>

4. Research methods

The current thesis is split into two primary activities, which are presented visually in figure 4. The first activity consists of building a web service to aid in gathering data from Reddit, which can be extended to other platforms as well. The gathered data can be inspected and analyzed qualitatively and, selected for creating any number of credibility-related surveys that can be shared with participants. After the web service was built, a four-month period is spent on gathering data from Reddit through scraping and adjusting the scraping algorithm to fix any bugs or avoid issues causing data to be stored in undesirable formats. The data gathering tool is described in detail in chapter 3.

The second activity consists of an actual survey conducted using the Prolific crowdsourcing platform. The resulting data from the survey is then analyzed both quantitatively and qualitatively using a thematic analysis (Braun and Clarke, 2006).

The research aims to answer the following two research questions, and a design objective to build a data gathering tool that helps building the survey and gathering the necessary data to answer the research questions:

- **RQ1:** As Reddit posts gain popularity through votes, is the credibility of a reddit post influenced by its popularity? And if yes, in what way?
- **RQ2:** What other factors contribute to the perceived credibility of Reddit posts?

To remove any ambiguity, the current research defines a "reddit post" as a piece of content seen while browsing the main page and is the only aspect that is evaluated in the study. On the other hand, there are "comments" which contain people's reactions and thoughts to the post. This type of content is not evaluated in the study, though the tool built for gathering Reddit data does record comments as well.

The following sections go into more detail about the implementation of the crowdsourcing survey that was conducted for both a qualitative and quantitative analysis.

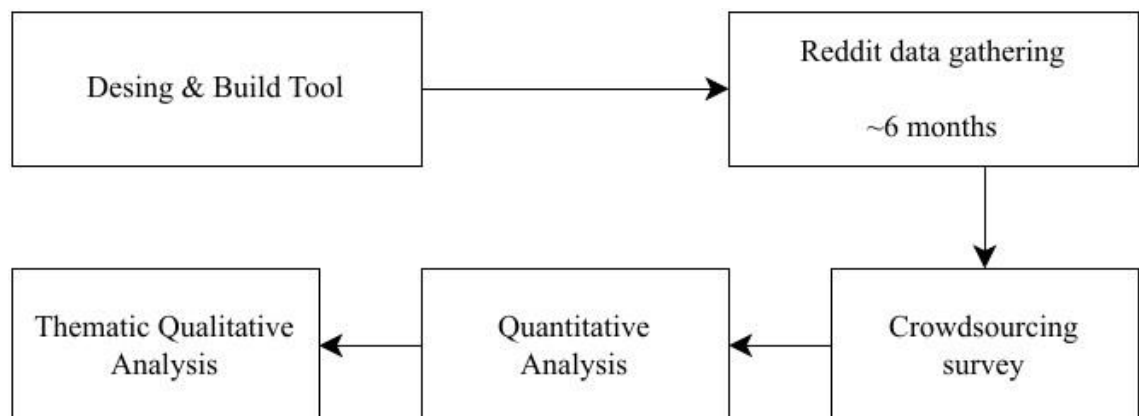


Figure 4: Research activities breakdown.

4.1 Survey Design

The main objective of the study is to find out what features of Reddit posts affect credibility and in what manner. Therefore, this section will describe in more detail how the actual crowdsourcing survey is designed, what data points are extracted and what decisions led to the final implementation.

A quantitative approach is used in the current study, with a focus on survey research as opposed to experimental research. A more detailed explanation of the method used is given in the following paragraphs, however an important distinction between experimental and correlational research is that in correlational research variables are uncontrolled by the researchers, resulting in the possibility of finding whether there is a correlation between two variables in the same population such as age group and credibility of a post (Leedy et al., 2019).

The second part of the survey consists of a series of credibility questions for multiple Reddit posts. Through the use of the data gathering tool, a researcher is able to select multiple Reddit posts to add to a survey. Every Reddit post selected will be added to the survey multiple times (referred to as "*variants*" in the tool), but every time containing different values for features that can change in time such as upvotes, comments, awards and so on. The addition of different variants to a survey would allow the analysis of credibility perceptions based on the different features, thus allowing the possibility of finding whether the popularity of the post affects credibility, as opposed to the actual content or the source of the content.

4.1.1 Survey respondents

The survey is conducted through the platform Prolific¹⁰, a platform used in research for crowdsourcing. During the creation of a crowdsourcing survey the researcher is able to define different rules for what types of participants are needed for the survey. For the purposes of this thesis and with the goal of gathering a data set as diverse as possible, no restrictions are set. Once microtaskers access the survey, they will first complete an introductory questionnaire regarding their age, education, gender (all optional, see table 3), and additionally about their experience in using Reddit, frequency of social media usage, and lastly about their opinion of their ability to tell apart credible and not-credible content (see table 4). A detailed description of the final respondent demographics is presented in chapter 5.

4.1.2 Questionnaire

Table 3 presents the list of questions asked in the introductory part of the survey. The first three questions are related to demographics, while the latter three represent their social media usage and ability to differentiate credible/not-credible media.

In questions where the microtaskers needs to answer based on a scale, 5-point Likert-type fully-labeled scales were used. As discovered by Weijters et al. (2010) and Revilla

¹⁰ <https://www.prolific.co/>

et al. (2014), 5-point fully-labeled scales are recommended for the general public, as the data is more likely to be of a higher quality.

Table 3: List of introductory questions microtaskers were asked to answer.

Question text	Possible answers
What gender do you identify as?	Male; Female; Other
What is your age?	Any number
What is your nationality?	Select from list of nationalities
What is the highest level of studies you graduated?	Primary school; Middle school; Secondary school; Post secondary; Undergraduate/Bachelors level; Graduate/Masters level; Doctoral studies; Post-doctoral
Have you used Reddit before? How often?	1 = Never used it; 2 = I rarely use it; 3 = I use it sometimes; 4 = I use it at least once a week; 5 = I use it every day
How much do you use social media, in general?	1 = I never use social media; 2 = I rarely use social media; 3 = I use social media now and then; 4 = I use social media at least once a week; 5 = I use social media every day
How would you evaluate your ability to differentiate between fake/misleading media and true/credible media?	1 = I find it difficult to differentiate; 2 = I find it somewhat difficult to differentiate; 3 = I find it neither difficult nor easy to differentiate; 4 = I find it somewhat easy to differentiate; 5 = I find it easy to differentiate
What do you think about Reddit as a news source?	Free text
How do you evaluate the credibility of a post?	Free text

Furthermore, table 4 presents the list of questions in the second part of the survey. These questions are presented in a succession, for every Reddit post the microtasker has to answer. As one Reddit post has multiple variants, only a single variant will be presented to a person, at random. This ensures that a person will not respond with the same answers again when they see the same post.

Table 4: List of credibility related questions microtaskers were asked to answer.

Question text	Possible answers
How credible do you find the following Reddit post? (a screenshot is also presented under the question text)	1 = It is not credible at all; 2 = It is somewhat uncredible; 3 = I'm neutral; 4 = It is somewhat credible; 5 = It is very credible
Would you upvote or downvote the post?	Upvote / Downvote
Please explain why you chose the specific upvote/downvote	Free text
How familiar are you with the topic of the post?	1 = Not familiar at all/never heard of it; 2 = I have heard of it, but no other familiarity; 3 = Limited knowledge of the topic; 4 = Moderate knowledge on the topic; 5 = High or very high knowledge on the topic
How would you characterize the content of the post?	I find the title hard to read or understand; I find the title easy to understand; I find the title misleading; I find the post offensive; I disagree with what the post claims; I agree with what the post claims; I have no opinion; Other, please specify below
If you have another way to characterize the post, please specify below	Free text
Taking into account the previous answer, how does it affect your view on the credibility of the post?	1 = Very negatively; 2 = Somewhat negatively; 3 = Neutral; 4 = Somewhat positively; 5 = Very positively

In this part of the survey the microtaskers are asked to rate how credible they view a particular Reddit post. Additionally, they are asked other related questions that can help correlate knowledge of a topic, language used in the content, personal biases in relation to credibility. For instance, a low credibility score could be correlated to hard to read language or to the fact that the person doesn't understand the topic. They are also provided with an option to add their own answer in case they characterize the post in some other way.

4.1.3 Reddit posts selected for the survey

An important consideration for the survey are the topics used for finding Reddit posts the microtaskers can assess. For the purposes of this study, some topics were purposefully left out, such as politics. Choosing a single topic can be rather limiting, as some people could be more familiar with technology for example, but not so much in medicine. Thus, it was decided that choosing multiple topics for posts can yield more interesting results and the chances are higher that microtaskers answer both topics they are familiar with and topics they are less familiar with.

A set of three topics were chosen for creating the final survey microtaskers will answer:

Science - scientific communication is usually more formal, contains more complex language and, as shown by A. Hubner et al. (2021), scientific content is perceived as more credible in general. Thus, science topics were chosen to compare with previous research and to the other topics chosen;

Technology - technology is used in every aspect of our lives, and recent breakthroughs, for example in artificial intelligence¹¹, have flooded the internet. Thus, technology was chosen as a trendy topic that more people might be familiar with.

Business - recent events in business and economy-related news have also seen their fair share of public attention, for example the recent acquisition of Twitter¹² or layoffs in large companies¹⁴, therefore business related news were as well.

Table 5 presents the list of Reddit posts that were selected for the credibility section of the survey. Each participant was asked to evaluate the credibility of a total of 14 Reddit posts.

Twelve of the Reddit posts chosen were further split into four separate "*variants*" with different number of upvotes and comments, scraped at different time intervals. The reason for this was the possibility of analysing whether there is a difference in credibility of the same post but at different number of upvotes, comments or even awards. Each participant was only presented with a single variant of a post, in other words, a participant would not rate the same post twice. In addition, two extra posts were included that are meant to represent *controversial* posts, where the number of upvotes is close to the number of downvotes, this is indicated by the "ratio" provided by the Reddit API's which is close to 0.5, the highest possible being 1, and 0, the lowest.

¹¹ <https://openai.com/>

¹² https://en.wikipedia.org/wiki/Acquisition_of_Twitter_by_Elon_Musk

¹⁴ <https://layoffs.fyi>

Table 5: Reddit posts participants were asked to rate

Post title	Upvotes per variant	Comments per variant	Average credibility
A) <i>A better predictor of workplace stress, than heart rate — model finds that people who are stressed make more mistakes when typing, and move the mouse pointer more often, less precisely</i>	51, 203, 2911, 11730	5, 10, 81, 260	3.58 (SD = 0.98)
B) <i>AI Theorist Says Nuclear War Preferable to Developing Advanced AI *</i>	1	128	2.14 (SD = 0.98)
C) <i>An Entire Generation is Studying for Jobs that Won't Exist</i>	0, 516, 2999, 7916	54, 103, 471, 1079	3.14 (SD = 1.12)
D) <i>Droughts are coming on faster: Higher global temperatures are increasing the frequency of flash droughts</i>	226, 915, 1201, 2985	6, 30, 38, 128	3.91 (SD = 0.94)
E) <i>Engineers develop water filtration system that permanently removes 'forever chemicals'</i>	0, 212, 495, 1796	3, 12, 16, 42	3.05 (SD = 1.00)
F) <i>Judge finds Google destroyed evidence and repeatedly gave false info to court</i>	0, 248, 8611, 34928	2, 19, 337, 978	2.73 (SD = 1.03)
G) <i>New York Times says it won't pay for Twitter verified check mark</i>	0, 0, 7744, 54947	4, 115, 673, 3121	3.75 (SD = 1.02)
H) <i>Nuclear energy: How environmentally-friendly and safe is it? *</i>	1	113	3.80 (SD = 0.95)
I) <i>Research confirmed that contrary to claims by anti-vaccine proponents, COVID-19 vaccines pose only trivial risk of venous thromboembolism (VTE), or blood clots. In addition, the study found that becoming infected with COVID-19 poses a significant risk of blood clots.</i>	0, 668, 2910, 10899	4, 60, 294, 669	3.36 (SD = 1.18)
J) <i>Stephen Hawking warned AI could mean the 'end of the human race'</i>	0, 0, 535, 2684	0, 53, 187, 653	2.94 (SD = 1.10)
K) <i>The newest version of ChatGPT passed the US medical licensing exam with flying colors — and diagnosed a 1 in 100,000 condition in seconds</i>	0, 0, 0, 44814	1, 14, 122, 2922	2.72 (SD = 1.03)
L) <i>The wave of lawsuits that could kill social networks — Large platforms face several legal challenges in the United States accusing them of knowingly harming the mental health of young people</i>	0, 314, 694, 1771	5, 38, 67, 179	3.45 (SD = 1.01)
M) <i>There's No Such Thing as Artificial Intelligence The term breeds misunderstanding and helps its creators avoid culpability.</i>	0, 127, 2228, 5562	6, 38, 245, 673	2.63 (SD = 1.04)
N) <i>TikTok Tracked Users Who Watched Gay Content, Prompting Employee Complaints</i>	0, 63, 423, 792	1, 7, 32, 98	2.69 (SD = 1.05)

* posts that had only a single variant with a ratio of upvotes close to 0.5

4.2 Quantitative analysis

The quantitative analysis mainly focused on the credibility observations, however other metrics were also gathered that could present a better picture overall of the perceived credibility of Reddit and the reasoning behind the participant's answers. Thus, besides the perceived credibility metric, the willingness to upvote, familiarity with the topic of the post and the view over the content of the participants, were taken as well into consideration.

Firstly, to find if credibility is affected by the popularity of a post a Kendall's *tau_b* correlation was run on the number of upvotes of a post and the perceived credibility observations from the survey. Furthermore, a Spearman's rank correlation was used to determine how the ratio between the number of upvotes and the number of comments on a post could influence credibility. These results are presented in the following sections. The two non-parametric correlation coefficients were chosen due to the non-normal nature of the data set found when running a Shapiro-Wilk test of normality ($p < .05$).

The current research also wants to find what other factors influence the perceived credibility of Reddit posts. Hence, as mentioned previously, the participants were asked how they view the content of the Reddit post.

One of the main actions you can take on Reddit when browsing is to either upvote or downvote content. Therefore, the survey asked users to report whether they would upvote or downvote the post. Three Mann-Whitney U tests were run on the upvote count, comment count and upvote-downvote ratio against the upvote/downvote response of the users to determine whether there is any statistically significant influence of the post features on the willingness to upvote.

Another related metric was the familiarity with the topic of the post, which the respondents were able to rate on a labelled scale of 1 to 5. A Mantel-Haenszel test of trend was run to assess if there is any linear association between topic familiarity and perceived credibility.

Finally, a Spearman's rank correlation was conducted to examine the relationship between the level of usage of Reddit reported by the participants and the credibility ratings.

4.3 Qualitative analysis

To gain a better view of people's opinion on Reddit and possibly find meaningful relationships between their opinions and actual credibility evaluations, a thematic analysis using the framework described by Braun and Clarke (2006) was conducted. The analysis was conducted on two of the questions given to participants during the survey. Specifically, they were asked to describe their opinion of Reddit as a news source as one question, and the second question required them to describe the process they go through when evaluating the credibility of a Reddit post.

Firstly, the answers to the two questions were extracted into separate spreadsheets. This permitted an easy and familiar visualization of all the responses. The participant responses were placed on the first column of the spreadsheet to leave plenty of space on the space to the right to write the most important ideas found in each response. Then, each response was carefully read and re-read to achieve a better mental overview of all the responses.

Some more interesting responses were marked with bold, and one of the responses was translated as it was written in Polish, interestingly the participant only answered in one of the questions in Polish but used English in the other.

The next phase included going through the responses again and coding all ideas, topics or opinions the participants wrote. Additionally, responses regarding the opinion on Reddit as a news source were annotated as "Positive", "Negative" or "Neutral". In case one response contained both positive and negative opinions, these were extracted into a second row in the spreadsheet and annotated accordingly.

Once coding was done, duplicate ideas were reduced to a single idea so there was no repetition. Then all codes were moved into a drawing board software for visually mapping and grouping related ideas to discover general themes.

Once the recurring themes were mapped and ideas were grouped, a second round of analysis was conducted to refine the themes and generate clearer definitions of the underlying ideas discovered.

Finally, the findings were synthesized into a report that is presented in the following sections. The next section presents the study results together with the quantitative and qualitative analyses.

5. Results

The crowdsourcing study was conducted based on scraped data from the Reddit website and crowdworkers were asked to rate the credibility of each Reddit post based on their own thoughts and beliefs (see tables 4 and 5 for the credibility survey questions and Reddit posts used in the survey). The following results section is split into three parts. Firstly, an overview of the demographics of the participants and their responses in the introductory part of the survey are presented. Secondly, an analysis of the credibility study is conducted to find whether there's a correlation between the credibility evaluations and other variables. Thirdly, a short overview of the data scraping tool is added.

5.1 Respondent demographics

The crowdsourcing study was conducted over the course of 5 days, through Prolific. A total of 68 people responded to the survey, each rating the credibility of 14 Reddit posts, resulting in a total of 952 credibility ratings. Table 6 presents the demographic data. A total of 43 females and 25 males participated in the study, with ages ranging from 19 years old, up to 90 years old. Three additional people answered the survey partly, however those were excluded from the analysis, and because of a problem in the survey system, some of the questions in the introductory part of the survey were overwritten, thus, some representations will have some of the data incomplete for two respondents.

Most participants (23, of which 18 females) are from the United Kingdom, 9 from Poland, 8 from Italy, 7 from Portugal, and all other nationalities were represented by 3 or fewer respondents.

Participants were also asked to state their education level. Most respondents (66%) have achieved at least an undergraduate diploma (42% undergraduate, 21% graduate, 3% doctoral), with the rest having secondary (15%) or post-secondary (18%) studies.

An overwhelming majority of the participants are White (64), with a majority of 40 being women (58.8%). Two people are of Black ethnicity, one Asian and last participant declared as "Other".

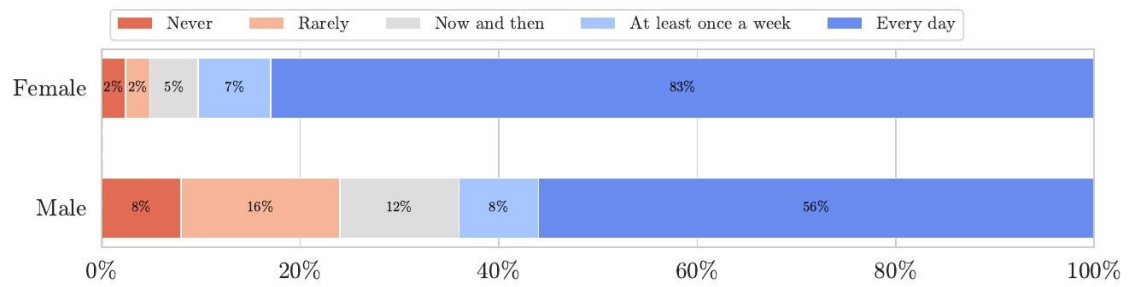
Before participants started rating the credibility of Reddit posts, they were first required to assess, based on their own opinion, their ability to detect fake news and also report how much they use Reddit and social media in general.

Table 6: Demographics

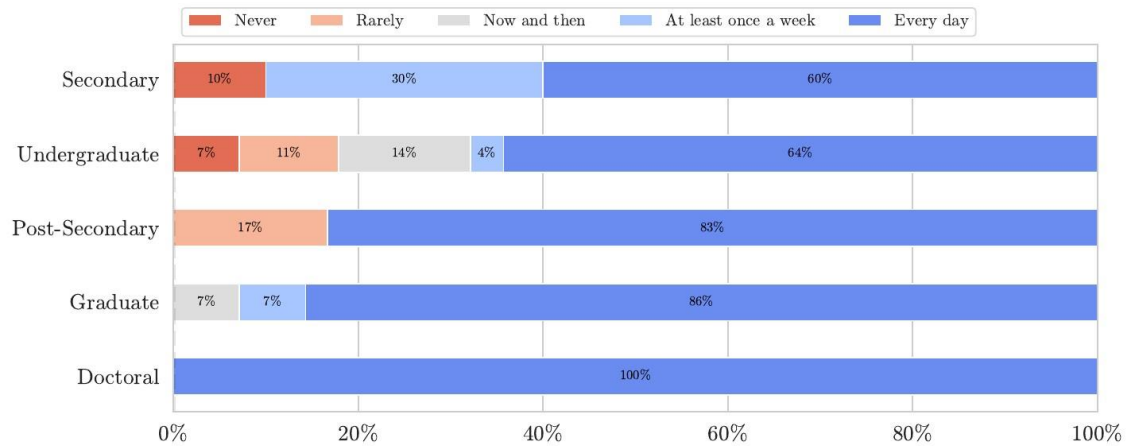
	Male	Female	Total
Total	25 (36.7%)	43 (63.3%)	68
Age			
18-25	3 (4.4%)	14 (20.5%)	17 (25.0%)
26-35	7 (10.2%)	10 (14.7%)	17 (25.0%)
36-45	3 (4.4%)	5 (7.3%)	8 (11.7%)
46-55	5 (7.3%)	6 (8.8%)	11 (16.1%)
56 or older	7 (10.2%)	8 (11.7%)	15 (22.0%)

Ethnicity			
White	24 (35.2%)	40 (58.8%)	64 (94.1%)
Black	1 (1.4%)	1 (1.4%)	2 (2.9%)
Asian		1 (1.4%)	1 (1.4%)
Other		1 (1.4%)	1 (1.4%)
Education*			
Undergraduate	12 (18.1%)	16 (24.2%)	28 (42.4%)
Graduate	7 (10.6%)	7 (10.6%)	14 (21.2%)
Post-secondary	5 (7.5%)	7 (10.6%)	12 (18.1%)
Secondary	1 (1.5%)	9 (13.6%)	10 (15.1%)
Doctoral		2 (3.0%)	2 (3.0%)
Nationality			
United Kingdom	5 (7.3%)	18 (26.4%)	23 (33.8%)
Poland	4 (5.8%)	5 (7.3%)	9 (13.2%)
Italy	2 (2.9%)	6 (8.8%)	8 (11.7%)
Portugal	4 (5.8%)	3 (4.4%)	7 (10.2%)
Netherlands	2 (2.9%)	1 (1.4%)	3 (4.4%)
Canada	1 (1.4%)	2 (2.9%)	3 (4.4%)
New Zealand	2 (2.9%)		2 (2.9%)
South Africa	1 (1.4%)	1 (1.4%)	2 (2.9%)
United States		2 (2.9%)	2 (2.9%)
Hungary	2 (2.9%)		2 (2.9%)
Australia		1 (1.4%)	1 (1.4%)
Mexico	1 (1.4%)		1 (1.4%)
Ireland		1 (1.4%)	1 (1.4%)
Slovenia		1 (1.4%)	1 (1.4%)
Albania		1 (1.4%)	1 (1.4%)
Greece	1 (1.4%)		1 (1.4%)
Spain	1 (1.4%)		1 (1.4%)

* Answers from two participants were lost due to a problem in the system that was later fixed.



(a) By gender



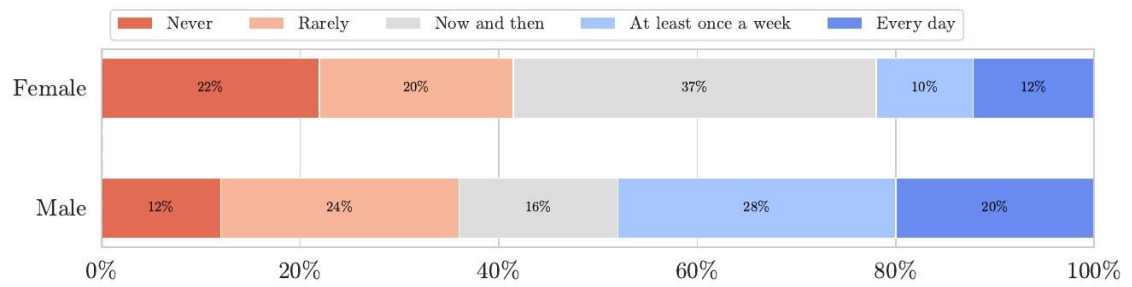
(b) By education

Figure 5: Self-reported social media usage

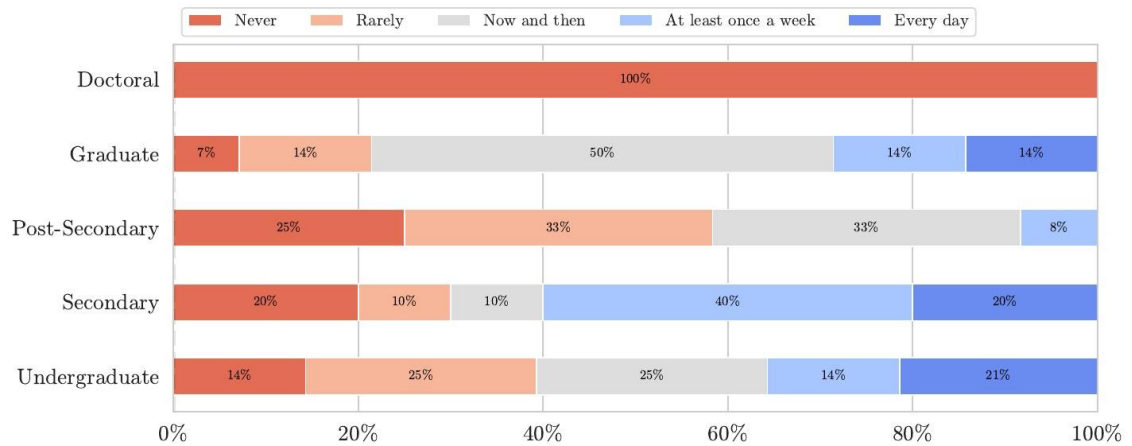
Firstly, figure 5a presents social media usage by gender, and figure 5b shows the same metric by education level. Out of all participants, 72% reported daily usage of social media. Of all females, 83% reported daily usage while only 56% of males reported the same. Overall, it seems that males use social media less compared to women.

When it comes to the usage of Reddit, only 12% of females use Reddit daily, while the proportion is 20% for males. On average, 15% of all respondents use Reddit daily, 16% use it at least once a week, while the rest of 67% use it less than once a week. Figure 6a shows the exact numbers for each gender when it comes to usage of Reddit.

When it comes to Reddit usage by education level, there seems to be no clear trend. While it does seem that undergraduates and secondary school graduates use Reddit to slightly higher degree, this might be due to the small sample of participants. Interestingly, out of the 2 doctoral level participants, both reported that they do not use Reddit at all. Figure 6b show Reddit usage by education level.



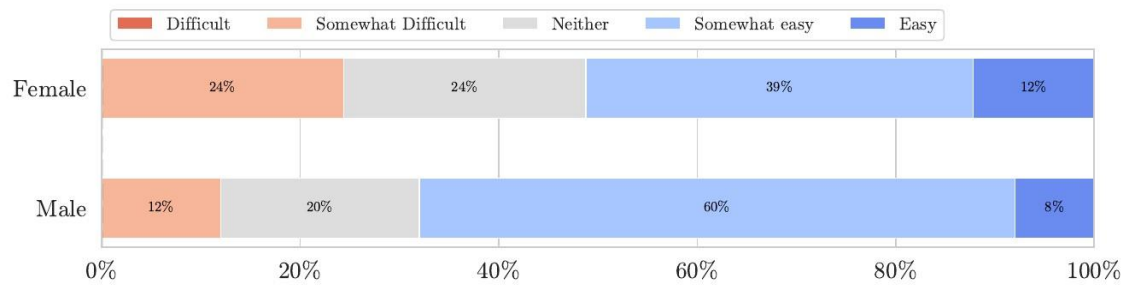
(a) *By gender*



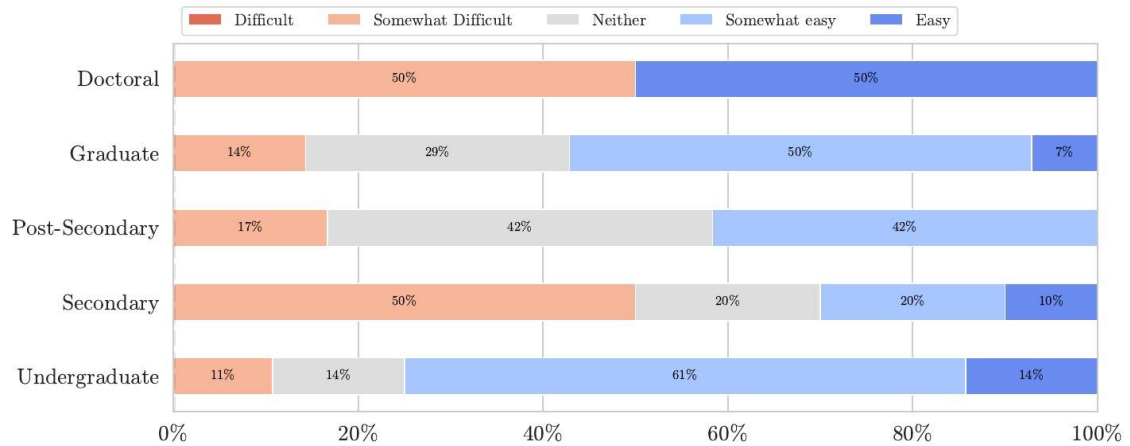
(b) *By education*

Figure 6: Self-reported Reddit usage usage

Lastly, based on the reports of the respondents, 10% of all respondents reported that they find it easy to differentiate between fake and real stories, but no one reported it to be difficult. 12% of females said they find it easy, while only 8% of men said the same, however, 60% of men reported that it's somewhat easy, while the percentage for females is 39%. Interestingly, when it comes to education, one doctoral student reported that it is somewhat difficult to differentiate, while the other reported it to be easy. Figures 7a and 7b can be inspected for more details.



(a) By gender



(b) By education

Figure 7: Estimated, self-reported ability to detect fake news

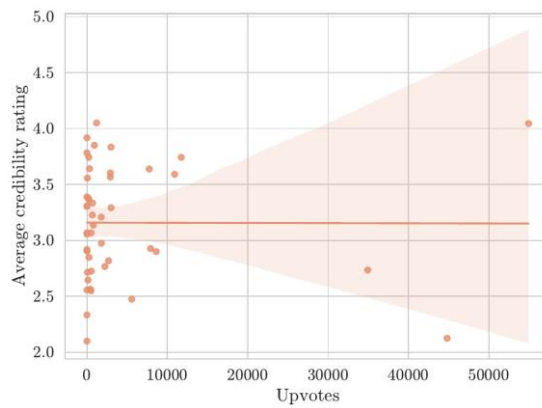
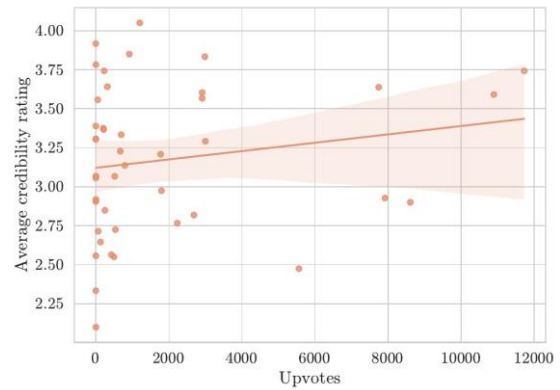
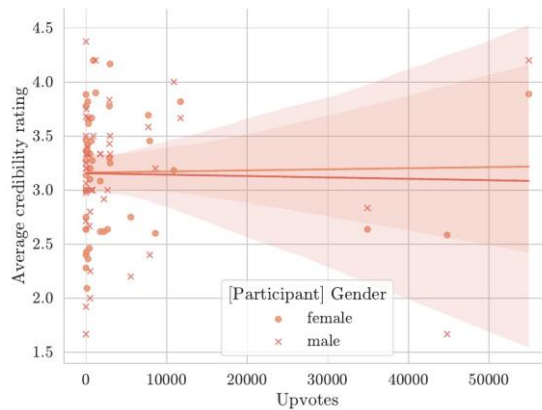
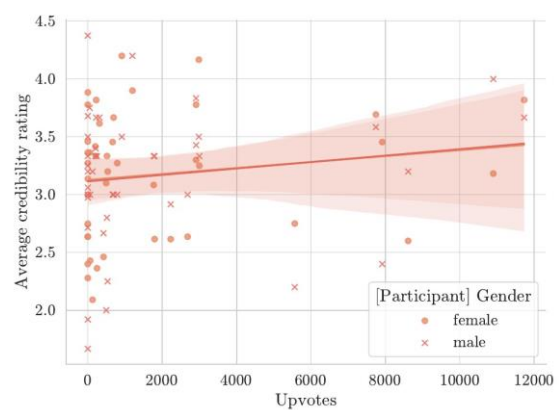
5.2 Quantitative analysis of credibility evaluations

The current section presents the quantitative analysis conducted on the credibility observations resulted from the survey. The analysis was conducted over the 952 observations from the 68 participants. The data was analysed using Python. On average, the credibility of all ratings is 3.139 out of a total of 5 ($SD = 1.147$).

To answer the first research question, "*Is the credibility of a Reddit post influenced by its popularity?*", an analysis of the relation between upvotes and credibility evaluation of the participants was conducted. A visualization of mean credibility ratings for each Reddit post by number of upvotes is presented in figure 8. A series of regression plots were used to visually indicate whether perceived credibility is influenced by the number of upvotes, figures 8 and 8c show the mean credibility of all responses and by gender respectively, while 8b and 8d show the same metrics but for a subset of the data, excluding the high-upvote extremes, as most of the posts have less than 20,000 upvotes.

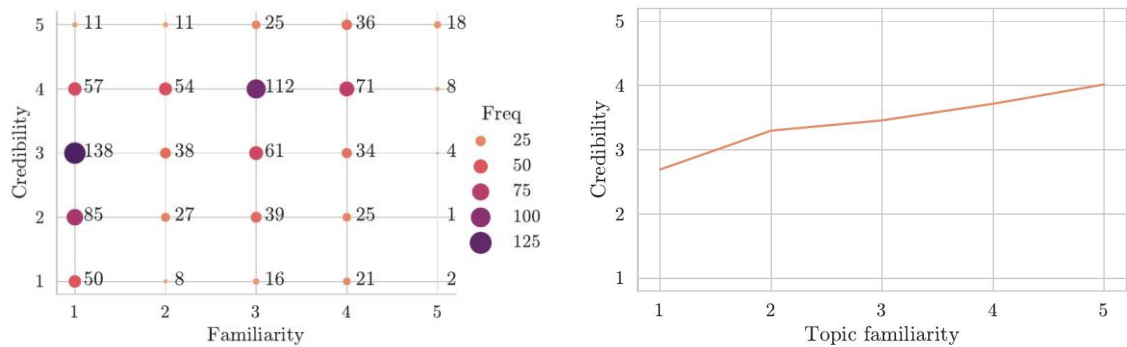
Table 7: Kendall's τ_{ab} correlation on the relation between number of upvotes and reported credibility

			Credibility	Post upvotes
Kendall's τ_{ab}	Credibility	Correlation Coefficient	1.000	.041
		Sig. (2-tailed)	.	0.105
		N	952	952
	Post upvotes	Correlation Coefficient	.041	1.000
		Sig. (2-tailed)	0.105	.
		N	952	952

**(a) Credibility by upvotes****(b) High-upvote extreme excluded****(c) Credibility by upvotes by gender****(d) High-upvote extreme excluded****Figure 8:** Mean credibility evaluation regression plot by the number of upvotes and gender

To determine whether there is any correlation between the number of upvotes of a Reddit post and the perceived credibility, a Kendall's τ_{ab} correlation was run. The results can be seen in table 7. There was a weak, positive association between the number of upvotes and the perceived credibility, however it was statistically insignificant, $\tau_b = .041$, $p = .105$ ($n = 952$). Therefore, according to the weak correlation between number of upvotes and perceived credibility, we can answer our first research question and conclude that a post's popularity does not affect the perceived credibility. The effect can also be observed in

appendix A. Interestingly, posts B and H were rated rather differently, both having an upvote ratio of 0.5 according to the scraped data. On one hand, post B shows a low credibility rating of 2.147 ($SD = 0.981$), while post H is rated at 3.808 ($SD = 0.950$). Other posts show no significant difference between the number of upvotes.



(a) Scatterplot of frequency of familiarity ratings in relation with credibility ratings. (b) Regression based on familiarity ratings in relation with credibility ratings

Figure 9: Topic familiarity in relation to credibility.

Related to upvotes, an analysis was also conducted on the ratio between the number of upvotes and the number of comments to see if there is any correlation between credibility and this ratio. A Spearman's rank correlation coefficient was calculated on the ratio between upvotes and comments, and the reported credibility by participants. There was a weak, positive correlation between the two variables $\rho_s = 0.102$, $N = 952$, $p = 0.001$, which was statistically significant. Flipping the two variables in the ratio, the Spearman's rank correlation coefficient on the ratio between comments and upvotes and credibility ratings resulted in a weak negative correlation, $\rho_s = -0.085$, $N = 952$, $p = 0.008$, which is statistically significant. These results suggest that, the more upvotes compared to comments, the higher perceived credibility, and the more comments compared to upvotes, the lower the perceived credibility. While this result is not conclusive enough, further research using larger data sets could further augment the result and determine whether the correlation is in fact significant.

Participants were also asked to rate how they feel about the post and its content (see table 4). Figure 10 shows the mean credibility evaluations in relation to the content style reported by the participants. On average, content that was viewed as offensive was rated lowest by both males and females ($M = 1.695$, $SD = 0.702$, $N = 23$), the same pattern is seen with content with misleading titles ($M = 1.977$, $SD = 0.901$, $N = 87$), content the participants don't agree with ($M = 2.067$, $SD = 0.864$, $N = 118$) or content that contains jargon ($M = 2.650$, $SD = 0.833$, $N = 40$). On the other hand, content that was easy to understand ($M = 3.619$, $SD = 0.932$, $N = 260$) or that the participants agreed with ($M = 4.136$, $SD = 0.808$, $N = 169$) were seen as more credible. Participants were also able to answer this question with "other" or "no feeling", however there were no significant justifications given. Based on the results gathered from this survey question, we can say that people in general see content as more credible when they understand it or agree with it.

Another metric that was captured during the study was the willingness to upvote. The respondents, on average, gave higher credibility ratings to posts that they would also upvote ($M = 3.860$, $SD = 0.789$, $N = 494$), while on the other hand the intention to down vote usually means the respondents don't find the post as credible ($M = 2.362$, $SD = 0.949$,

$N = 458$). Out of all credibility ratings, 494 showed the intention to upvote, while 458 showed the opposite.

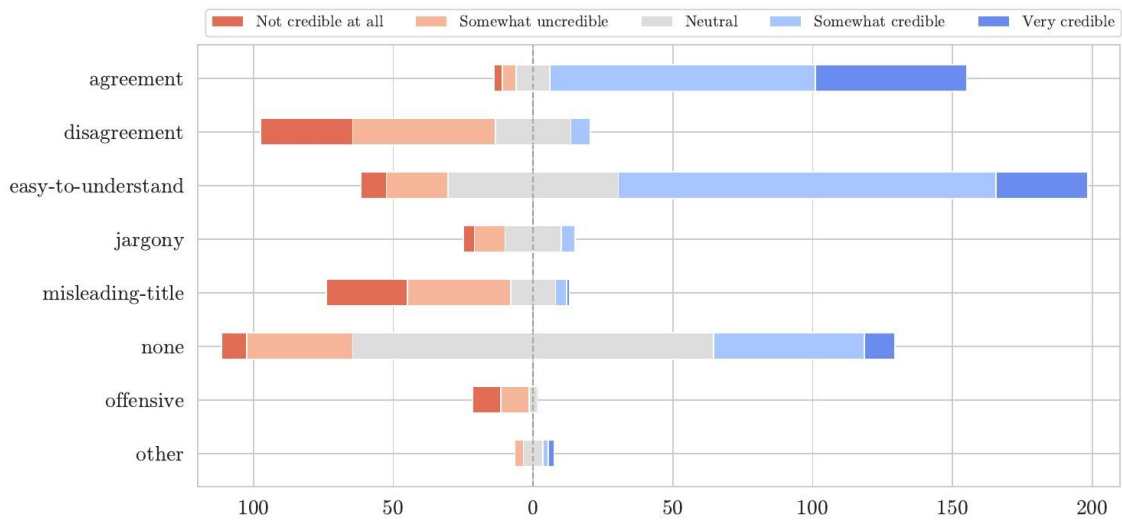


Figure 10: Credibility ratings by content style.

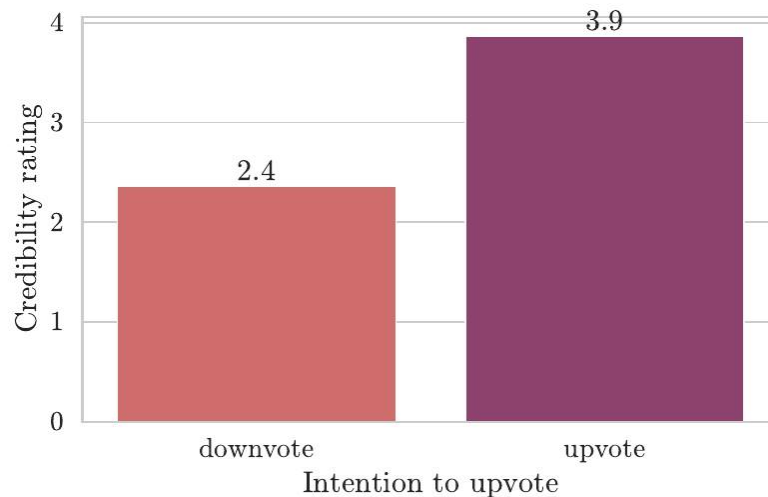


Figure 11: Intention to upvote correlated by credibility.

To assess whether there are any differences between post features and the willingness to upvote or downvote. Three Mann-Whitney U tests were run on the upvote score, number of comments, post upvote to downvote ratio and the reported upvote/downvote willingness. Upvote score was not statistically significantly different based on the willingness to upvote

($Mdn = 226$) or downvote ($Mdn = 203$), $U = 118, 359$, $z = 1.247$, $p = .212$. A similar statistically insignificant result was found for the comment number and willingness to upvote ($Mdn = 67$) or downvote ($Mdn = 98$), $U = 108, 488$, $z = -1.095$, $p = .273$. However, there was a statistically significant difference between the post upvote to downvote ratio and the willingness to upvote ($Mdn = .92$) or downvote ($Mdn = .91$), $U = 125, 023.5$, $z = 2.817$, $p = .005$. This finding, however, does not say much on its own. Specifically, the upvote ratio is, most of the time, hidden from the user's view, or, at most, harder to observe. Therefore, it might be that there is another variable that affects the

result, it could be the actual content or something else entirely that was not tested for in this study.

Furthermore, respondents were also given the task to estimate their familiarity with the topic presented in the post they needed to rate. Appendix B shows the credibility evaluations of each post and the reported topic familiarity by users.

To determine whether a linear association between topic familiarity and credibility exists, a Mantel-Haenszel test of trend was run. Both topic familiarity and credibility are categorized on a scale of 1 to 5. The Mantel-Haenszel test showed a statistically significant and positive linear association between the two variables, $\chi^2(1) = 86.985$, $p < .001$, $r = .302$. In other words, the more familiar with the topic a user is, the higher the perceived credibility. Figure 9 shows how the trend is exhibited. It seems that people tend to view a post as more credibility if they have knowledge about the topic. Conversely, credibility is rated lower when familiarity is low. Furthermore, correlating topic familiarity with the content that were labelled as containing jargon, it was found that, for content containing jargon the topic familiarity on average is rated at 1.275 ($SD = 0.598609$), while credibility being 2.650 ($SD = 0.83359$).

A last metric that was inspected was the correlation between the reported usage of Reddit and credibility was tested. A Spearman's rank correlation was conducted to examine the relationship. There was a weak positive correlation between the level of usage of Reddit and credibility, $\rho_s = 0.069$, $N = 952$, $p = 0.032$, which is statistically significant. However, we think that a good conclusion cannot be taken from this result, while the correlation is positive and significant, indicating that the higher the usage of Reddit, the higher the users perceive the credibility of posts, further research should be conducted on a larger data set that could complement these findings.

All in all, we can now answer the second research question, "what other factors contribute to the perceived credibility of Reddit posts?". As we presented earlier, credibility is indeed affected by the content and the way it's presented. Offensive, jargony or content that the person does not agree with is seen as less credible, while easy to understand or agreeable content is more credible. Also, the more familiar a user is with the topic of the content, the more credible they perceive it. Lastly, while the differences were small, the amount of experience a user has with the platform also affects credibility positively, though more research could be conducted in this area.

5.3 Qualitative analysis

The participants were also given the opportunity to write their own words regarding their process in evaluating credibility of posts. Following the procedure detailed in 4.3, the main themes discovered in the process are presented in the following sections.

5.3.1 Credibility evaluation of Reddit posts

As part of the introductory part of the survey the participants were asked to answer, with their own words, to the question "*How do you evaluate the credibility of a post?*". As a result of the thematic analysis on the participant answers, three primary credibility evaluation methods were discovered. An overview of the results is provided in table 8.

Shallow Evaluation

It was identified that some respondents, 21 of 68, make part or even their entire evaluation based on surface-level features of a Reddit post. We define shallow evaluation as the type of evaluation where only features that are available "at a glance" are evaluated, such as the title of the post, number of upvotes or comments, the source of the content, author, or even the post photo when the case.

In terms of initial impression, I look to the layout of the post. If the title is easy to read, unopinionated, and the photo chosen is also clear and coherent, I naturally perceive it as more reliable. However, if the title is too wordy, uses incorrect spellings/grammar, or written in an unprofessional way, then I naturally discredit it. After initial impressions, I mainly look then to the link attached. If I recognise the source to be relatively objective and reliable, then I don't question it much more. However, links to pop-culture blogs or news immediately makes it seem like an opinion-piece to me, rather than an unbiased article. Additionally, the interactions on the post give me some insight into its credibility. For example, a post with lots of comments, and a high amount of upvotes makes me assume that it's at least somewhat credible (or at least, not obviously wrong). (female, 19)

I can't until I open it up. But if I can't, I check the source, the date, sort the comments by controversial and try to analyze the answers that each of them got so I know how people are defending or attacking the post and evaluate if their arguments make sense. (female, 22)

First I check the credibility of the title, then I check the authority of the source. (female, 58)

Reading the title, mainly, and then look at the number of upvotes. (male, 46)

I look at link and number of upvotes (female, 30)

Shallow evaluation was rarely mentioned as the only method of evaluation, most participants prefer to go deeper. As this study mainly focused on surface-level features, it is interesting to see how, at least in this case, the number of upvotes does not affect credibility, unlike what some of the answers like to mention.

In-depth Evaluation

Interestingly, many respondents claimed they prefer to go in more depth and read the actual content (38 of 68), or even go as far as cross-reference with other sources before assessing the credibility of a post. Furthermore, participants mentioned that they also use the comments to a post as a way to evaluate credibility, as many times comments can give much-needed context to a post or even bring additional or contradictory facts that may have been either missed in the original post, or were entirely wrong.

The best way is to always read it yourself and then check what other sources have to say on the same matter. Reading the comments

sometimes help as well as there can be constructive criticism. (male, 29)

Others also like to check the Reddit profile of the author. Because anyone can share posts on Reddit, the authors are rarely the actual news outlets to actually publish on Reddit, it can be anyone.

I evaluate the headline and where it's been posted from, as well as checking the profile of the user who has shared the post, to see what sort of other posts they've shared in the past; it all helps to evaluate whether they are a genuine news source or not. (female, 38)

I always need to contrast its information with other sources, because anyone can write a Reddit post. (female, 24)

Another less quantifiable metric that people look into is how the content presented is structured. The quality of the actual content matters and can show credibility, while poorly written content with errors does not. Furthermore, respondents mention that they look for alarmistic, controversial, or content that is written in a way to make it tempting to click on it, and if the content matches their definition of those terms, they might discard the post as not credible.

first i look at the tone of the title. is it very alarmistic, panicked, angry? then i look at what the title says, does it explain the content well or is it written badly? then i look at the source. after that i look at the content and read the comments. often the comments will have more information about the credibility of the post (female, 26)

Wheter [sic] they use controversial content to attract people's attention or provoke them to click on link or state to the facts and telling what article is about without unnecessary words (female, 25)

Therefore, when talking about in-depth evaluation, we refer to the act of going beyond the surface-level features. As shown, respondents tend to go for in-depth information to understand the context of the post. They want to see what others have to say in the post comments, evaluate their opinions and whether they add additional context that was omitted, downright wrong, or even are just rumors, in the original post. Some even go as far as looking at actual scientific publications, when applicable, before making their own credibility evaluation.

Experience-based Evaluation

The third type of evaluation is experience based, 31 of respondents using related methods. What is meant by experience is the assumptions, opinions or knowledge that the readers possess prior to even having read the content. For instance, respondents mention that they tend to use their own "*common sense*" as a method for evaluating the content. While this does not say much as a piece of text itself, we can try to understand what they actually mean by that. Another example of experience represents the person's actual expertise. As also shown in this thesis, actual familiarity with the topic presented in a post has an effect on the perceived credibility.

Above of all I base the intrepretation [sic] of the News with my knowledge (male, 50)

I use common sense plus whatever knowledge I possess on the topic (male, 68)

I use my own knowledge and the mainstream of the articles I have read on the subject as a basis (male, 39)

Evaluation doesn't necessarily need to be done solely based on experience. Experience based evaluation can also be combined with Shallow evaluation, as some respondents also mention. For instance, by only reading the title they also correlate the respective information with knowledge they already possess.

just by reading the title i think I'm able to establish if the information i'm presented with is true, false or exaggerated (based on my knowledge). then i check where the article is coming from. if it's a source that i find unreliable or that i've never heard of i would probably dismiss the article. if it's from a reliable source ii would probably just accept the information adn move on (female, 22)

Table 8: Breakdown of evaluation types based on evaluated features discovered in the thematic analysis

Shallow Evaluation	In-depth Evaluation	Experience-based Evaluation
Number of upvotes	Reading comments	"Common-sense"
Number of comments	Reading post content	Own expertise/knowledge
Author	Cross-referencing	
Source link	Secondary sources	
Title	Author profile	
Photo	Structure of content	

These findings can be correlated with other previous research regarding credibility. Metzger et al. (2010) describe five heuristics used for credibility evaluation, and three of them are also prevalent in this study.

Our findings regarding shallow and experience-based evaluation go in line with the reputation heuristic discovered by Metzger et al. (2010). They found that the reputation of the source of information is prevalent in the evaluation of credibility. Our findings also adhere to well-known research around source credibility and surface credibility (Hovland and Weiss, 1951; Tseng and Fogg, 1999). Additionally, the findings go partly in line with the endorsement heuristic, or also referred as conferred credibility (Flanagin and Metzger,

2000). The endorsement heuristic refers to the tendency to view content as more credible when others report positive interactions. In this case, shallow-evaluation goes in line with the heuristic, however on the other hand the quantitative results go partly against the heuristic as upvotes, which can be seen as a type of endorsement, do not affect credibility. Finally, the findings go in line with the consistency heuristic, which mentions cross-validation of sources as a way of achieving credibility. This goes in line with our findings in the in-depth evaluation method, where participants mentioned they prefer to check other sources before determining the credibility of a post.

5.3.2 Reddit as a news source

A second analysis was conducted on the responses to the question "*What do you think about Reddit as a news source?*". As this question gave the opportunity to the respondents to state their opinion, the results were grouped by the attitude of the opinion: positive, negative or neutral. In total, there were 37 negative opinions, 20 positive and 13 neutral. These findings were also correlated to the reported Reddit usage of the participants. It was found that, participants with a negative opinion show an average Reddit usage of $M = 2.86$, positive opinions of $M = 3.65$ and neutral opinions $M = 2.23$. The responses match the neutral opinions, it was noticed that most of the neutral respondents actually mentioned that they have no opinion because they do not use or have much knowledge of Reddit. The positive opinions however show an interesting result. It seems that the more experienced users actually see Reddit as a good news source, which was also proved in the quantitative analysis, albeit with a weak correlation.

Of the positive opinions, a recurring aspect of Reddit that the respondents saw as beneficial was the community aspect of it.

It's a pretty decent portal, the articles in it are mostly credible, if something is wrong, they are downvoted

I enjoy it as I love the open comment ability. I enjoy reading people's responses to articles.

The participants also, while acknowledging this fact, they also acknowledge that sometimes it may be the case that the most endorsed content might not always be correct or true, or that some subreddits promote certain news outlets and restrict others.

I don't generally use it as news source but I would rate it as a decent outlet for news as the website offers easy access to the consensus of the community (using the karma system). Although the most upvoted opinion is also not always correct.

I think it's nice that anyone can post, upvote, downvote and comment. However I find it problematic that certain subreddits prefer specific news sources and channels.

Others also appreciate the fact that, through Reddit, you can find new perspectives and topics you might have not have heard about otherwise.

I think that Reddit can be a good place to read lots of perspectives on one topic and give yourself a broader range of information. Within one post's comment section, you're likely to see varying opinions, which may open up your mind to a perspective you haven't yet been looking from. The same cannot be said for news channels or specific newspapers/blogs/websites.

It is eye opening, I find out things I otherwise wouldn't know

On the negative side, respondents claim that the way Reddit is structured can amplify the "echo-chamber" phenomenon (Cinelli et al., 2021). Effectively, when you are immersed in a type of content or ideology, you keep seeing content revolving around those ideologies and stop finding opposing opinions.

I have very mixed feelings on Reddit as a news [sic] source because it completely depends on what subreddits you decide to follow, and what you engage with at most. So if I was for example to constantly follow and engage with anti vaccine content, I would be shown fake news frequently. If I only am exposed to fake news then that limits my perspective. I do enjoy reading scientific information there, and prefer it to some other social media for that purpose, as I see many commenters judge on the quality and truthfulness of the articles.

Another problem people see with Reddit is the ability to create anonymous accounts. Reddit does not require users to provide their full name, therefore people post with pseudonyms, and the respondents claim that it is easy to post anonymously and make people believe what you have to say.

I don't see this platform as a very credible source. You can anonymously(!) write anything you want and people will believe in it

It seems like, overall, there are mixed feelings about Reddit as a news source. And this might be true for any type of social media.

6. Discussion

The thesis aimed to study what factors influence the perceived credibility of Reddit posts. To achieve this, a web-based research tool has been developed that can scrape the Reddit website automatically and save historic data of the content posted by the users of Reddit. A researcher can select multiple communities that they want data, at what intervals of time should the scraping take place and how many posts should be scraped at a time. This allows for fine-grained control of the data sets that are to be collected. Additionally, at regular intervals, the tool scrapes each saved post again to create a historical view of post, allowing researchers to view the way post features, such as the score, number of comments or awards, change over time.

The tool was then used to conduct a crowdsourcing survey on the Prolific platform. The survey was conducted over the course of five days, with 68 total participants. Each participant was required to rate the perceived credibility of fourteen Reddit posts, along with other more specific questions regarding their usage of Reddit, content style, and so on. The survey yielded a total of 952 credibility ratings, which were then analysed to answer the two research questions described in the following section.

6.1 Answering the research questions

To contribute to the knowledge pool surrounding credibility, this research aimed to answer two main questions.

RQ1: *As Reddit posts gain popularity through votes, is the credibility of a Reddit post influenced by it's popularity? And if yes, in what way?* This question was answered by analyzing the results gathered during the survey. As each participant was required to rate the credibility of every post, and at the same time each participant was given a post with a different feature, such as the number of upvotes, it was possible to analyse the ratings and determine whether the upvote count affects credibility. The results showed that there is a slight tendency to believe a post more if it has more upvotes, however the correlation was not statistically significant. Furthermore, there was no indication that showed whether a single, isolated post, would receive a higher credibility rating based on its quantitative features. In other words, the same post rated at different number of upvotes or comments was not seen as more or less credible when the values changed.

Therefore, to answer the first research question, this study did not find any evidence to prove that credibility is influenced by the popularity of a post. Our results also show a possible correlation between the ratio of upvotes to comments, and credibility, however the correlation was weak.

These results may also be owed to the smaller sample size; however, these results go against past research which supported the notion that higher levels of endorsement would result in more credible content, or also cited as the "bandwagon effect" (Borah and Xiao, 2018; Metzger et al., 2003). This might suggest that Reddit does not work in the same way as other social media platforms, such as Facebook or Twitter. Also, there might be other variables that might affect credibility that were not taken into account in this study, such as the actual message of the post, tone, or the participant's biases.

RQ2: *What other factors contribute to the perceived credibility of Reddit posts?* In order to address this question, a series of subsequent analyses were conducted on the resulting data from the survey.

Firstly, participants were asked to provide their ratings on the post and its content. Generally, offensive content received the lowest ratings from both males and females. Similarly, content with misleading titles, content that participants disagreed with, and content containing jargon also received relatively low ratings. Conversely, content that was easy to understand or that participants agreed with was perceived as more credible. These findings might have an explanation, and it can be correlated to the surface credibility defined by Tseng and Fogg (1999), especially because this survey only analyzed surface-level features of posts. The results might also be explained by Petty and Cacioppo (1990), as they describe how receiver-related factors affect credibility. This might indeed be the case, especially considering the effect of offensive content or agreeable content, as the personal perceptions of the content will cloud someone's judgement and take the decision that is most suitable to their personal opinions, in this case for example, an offensive article will automatically be discredited as not credible.

Additionally, it was found that a higher level of familiarity with the topic discussed resulted in higher levels of credibility. The same goes for the levels of Reddit usage the participants reported, the more they used Reddit, slightly higher credibility scores were given. This could be an important finding, showing that future research could account for these differences when studying different subreddits and account for biases in the user's perceptions and experiences. For example, when studying the same subreddit, results could differ based on who the participants are: are they frequent users of the subreddit, or are they users who never visited the subreddit. This finding also bears some resemblance to the *experienced credibility* of Tseng and Fogg (1999), but also to what Wathen and Burkell (2002) discuss. For the current results, we can say that as the topic is more familiar to a person, they are more likely to find it believable. It can also go the other way around, as an expert might be able to tell what is credible from what is less credible. At the same time, one could speculate that some people could evaluate their knowledge on a topic higher than it actually is so they end up believing actually wrong content. On the other hand, based on the P-I theory defined by Fogg (2003), we could possibly correlate the lower credibility scores of people with a lower familiarity due to lack of interpretation. As Fogg mentions, it might be the case that people who don't understand a topic might not even try to give it too much thought and dismiss the content and rate it as not credible. However, this might need more actual research as it's highly speculative.

In addition to the findings from the quantitative analysis, a thematic analysis was conducted to find, on one hand, how people evaluate the credibility of Reddit posts, and on the other hand, what they think of Reddit as source of news.

For the first question they were asked, three main types of credibility evaluation were discovered as a result of the thematic analysis. Firstly, people evaluate surface-level features, such as upvotes, number of comments, the source link, the date the content was posted or the title. This was called "Shallow evaluation", and it complements the surface credibility type defined by Tseng and Fogg (1999). Secondly, "In-depth evaluation" happens when the reader actually goes one step further and reads the actual content, tries to find other sources to cross-reference and determine the credibility of the content. They also take into account the way the content is structured, the quality of the content or if it's alarmistic or written in such a way that tempts the users to click. This type of credibility, while referring to common cues that affect credibility by past research, was not found to

be discussed yet, especially in regards to the *depth* aspect of the credibility evaluation. The third and final type of evaluation is the one based on experience ("Experience-based evaluation"). It shares some aspects with shallow evaluation and was also explained by Tseng and Fogg (1999), but it focuses on the reader itself. Readers also tend to evaluate the credibility based on their personal experiences, and some even said they used "common sense" to evaluate the credibility, suggesting they assess credibility by "gut-feeling". As one of the respondents claimed, what sounds too good to be true it probably is. This is also related to their past experiences. The readers are able to reference content to other information they read in the past and are able, based on this gained experience and knowledge, to determine how credible some online content is. Tseng and Fogg (1999)

When it comes to Reddit's ability to be a credible news source, respondents mostly expressed mixed feelings. In general, those who had more experience using Reddit saw it as a good platform for news especially because of the community aspect. Many people can post on Reddit, so differing opinions can rise up with accompanying discussions that complement, or argue against those opinions. On the other hand, others claimed that Reddit is a bad platform exactly because of its opinionated nature, or because the post content algorithm makes it so the most upvoted content rises to the top, and content that people disagree with remain at the bottom, creating the so-called "echo chamber", where the same opinions get propagated and it's hard for opposing views to be seen. Another problem that people saw is the way people can use Reddit, there is no need to share your real name, so anonymous users, which can be anyone, from news outlet, business or government representatives, to regular users like us, can post any type of content, and with a carefully worded message, they can make others believe something that is fake or wrong.

To answer RQ2, it was found that credibility is indeed affected by the way the person sees or understands the content. Additionally, familiarity with the topic of the content was also found to affect credibility in a positive way. Lastly, familiarity with Reddit itself seems to have an impact on the perceived credibility, showing that more veteran users of Reddit usually put more trust into the content they read on the platform.

6.2 Limitations

As with any study, this one is not without its limitations. There are many ways the study could have gone better.

Firstly, the sample of participants was not very diverse. As this was not something that could have been controlled through Prolific, the number of females outnumbered that of males. Furthermore, both national and racial diversity was low. As Prolific is a UK based company, it was expected that the most participants would be from the UK.

In regards to the credibility observations, the final data set was rather small, with a total of 952 observations, for a total of 14 Reddit posts. As the data gathering tool was able to scrape more than 16 thousand Reddit posts in just a few months, the initial plan was to build the survey in such a way that respondents could respond to as many posts as possible. However, this was deemed unfeasible for the purposes of this thesis, and only a small sample of posts were chosen. This is another limitation of the study. As the tool was unable to scrape data from the past (it was not built for that), it would have been difficult or nearly impossible to set it to gather posts that could be used to compare with other research, hence the posts selected for the study were manually selected based on three topics that were found neutral enough to not be influenced by political aspects. This

is something that possible future implementations could handle, with better search functionality for posts and hopefully a larger pool of microtaskers to rate the credibility.

Another limitation present in the study is the actual credibility assessment part. Microtaskers were not able to open the actual post, read the comments or the original article, and they were forced to only give surface credibility assessments. Future research should focus on giving people more content to assess, however that might also impact the way the studies will be design. The current design allows for a greater ability to annotate Reddit posts with credibility assessments that could be used for automated analysis and Machine Learning. Allowing participants to read the actual content and comments will slow down the process and will probably result in a qualitative-focused study.

Lastly, the data gathering tool is not as feature-complete as initially desired. While it scrapes reddit reliably, it is not able to scrape it at a fast rate. Additionally, the tool is only saving the first page of comments. Therefore, if a reddit post has more comments than viewable on the first load, only a part of all comments will be saved. It is also not possible at the moment to build surveys with custom questions. The tool is indeed in need of more work and further research can expand on it, even if it only borrows ideas or parts of the implementation.

6.3 Future work

There are a few directions future research can focus on. First of all, as the data gathering tool is open-source and built with modern technologies, it can be built upon to support future research on Reddit. This might be an important step especially due to the recent changes in Reddit's API policies¹³, and the fact that PushShift is reported to have been taken down in light of the same news¹⁴.

Additionally, as the tool is able to gather historical data of Reddit posts, future research could look at the trend aspects of Reddit posts in relation to credibility. Specifically, could the credibility of a post be linked to how fast, or slow, it has risen in popularity? Furthermore, the tool also saves a part of the comments on each post, therefore there's a possibility automated analysis could be conducted on the changes in discussion topics in the comments. These are just some ideas that could further give inspiration to others.

Lastly, an important improvement that could be made is related to how Reddit posts are currently stored using the tool. At the moment, each post is linked to a subreddit, and also it's user-given Flair is stored. However these are just some generic topic names, such as "Health" or "Politics". Other improvements could use some form of automated grouping of posts by events. For example, the COVID pandemic, while mostly a health related issue, actually has impact on a wide array of fields and discussion topics. Therefore, a more advanced grouping system could identify and gather information about a specific event from multiple subreddit, spanning a larger amount of time, and that data could be analyzed to identify patterns, discussions, or features that otherwise could be missed in identifying what makes one story credible and the other less credible when they appeared in different places.

¹³ <https://techcrunch.com/2023/04/18/reddit-will-begin-charging-for-access-to-its-api/>

¹⁴ https://www.reddit.com/r/pushshift/comments/13mhuzq/api_has_been_taken_down/

7. Conclusion

The current thesis aimed to study the perceived credibility of Reddit posts and answered the two research questions related to the effect of popularity of a Reddit post on perceived credibility, and subsequently, what other factors contribute to the perceived credibility of Reddit posts.

To answer the two research questions a Reddit scraping tool was built to gather and save historical post data from Reddit. The resulting data was then used to conduct a crowdsourcing study with participants from the Prolific platform. The participants were required to assess the surface credibility of fourteen Reddit posts, along with other free-text answers that were analyzed as part of a qualitative analysis. The credibility evaluations were then used in a quantitative analysis.

To answer the first research question, it was found that the number of upvotes of a post does not have any significant effect on its perceived credibility. At the same time, the ratio between the number of upvotes and the number of comments seemed to have a small positive correlation, suggesting that the more upvotes compared to comments, the higher the perceived credibility. These results go against some past research around the "bandwagon effect", therefore it is suggested that more research is done around this aspect as the sample size was also limited for this thesis.

The second research question was met with interesting answers. Firstly, it was found that jargony or offensive content is found less credible, while easy to understand or agreeable content is more credible. Furthermore, the more familiar a user is with the topic discussed by the post, it's more likely they view it as credible. Finally, it was also found that more experienced users of Reddit have a tendency to see content as slightly more credible.

While the results of the quantitative analysis answer some questions around the credibility of Reddit content, the qualitative analysis yielded some more interesting answers. When asked how people evaluate the credibility of Reddit content, three main types of credibility evaluation were discovered: "*Shallow evaluation*", "*In-depth evaluation*" and "*Experience based evaluation*". Additionally, based on participant answers, Reddit is, on one hand, a good news platform due to the community aspect of it which allows diverse opinions and fact-checking using the comments section, and on the other hand it is a bad news source due to the possibility of anonymously posting fake content that looks credible, or due to the way the most common opinions are most prominent and opposing views are demoted due to the Reddit's ranking algorithm.

There are multiple contributions this research brings. First of all, the data gathering tool is an important contribution as it is open-source and it can be further developed to provide more tools for Reddit researchers to scrape and analyze Reddit data in the future, especially in light of new Reddit regulations. Secondly, the difference in how credibility is viewed in relation to popularity is an interesting finding as it shows how Reddit works differently to other platforms, suggesting that more research could be conducted to understand exactly why that is. Thirdly, the way credibility is affected due to the nature of the content or experience of the users shows that future research could account for these differences when studying specific subreddits and adjust for user biases. Finally, the three types of credibility evaluation can prove helpful in explaining how people actually evaluate content from multiple perspectives, and future

research could go in more depth around these types of evaluation, especially in the case of Reddit.

Author's thoughts

While it has its limitations and problems, I think it was, overall, a memorable experience working on the thesis. I am, personally, rather pleased with the data gathering tool, and I hope I can find some more time to fine-tune it and possibly have it working on actually gathering data from Reddit, especially now after news regarding Reddit charging more for their API's and PushShift no longer working. I am also quite happy with the evaluation types finding, I think it was one of my most interesting realisations.

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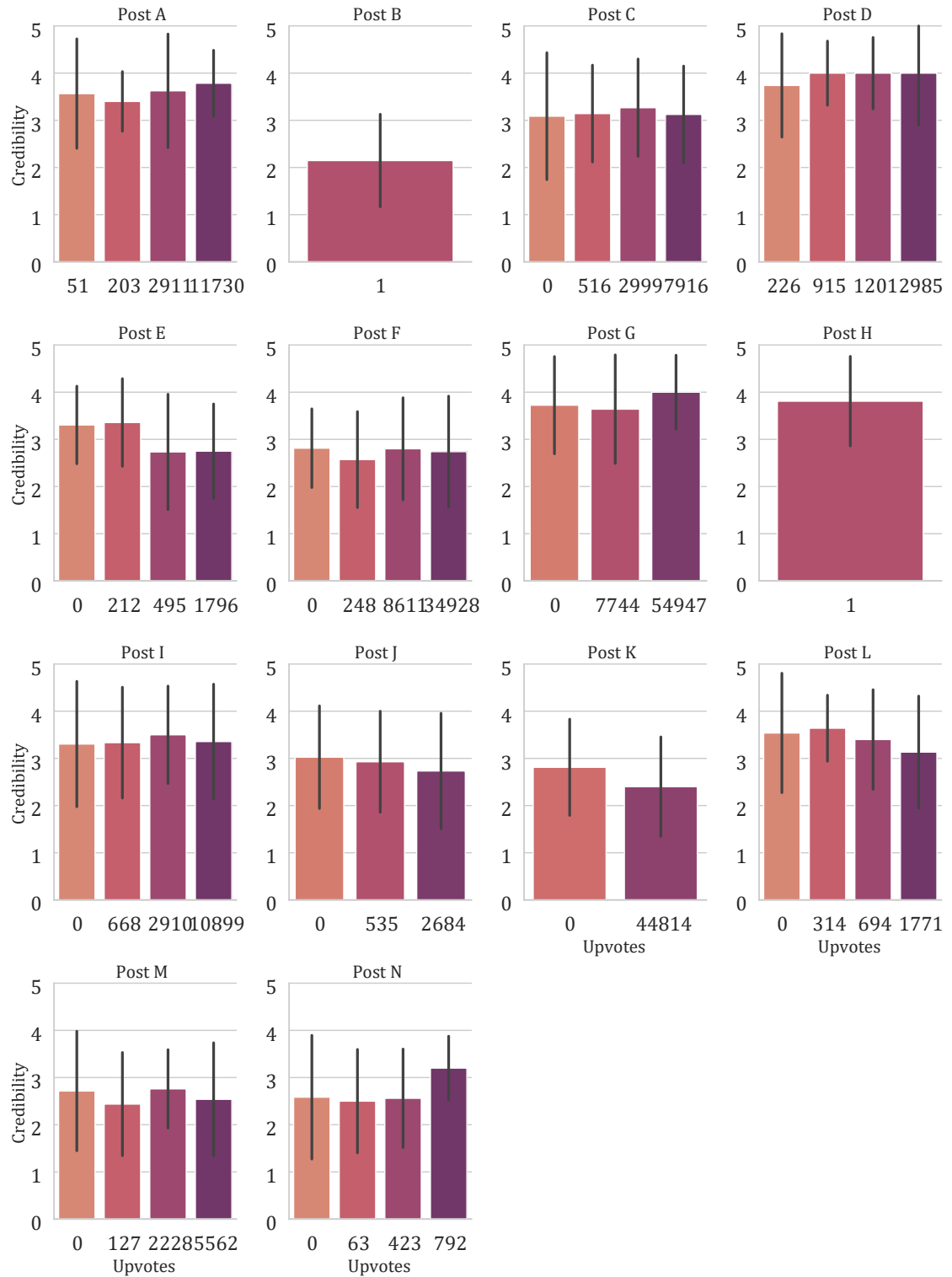
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Appendix A. Credibility number by upvotes, grouped by post



Appendix B. Credibility evaluation for each post in relation to topic familiarity.

