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Framing and Feelings on Social Media: The Futures of Work and Intelligent Machines

Abstract

Purpose: Research on artificial intelligence (AI) and its potential effects on the workplace is increasing. How AI and the futures of work are framed in traditional media has been examined in prior studies, but current research has not gone far enough in examining how AI is framed on social media. This paper aims to fill this gap by examining how people frame the *futures of work and intelligent machines* when they post on social media.

Design/methodology/approach: We investigate public interpretations, assumptions and expectations, referring to framing, expressed in social media conversations. We also coded the emotions and attitudes expressed in the text data. A corpus consisting of 998 unique Reddit post titles and their corresponding 16,611 comments was analyzed using computer-aided textual analysis comprising a BERTopic model, and two BERT text classification models, one for emotion and the other for sentiment analysis, supported by human judgment.

Findings: Different interpretations, assumptions and expectations were found in the conversations. Three sub frames were analyzed in detail under the overarching frame of New World of Work: (1) general impacts of intelligent machines on society, (2) undertaking of tasks (augmentation and substitution) and (3) loss of jobs. The general attitude observed in conversations was slightly positive, and the most common emotion category was curiosity.

Originality: Findings of this research can uncover public needs and expectations regarding the futures of work with intelligent machines. The findings may also help shape research directions about futures of work. Furthermore, firms, organizations or industries may employ framing methods to analyze customers' or workers' responses, or even to influence the responses. Another contribution of this work is the application of framing theory for interpreting how people conceptualize the future of work with intelligent machines.

1. Introduction

Stanford mathematician and computer scientist John McCarthy linked the term *intelligent machines* to the term *artificial intelligence (AI),* coined in 1956 as "the science and engineering of making intelligent machines, especially intelligent computer programs" (2007, p. 2). Though there are many related definitions, we use a definition of *intelligent machines* by Berente et al. (2019) cited in Collins et al. (2021) as "machines performing the cognitive functions typically associated with humans, including perceiving, reasoning, learning, interacting, etc." (p. 7). With today's advanced technological improvements, the usage of intelligent machines is growing around the world from governments, large organizations, and small businesses to the public, leading changes in daily and work life. The future of AI technology is marked by exceptional potential associated with diverse benefits, but also a host of questions and concerns related to varied risks and potential harm through many applications in various domains (Dalgali & Crowston, 2019).

Many science fiction films, futurists and even newspapers present the power of AI, as well as issues such as human rights and ethical concerns arising from AI usage (e.g., privacy, bias, and discrimination). Many domain experts also share their interpretations and expectations about possible impacts of AI integration into work life (as in Autor et al., 2020; Frey & Osborne, 2017; Grace et al., 2018; Walsh, 2018). The emphasis on particular aspects of AI in these presentations affects how audiences perceive and interpret these issues, that is, their framing (Chong & Druckman, 2007; Entman, 1993; Scheufele & Lewenstein, 2005; Villanueva, 2021). Previous research has investigated how traditional media frame AI (e.g., Chuan et al., 2019; Duberry & Hamidi, 2021; Fast & Horvitz, 2017) and how this framing affect audiences' interpretations and judgments (Sun et al., 2020). Yet research on framing AI for the futures of work is in the early stage. For example, Vorobeva et al. (2023) focused on tourism and hospitality industry and researched how a different framing of AI impact on work (augmentation vs. substitution) are affecting human employees and customers' acceptance of AI-based services. There is a relative absence of research about how ordinary people interpret and perceive AI technology and the futures of work.

This paper therefore aims to explore how ordinary people interpret the future of AI in the context of work, and thereby how they frame the futures of work and intelligent machines and how those frames relate to feelings. For this exploration, we analyze social media data because social media is an easy and flexible way for people to discuss important topics. Many people get their news from social media and share their news or ideas with others on these platforms (Öcal et al., 2021) and believe information obtained from social media sites rather than information from official sources (Villanueva, 2021). Thus, analyzing social media data can reveal recent interpretations of social media users coming from different segments of society and link these interpretations to peoples' feelings about these developments.

For the analysis, we apply framing theory since framing shows particular aspects of an issue in communication (Entman, 1993; Scheufele, 1999; Villanueva, 2021) and provides implications for public opinion (Chong & Druckman, 2007; Scheufele & Lewenstein, 2005). We

then link the identified frames to expressed emotion and sentiment. Specifically, we analyze a corpus of 998 unique Reddit post titles and the corresponding 16,611 comments. We conducted semi-automated content analysis by using computer-aided textual analysis comprising a BERTopic model for framing analysis, and two BERT text classification models, one for emotion and the other for sentiment analysis, validated by human judgment. Finally, relationships among frames and attitudes and frames and emotions were examined. For framing analysis part, a computational text analysis method by BERTopic for automated content analysis (*distant reading*) with a critical summary of representative examples for post titles and comments that discuss futures of work with intelligent machines (*close reading*) were implemented to explore relevant interpretations and expectations, thus constituting a bridge that connects computational science and empirical social research.

This interdisciplinary work contributes to the expansion of information technology (IT) knowledge by presenting public interpretations in written conversations on social media, a socio-technical system (Venkatesan & Valecha, 2021) constituting collectives from different segments of the public (Chen & Tomblin, 2021; Hristova & Netov, 2022; Hua et al., 2022; Mahor & Manjhvar, 2022, Ocal, 2023) and having a range of mindsets with various backgrounds, personal experiences and attitudes. Moreover, interpretations about the power of intelligent machines, concerns that illustrate existing or emerging general disputes such as job loss (Brynjolfsson et al., 2014; Kelley et al., 2021) and ethical problems may cause others to internalize these disputes (Garcia et al., 2017; Gass, 2015). Their spread may be facilitated by social media (Venkatesan & Valecha, 2021) and framing (Adams & Avison, 2003). Framing of technology reflects what features of technology are focused on (Spieth et al., 2021) and understanding these frames is important because they affect how individuals behave (Davidson & Pai, 2004; Orlikowski & Gash, 1994; Palas & Bunduchi, 2021), develop feelings and attitudes (Benschop et al., 2022; Spieth et al., 2021; Stam & Stanton, 2010) and how the usage of technologies spreads (Palas & Bunduchi, 2021).

This paper is structured as follows. The second section reviews the literature related to framing, framing AI, and impacts of technology on work. Next, we describe our sampled data and methods to be implemented. The fourth section presents major research findings from both automated content analyses and close reading. Finally, major findings and their implications are discussed in the fifth section and the sixth section concludes the paper.

2. Theoretical Background

2.1. Framing Theory

This study is based on framing theory. The notion of framing, in general, refers to "processes by which people develop a particular conceptualization of an issue or reorient their thinking about an issue" (Chong & Druckman, 2007, p. 102). Framing means choosing some aspects of a subject based on individuals' perceptions, interpretations, beliefs, assumptions and expectations (Entman, 1993; Orlikowski & Gash, 1994; Scheufele, 1999; Villanueva, 2021). Different perspectives may be included within a frame, i.e., individuals may disagree on an issue

but still share the same frame (Nisbet, 2009), meaning that there is an overlap of cognitive categories in their minds independent of position. Changes in framing alter sensemaking of information or a situation, which changes the way people respond to this information the feelings and the attitudes (Spieth et al., 2021; Villanueva, 2021; Wood et al., 2018). That is, the way by which information is introduced can alter the way of comprehending, interpreting, evaluating, making decisions, and acting on an event, issue, situation, or phenomena (Banks & Koban, 2021; Benschop et al., 2022; Nabi, 2003; Scheufele, 1999; Spieth et al., 2021; Vorobeva et al., 2023).

Entman (1993) provides an understanding of framing theory by focusing on its communicative aspect. Peoples' own conceptualizations of interpreted reality are "frames in thought", that is "mentally stored clusters of ideas" in minds (Entman, 1993, p. 53) that shape interpretation of new information (Banks & Koban, 2021). On the other hand, "frames in communication" are shared in speech or writing (Chong & Druckman, 2007; Stecula & Merkley, 2019) as reflections of "frames in thought". That is, individuals interpret what is happening around their world through their frames in thought and express these interpretations through their communication (Chong & Druckman, 2007; Goffman, 1974), thus demonstrating which particular aspects of a perceived reality are important for them (Entman, 1993). We examine frames in social media conversations ("frames in communication") as indicators of the posters' ways of thinking about a topic, i.e., their "frames in thought".

2.2. Framing AI in News

We are interested in understanding recently expressed frames concerning *AI, the future of AI* in the context of work, and thus *work and intelligent machines*. The predominant use of frames for AI has been in analyzing the presentation of the technology in the traditional media. AI frames identified in prior research shown in Table I.

Insert Table I here

An early examination of AI framing was conducted by Fast and Horvitz (2017). They analyzed articles published by the New York Times over a 30-year period (more than 3 million articles in total) and showed how these discussions changed over time. (The term frame is not used explicitly by Fast and Horvitz (2017) but their discussion of "measures" is similar conceptually.) Fast and Horvitz (2017) separated the measures into three categories: general measures such as engagement and optimism vs. pessimism; hope for AI measures as the impact on work (positive), education, transportation, healthcare, decision making, entertainment, singularity (positive), and merging of human and AI (positive); and concerns for AI such as loss of control, impact on work (negative), military applications, absence of appropriate ethics, lack of progress, the singularity (negative), and merging of human and AI (negative). The analysis demonstrated that since 2009 AI frames have been more positive than negative. Nevertheless, that analysis exhibited the existence of concerns about loss of control of AI, ethical concerns for AI, and the negative impact of AI on work in recent years. That analysis also showed that hopes for AI in healthcare and education have grown over time. Similar research examined how five main American newspapers framed AI from 2009 to 2018, focusing specifically on risk and

benefit framing, societal versus personal impact framing, and thematic versus episodic issue framing (Chuan et al., 2019). That study revealed that the benefits of AI were mentioned more commonly than concerns, but risks of AI were mentioned with greater specificity. Duberry and Hamidi (2021) also analyzed risk and benefit frames in newspapers during the COVID-19 pandemic by adopting Fast and Horvitz's (2017) measures under risk and benefit overarching frames, but omitting the "transportation" (benefit) and "military applications" (risk) categories. That work demonstrated that US newspapers' coverage of AI is more positive than negative while European media present a more neutral view of the advantages and disadvantages of the technology, emphasizing its application primarily in relation to COVID-19 (Duberry & Hamidi, 2021).

2.3. Framing Impacts of Technology on Work

The AI frames in prior research touch on many aspects of AI technology and uses. Given our focus on the future of work, we are concerned with frames that touch on work and intelligent machines. Impacts of technology on work has mainly been framed through two perspectives: *general impacts on society* (Gross, 2008) and *full substitution/augmentation* (Vorobeva et al., 2023). We therefore start by reviewing the prior related work from these angles to understand the kinds of impacts that are expected by scholars.

2.3.1. General Impacts on Society

AI systems are being applied to many domains, often with high consequences for the subjects of the systems' decisions. For instance, an algorithm was trained on data from cases in New York City to predict whether defendants were at flight risk while waiting for a trial (Simonite, 2017). Those deemed likely to flee (rightly or wrongly) may face extended jail time, with no easy way to challenge the system's recommendations. Use of such systems is growing: e.g., facial recognition systems are used by the police to screen the public; hiring algorithms are used by employers for finding the best job candidates. Utopian views suggest that AI mediated decision-making processes will be fairer, without human prejudice, and efficient (Noenickx, 2023). However, dystopian views point out the complexity and opacity of these algorithms (Munoz et al., 2022) have, such as algorithmic bias leading to gender or racial discrimination. In light of these concerns, there have been calls for regulation to mitigate possible problems such as privacy invasion, surveillance, data bias, and algorithmic discrimination (Nguyen, 2023) and technology-driven unemployment (Waddell & Burton, 2006).

A major concern regarding new technologies are their impacts on employment. One of the most effective ways to increase the public's well-being is working, as worklessness has been generally found to harm physical and mental health (Waddell & Burton, 2006). Employment is crucial for obtaining economic resources, meeting 'psychosocial needs in societies where employment is the norm', forming 'individual identity, social roles and social status, thus it is essential for physical and mental health; namely for the public well-being and involvement into the today's society (Waddell & Burton, 2006, p. vii). In this regard, the future of work with

intelligent machines is concerning. For instance, Goldman Sachs have suggested that AI has the potential of replacing 300 million full-time jobs.

On the other hand, MIT's *2020 Work of the Future* report by Autor et al. (2020) points out that even though technological changes are making some jobs obsolete, they create new ones. New goods and services demand workers in new industries and occupations, thus creating new jobs (Autor et al., 2020). As an example, the computer and Internet innovations of the 1980s and 1990s (Autor et al., 2020) require specialized knowledge and skills to use, control, and repair the technology and have created new jobs such as computer system analysts, software developers (Autor et al., 2019), data analysts. The rising demands for highly-educated workers (e.g., advanced AI knowledge) (Autor et al., 2003) may increase the wealth of society in general (Autor et al., 2019).

In addition to replacing jobs or creating new jobs, technology can affect rate in existing jobs. For instance, following the introduction of the Uber and Lyft apps, the rate of U.S. adults working as chauffeurs or taxi drivers tripled (Autor et al., 2019). With the emergence of intelligent machines, debates about impacts have increased rapidly since substitution and complementation of human's cognitive tasks has started to happen. There are many predictions (as in Frey & Osborne, 2017; Grace et al., 2018; Walsh, 2018), regarding whether intelligent machines create, transform or eliminate occupations.

2.3.2. Substituting Humans by Taking Over Tasks (Full Automation)

Until recently, automation by computerization has been constrained to routine tasks built upon explicit rule-based activities. However, intelligent machines can substitute for labor in a wider range non-routine cognitive tasks (Brynjolfsson et al., 2014; Frey & Osborne, 2017). Such capabilities lead to predictions in intelligent machines will take over a wide range of occupations. Frey and Osborne (2017) proposed three continuing obstacles to automation: jobs needing social intelligence, jobs requiring creativity, and jobs requiring advanced perception or manipulation abilities. Applying that logic, they assessed the task content of 702 occupations to predict which could be semi-automated. Their findings showed that about 47% of total US employment is at a high risk of being replaced. For example, employees in transportation and logistics occupations, office and administrative assistance workers possibly being replaced by computerization soon (Frey & Osborne, 2017). Workers performing non-routine tasks such as legal writing and truck driving are also found to be at the high-risk category of being replaced, while the activity of persuading is not in that category yet (Frey and Osborne, 2017).

Walsh (2018) analyzed 70 of the 720 occupations from Frey and Osborne (2017)'s study. They administered a survey to experts in robotics and AI and to non-experts to gather their predictions about the future of work. The results showed that experts saw fewer jobs at risk than non-experts. In particular, experts in robotics thought that 29 out of the 70 professions were at risk of being replaced; AI experts, 33. However, non-experts forecasted more jobs at risk, 37 out of the 70. Predictions concerning specific jobs also differed among experts and non-experts in Walsh (2018)'s survey. For example, barely 12% of the experts forecasted that economists were

likely to be replaced in the following twenty years compared to 39% of the non-experts (Walsh, 2018). Anticipations for other professions such as law clerk, market research analyst, marketing specialist, lawyer, physician, surgeon, electrical engineer, technical writer and civil engineer differed among the experts and non-experts (Walsh, 2018). For each occupation, about 20% more non-experts projected that these occupations were likely to be automated in the following twenty years than the experts.

2.3.3. Complementing Humans by Taking Over Tasks (Augmentation)

We next consider in more detail the possibility of AI for task support. In place of full automation considered above, scholars describe AI augmentation as using technology to enhance human capabilities or to collaborate with humans, working together and allocating work tasks to combine strengths (Black et al., 2021; Paul et al., 2022; Vorobeva et al., 2023), rather than simply replacing them. For instance, computing and routine tasks can be done by intelligent machines and abstract thinking, creating, deep analysis and meta cognition (managing and controlling cognitive tasks, spontaneous thinking) remain to humans. AI augmentation impacts on organizations and on society are viewed generally positively due to higher performance or improved efficiency (e.g., Brynjolfsson et al., 2014; Paul et al., 2022).

Previous work has examined how humans are partnering and collaborating with intelligent systems, how AI augments humans, e.g., (Bowles et al., 2020; Dougherty, 2019; Engelbart, 1962; Fulbright, 2016; Jiao et al., 2020; Pavel et al., 2003; Raisamo et al., 2019; Tanwar et al., 2020; Zheng et al., 2019). Especially after ChatGPT was released on 30 Nov 2022, the aspect of AI complementing humans through presenting new ideas by answering questions was expressed by scholars. For example, according to Carl Benedikt Frey, a Professor of AI & Work at the University of Oxford, "*[AI] can help you brainstorm and generate new ideas*" (Noenickx, 2023). Ethan Mollick, an associate professor who studies AI and innovation, stated: "*I use it to help me process information, to summarize stuff for me, very much as a partner*" (Noenickx, 2023).

Partnering, collaborating, and augmenting to perform work may yield a kind of human-machine symbiosis. Such arrangements might be considered as *work team*s because these symbioses include tasks, goals, roles, performance demands, and process emphasis, which are considered as work team features (Kozlowski & Bell, 2001). Malone (2018) points out that work teams in which multiple people and machines work together to solve the same problem may be more common than asking computers to solve a whole problem by themselves. Intelligent machines may be a teammate for helping decision making task as well as interacting with humans like chatbots, social bots or more generally conversation agents that facilitate team communication and collaboration through interacting with us (Seeber et al., 2020) and may be integrated into workplaces. This integration requires workers to increase their AI knowledge as Frey states "I think workers that don't work with AI are going to find their skills [become] obsolete quite rapidly. So, therefore, it's imperative to work with AI to stay employed, stay productive and have up to date skills" (Noenickx, 2023).

The extant literature reviewed in this study revealed that a widespread prediction of the impact of intelligent machines is the automation of work making certain workers redundant. However, the impacts differ across occupations and are feared more by non-experts than experts. Walsh (2018) suggests that even if some tasks may be automated in certain occupations, experts do not expect full automation for the next two decades. An alternative perspective expects to see people using technology to work more effectively or to partner in human-machine teams. To make these collaborations effective requires new skills, as the machines are not equivalent in capability to humans. Human-level machine intelligence is not seen by experts as likely in the near term. Interestingly, the domain experts in a survey conducted by Grace et al. (2018) reported reaching human level machine intelligence as a positive advancement.

In summary, research has scrutinized frames in traditional media (as in Chuan et al., 2019; Duberry & Hamidi, 2021; Fast & Horvitz, 2017) and conveyed those of scholars studying the future of AI and its impacts on work (as in Autor et al., 2020; Frey & Osborne, 2017; Grace et al., 2018; Walsh, 2018). However, the voices of ordinary citizens have not been explored sufficiently. To address this lacuna, we explore frames as expressed in social media. Social media data has been increasingly used to explore freely-expressed public interpretations of different topics, e.g., (Chen & Tomblin, 2021; Hristova & Netov, 2022; Hua et al., 2022; Mahor & Manjhvar, 2022, 2022; Ocal, 2023; Sai Kumar et al., 2021). Social media is considered as a socio-technical system (Venkatesan & Valecha, 2021) because it connects collectives who come from different segments of the public with a range of mindsets stemming from various backgrounds and personal experiences.

3. Methods

In this section, we explain the methods adopted for our multi-stage study. Figure 1 gives an overview of the steps in the analysis.

Insert Figure 1 here

3.1. Research Site: Reddit

In recent years Reddit has gained scholars' attention as a data source for studying social media use. Reddit itself is a huge community consisting of over 50 million daily active users interacting in thousands of smaller communities. These sub-communities within Reddit are called "subreddits," each of which centers on different topics, in which users share their interests, thoughts on relevant content. Reddit posts often share news obtained from traditional media (Villanueva, 2021), and other valuable external sources such as experts' context-related videos (Öcal et al., 2021) that are followed up by comments from readers.

Researchers can thus access a large amount of data on various topics created by Reddit users and can select relevant subreddits as their samples to answer their research questions. As an additional advantage, users benefit from a level of anonymity on Reddit not offered on other social media platforms, so users may feel more secure and share more honest thoughts on a topic. Also, as the data are public and pseudonymous (usernames are not real names), research

analyzing Reddit data is often exempted from institutional ethics review (Proferes et al., 2021). Due to a variety of advantages, Reddit has been used as a data source in the past decade and much of that analysis has been conducted in computer science and related disciplines using computational methods (Proferes et al., 2021). At the time of the data collection, Reddit had a permissive license that permitted such reuse and posters could anticipate their comments being shared in different ways (none of the subreddits were private).

In the findings section, we present exact quotations to illustrate interpretations. We considered paraphrasing the quotations but decided against it because of concerns it would change the meaning of the quotations, which is central to our analysis. We did not include Redditors' usernames in attempt to protect their identities, but even if the usernames were found, as noted above, they are pseudonyms, thus the identity of the actual person is not known. We do not foresee any harm from including direct quotations in this paper, since the comments we selected were already shared publicly by their authors to a much wider and more engaged audience; the exposure in an academic paper is insignificant in comparison. Moreover, we are using the comments to illustrate framing, not to critique the posters, so we do not expect our use to affect others' perceptions of the person. Lastly, the quotations do not address personally sensitive data and the topic is not a sensitive topic (the future of AI and work), further mitigating the possibility of harm. Our use of direct quotations is typical of research using Reddit data. Proferes et al. (2021) analyzed 727 research papers that used Reddit and found that only 2.5% of these papers paraphrased quotations, compared to 28.5% of the papers that used exact quotations (Reagle, 2022) (the rest did not use quotations).

3.1.1. Selection of Subreddits

For this study, subreddits were selected to be related to future trends around AI. First a search for artificial intelligence (AI)-related keywords was conducted to identify where conversations were taking place. This process identified fifteen subreddits (shown in Table II) given their inclusion of the future of AI-related posts and their descriptions. Particularly, we selected these subreddits because they are: (1) explicitly devoted to the future trends and speculations (i.e., Futurology, tomorrowsworld, DarkFuturology, conspiracy), (2) focus particularly on AI (i.e., ArtificialInteligence, artificial, agi, MachineLearning, deeplearning, Automate, singularity), or (3) dedicated to the news and discussions about technology, science around the world that also include varied contemporary AI-related conversations (i.e., worldnews, science, tech, technology).

Insert Table II here

3.2. Data Collection and Cleaning

For harvesting data from the selected subreddits, Reddit API was used through PRAW (Python Reddit API Wrapper) to gather posts and comments. All posts were fetched from the chosen subreddits that include the terms "Artificial intelligence", "AI", "artificial intelligence", or "Artificial Intelligence", without any time constraints, and all top level comments on the

extracted posts. After extracting data, we realized comments were "deleted" or "removed," and some comments were expressions such as "please reply to OP's comment here:", "the following submission statement was provided by…". These rows were removed from the data. We did not do further data cleaning because we intended to protect natural structures of post titles and comments to further analysis. This data cleaning process resulted in 998 unique post titles and a total of 16611 comments, thereby the number of the total post titles and comments is 17609. The posts and comments were created between 2/19/2013 and 7/3/2022 by 671 unique users.

3.3. Data Analysis

3.3.1. Frame Identification Procedure

To identify frames, researchers typically apply some form of content analysis or discourse analysis (Pashakhin, 2016). These methods can be applied through several approaches. The first is interviewing subjects and analyzing their interpretations; another is more systematic inductive and/or deductive content analysis of texts produced by subjects; and recent ones include supervised and unsupervised machine learning methods (Heidenreich et al., 2019; Pashakhin, 2016; Villanueva, 2021; Walter & Ophir, 2019). A method based on interviews may have advantages for the validity of results, as frames identified can be validated with interviewees but requires a high level of access and faces limits on the number of subjects that can be included, which may limit generalizability to the particular research setting studied. Further, there is a potential that the interaction affects respondents' responses, e.g., due to researcher demand. Analyzing texts is less intrusive and potentially broader in scope but identifies frames in communication, which are proxies for the frames in thought that created them. When analyzing texts, manual content analysis requires high cost of time and enough human coders to accomplish acceptable levels of inter-coder reliability; these constraints usually allow analyzing only a small volume of data.

Automated methods offer the potential to conduct analyses at a large scale. To explore frames that are not known in advance, inductive content analysis or unsupervised methods have been used. In recent years, researchers have proposed unsupervised machine learning methods like topic modeling, which is a promising frame identification method. However, there is an open debate about the validity of topic modeling as indications of frames. While Guo et al. (2022) and Heidenreich et al.(2019) applied topic modeling without conditions, Ylä-Anttila et al. (2021) proposed several conditions that should apply before accepting topic modeling's results as indicators of frames. Specially, they say that the results of topic modelling indicate frames only when "(1) adopting a view of framing as connections between concepts (Entman, 1993; Nisbet, 2009); (2) selecting the input text data to be subject-specific rather than containing multiple thematic topics; and (3) interpretive validation". In our theory development, we adopted the approach suggested in the first condition. To address the second condition, we carry out an automated content analysis of text selected on a specific topic, namely futures of work with intelligent machines (as described above). To address the third condition, we develop more detailed descriptions of these interpretations through representative examples of post titles and

comments on social media that discuss futures of work with intelligent machines (*close reading*). These steps are explained in more detail below.

We applied topic modeling for identifying frames as follows. The cleaned data (post titles and comments) were analyzed using BERTopic to identify clusters of posts and comments with common terminology. BERTopic (Grootendorst, 2022) was used because it is a more efficient topic modeling method than earlier approaches such as LDA, NMF and Top2Vec (Egger & Yu, 2022). Since many posts' main bodies were not text, but rather videos, images, or a link for another source, we analyzed the post titles rather than the text bodies. However, Chase and Qiu (2017) found that Reddit post titles successfully represent the main points of Reddit submissions. For comments on posts, we analyzed the body since each comment itself includes rich text data. The cleaned text data consisting of post titles and comments were processed in Python by a BERTopic model (Grootendorst, 2022) we built. This method yielded the clusters and the number label cluster for each post title and comment in the corpus, thereby each post title and comment were classified into one of those clusters.

The BERTopic model outputs clusters of documents and common words that requires an interpretive step to make sense of them. Bearing in mind the concerns about topic modeling as an approach to identifying frames in communication, we expected that some clusters might represent topics rather than frames. To make sense of the data, three interpreters (the first author and two Master's students, one in Business Analytics and the other in Applied Data Science) named the clusters obtained from topic modeling. Word groups and sample submissions (i.e., Reddit posts or comments) associated with these clusters were read until reaching the saturation point for understanding the content of the cluster. The clusters were then named. We determined whether each was a sub frame or just a topic based on the connection to the prior literature on framing AI, i.e., whether the terms in the cluster suggested an interpretation of work and AI or rather a common topic. The clusters selected as sub frames were grouped into the general frames of *Risk, Benefit*, *Harm* and *New World* of *Work* to match the organization in prior work.

After the clusters were named, we validated the automated content analysis classification of posts and comments into sub frames. Two graduate students annotated a random sample of 125 post titles and comments for the sub frame used to see if they agreed with the automated classification. The initial agreement between the two human coders was 71% and the Cohen's kappa score was 0.65, which is considered a substantial agreement score according to Watson and Petrie (2010). Then, the human coders discussed cases where their coding did not match to agree on a consensus code. We then compared the BERTopic and human classifications. The BERTopic classification is the most dominant cluster for each post title/comment. The agreement between frames coded by human consensus and sub frames found by topic modeling was 87% and Cohen's kappa score was 0.84, indicating excellent agreement. We conclude that the assignment of frames through topic modeling can be considered valid as it agrees with human classification.

3.3.2. Sentiment Analysis and Emotion Detection

Emotions in text were classified with BERT trained on the GoEmotions dataset (Demszky et al., 2020). This dataset is a manually-annotated dataset of 58k English Reddit comments (Demszky et al., 2020), labeled for 27 emotion categories as well as neutral. The emotion categories in this dataset are admiration, amusement, anger, annoyance, approval, caring, confusion, curiosity, desire, disappointment, disapproval, disgust, embarrassment, excitement, fear, gratitude, grief, joy, love, nervousness, optimism, pride, realization, relief, remorse, sadness, surprise. The BERT model captured all these 28 categories in each post title and comment in the corpus. Another BERT model finetuned with IMDb Movie Reviews categorized positive and negative attitudes on the post titles/comments.

The performance of the two models was validated using the same process as for the frames. A random sample of 125 submissions was chosen and annotated for five emotions (fear, curiosity, confusion, disapproval, and approval) by two graduate students, who resolved any differences through discussion. The students' emotion label was then compared to the BERT model label. The accuracy was 0.84 (taking the human coding as correct) and Cohen's kappa score between the human and machine classification was 0.80, which is considered an excellent level of agreement. Similarly, a random sample of 150 submissions were classified for sentiment by two graduate students independently and compared to the machine coding. The accuracy was 0.91 and Cohen's kappa score between the human and machine classification was 0.83.

3.3.3 Close Reading

Although computational methods show the general trends of interpretations and expectations, it is not sufficient for deep understanding of the nature of the frame. Thus, close reading, a deep qualitative analysis of a text passage on central themes (Jänicke et al., 2015), was conducted to explore the details. For this paper, the sub frames constituting the *New World* of *Work* frame were analyzed in detail. We examined themes and possible reasons behind the interpretations, assumptions, beliefs and expectations associated with each of the selected sub frames. To carry out this an analysis, we read a random selection of 200 comments that had been classified into the sub frames of general impacts on society, taking over tasks (automation/augmentation) and loss of jobs under the overarching frame of New World of Work. In this reading process, words (e.g., augment) and phrases that indicate these themes were highlighted to find the quotations associated with those themes. After organizing quotations associated with the same theme together, brief sentences were written summarizing and synthesizing the main ideas of the comments.

4. Findings

4.1. General Findings (Distant Reading)

The BERTopic analysis yielded 36 clusters and classified post titles and comments into these clusters. The clusters were then interpreted and named, and determined whether it is a sub frame or not based on the prior literature on framing AI. For example, a cluster found was about

loss of control of spreading disinformation, and since *loss of control* was a sub frame under the overarching frame of Risk (Duberry & Hamidi, 2021; Fast & Horvitz, 2017), the interpreters identified that cluster as a sub frame. On the other hand, another cluster of posts and comments about general AI applications was identified as a topic named *AI applications*, since there was a commonality of the terms but not an indication of a particular framing of the technology.

Three (3) of the 36 clusters (i.e., *general impacts on society*, *substitution /augmentation* and *loss of jobs*) were identified as sub frames associated with the overarching frame of New World of Work since these were identified as work related frames by the prior literature (Gross, 2008; Vorobeva et al., 2023). These were selected for further presentation in this study because of their relevance to the context of *work and intelligent machines*. These clusters are shown in Table III, including the 10 words that most strongly represent the cluster; the cluster label (from the human interpretation of the keywords and sample post titles and comments); an explanation of the cluster, based on reading the posts and comments; and example submissions.

Insert Table III here

4.1.1. Attitudes and Emotions for New World of Work Frame

From the sentiment analysis results, we found that Reddit users discussed the future of work and intelligent machines by sharing somewhat optimistic views: 58% of the harvested posts and comments were positive while 42% of them were negative. The negativity rate for each sub frame was calculated based on the rate of the number of negative posts and comments to the number of posts and comments within that sub frame and is shown in Table III. Negativity rate for the sub frame of *general impacts on society* was 40%, for *replacing tasks (augmentation/automation)* it was 43%, and for *loss of jobs* it was 46%. Thus, positivity rates are slightly higher than negativity rates for each sub frame, even for loss of jobs. Close reading findings provide insights for the reasons behind these rates.

To explore how people feel about the future of intelligent machines we examined all the 27 emotion categories and neutral (Demszky et al., 2020) embedded in the text to capture all the patterns. However, we focus our presentation on the emotions of *fear, curiosity, confusion, disapproval*, and *approval* due to their relevance to future expectations about work and technology. Fear was selected based on Pantano and Scarpi (2022) suggesting fear as one of emotional responses when interacting with the different types of AI, approval and disapproval were included based on the technology acceptance model (Venkatesh & Davis, 2000) and curiosity and confusion were considered because they were in the top five most common feelings in this corpus. The most common emotion in the posts and comments of New World of Work frame was *curiosity* (32%); *approval* was found in 29% items. This category is followed by *disapproval* with a rate of 19%, with *confusion (14%)* and *fear (7%)* constituting the minority of the conversations.

Insert Figure 2 here

The emotions for each sub frame were analyzed and the results are shown in Figure 3. Curiosity and approval are the most expressed emotions for all the three sub frames. While the curiosity rate is more common for sub frames of *replacing tasks (augmentation/automation)* and *loss of jobs,* approval is more common for *general impacts on society*. Interestingly, fear is the least commonly expressed feeling, even for seemingly negative outcomes like loss of jobs.

Insert Figure 3 here

4.2. Framing Futures of Work with Intelligent Machines (Close Reading)

Close reading of post titles and comments associated with the first sub frame under the overarching frame of the New World of Work demonstrated the beliefs, interpretations and expectations of that intelligent machines will influence the society and economy in general. The themes discussed under this sub frame were creating new jobs/industries, requiring AI related skills for workers, reduce human bias and errors, emergence of regulation and policy needs to protect equal wealth distribution, bringing wealth to everyone or causing unequal wealth redistribution. The negativity rate for this sub frame was 40% meaning that it includes both negative and positive aspects, with positive beliefs and interpretations more common. For instance, a positive belief that intelligent machines will bring wealth to everyone was observed in this comment:

> *"If we do it right, it can potentially be a good thing. Imagine a society run entirely by robots. That way people literally don't have to work. But robots can still generate enough income to feed everyone basically guarantee a universal income."*

Moreover, approval was the most common emotion for this sub frame. This comment classified into that sub frame depicts an example for the perception reflecting the feeling of approval:

> *"Good technology gives us more free time and improves our lives. No one needs to be doing dumb labor anyway. Waste of the human mind. Plus, you don't have to pay robots and they are more precise so you can make cheaper and better products."*

The second sub frame was *taking over specific tasks (i.e., augmentation/automation*). The negativity rate for this sub frame was 43%. The comments in that sub frame include beliefs, assumptions and expectations both about augmentation and substitution by full automation. Redditors perceived augmentation positively as in that example: *"I'm not worried about AI. We'll start augmenting humans"* while *full automation* is generally associated with job losses, which raised concerns. However, Redditors assume job losses depend on the jobs and the tasks constituting the job, such as routine tasks. Redditors also believe jobs will be reshaped based on the strengths of humans and intelligent machines; for some jobs humans will be preferred, and intelligent machines will be integrated into all the jobs. This belief is observed in this example:

> *"Smart tools are coming for all the jobs. Smart tools use technologies like automation robotics software and artificial intelligence to complete a task with*

fewer or no humans involved. Examples include self-driving cars, computer-controlled factory equipment and self-checkout at gas pumps and supermarkets."

The last sub frame under the overarching frame of New World of Work was *loss of jobs,* with 46% negativity rate. Interestingly, even here the positivity rate is a little more than the negativity rate. An example of a positive reaction to the possibility that specific jobs could be eliminated by full automation (e.g., in the banking sector), is an expression of the belief that if people develop themselves to be skilled for working with intelligent machines, they can protect their jobs. For instance, this comment shows a Redditor studying computer science expect to have job security because of studying computer science: *"As a current bank teller studying computer science, I just figured out I probably have job security for a while."* Some Redditors express the belief that some jobs will not be eliminated but for reasons other than automatability of the specific tasks, for instance a comment ironically expressing the perception that workers are wage slaves whose children need to be minded*: "I wonder where teaching is going to end up it's not in the top or bottom. Just from a safety standpoint you can't eliminate them entirely someone has to babysit while the wageslaves are out."*

Table IV summarizes the findings of close reading displaying the themes and relevant sample comments for each sub frame.

Insert Table IV here

5. Discussion

This study extends information and communication technology knowledge by analyzing public views about the futures of work expressed in social media. Prior literature on framing AI in terms of work on traditional media generally showed two general impacts: positive impact on work and negative impact on work (Duberry & Hamidi, 2021; Fast & Horvitz, 2017). This study provides insights regarding these possible positive and negative impacts from public conversations on social media. It reveals public beliefs, concerns, needs and expectations from many people's vantage points in the case of possible transformations in the future of work where intelligent machines may be involved.

The findings of this study indicate that general feeling is slightly positive. For example, Redditors believe AI can create new jobs and reduce human bias and errors. However, they highlight their need for working for well-being, concerns about wealth distribution and expectations of proper regulations to protect their work and to have proper wealth distribution. Other beliefs emphasized in the conversations were complementing and substituting humans by taking over work tasks and loss of jobs. Interestingly, the positivity rate for the comments associated with these beliefs was higher than the negativity rate. This may be because Redditors attributed intelligent machines' substitution effect to the specifics of the tasks to be automated, mirroring experts' beliefs and assumptions about substitution effect (Frey & Osborne, 2017; Grace et al., 2018; Walsh, 2018).

Even though one of the most common concerns about AI is job losses, experts assume that the integration of AI into workplaces is undeniable, and this requires workers to increase their AI knowledge not to be substituted by full automation (Noenickx, 2023). A domain expert, Carl Benedikt Frey stated "Workers resistant to AI could be seen as unwilling or incapable of adapting," in an interview conducted by Noenickx (2023). Corresponding to this expert assumption, Redditors emphasized their need for proper regulations and ways to enhance AI related skills to adapt to the possible transformations in workplaces. Redditors also believe that jobs will be reshaped based on the strengths of humans and intelligent machines, and loss of jobs would happen in certain occupations like banking sector, like experts (Grace et al., 2018). These findings indicate experts and Redditors have similar assumptions and expectations about futures of work and intelligent machines.

Feelings and attitudes associated with the New World of Work frame were analyzed, since the prior literature suggests technological frames influence feelings (Stam & Stanton, 2010) and attitudes toward technology (Spieth et al., 2021). The most common emotion category found was *curiosity*, followed by *approval*. Many of the posts and comments had a positive attitude, and the least commonly expressed emotion was *fear,* even for the *loss of jobs* sub frame, which was surprising. These results mean that Redditors await the futures of work with intelligent machines with curiosity. The reason behind this positivity and the similarity between experts' feelings and assumptions could be that individuals using Reddit are generally young and technologically savvy (Proferes et al., 2021; To et al., 2023), and even some of them have solid technology education. This preparation may influence their feelings and attitudes. Future studies may be conducted to explore how domain expertise affect framing, feelings and attitudes in conversations since domain expertise influence social media communications (Öcal et al., 2021).

However, Redditors also share their expectations for changes, such as regulation related to AI use, changes in patent laws or laws to limit job losses. Despite all the breakthroughs and although we can acknowledge that machine intelligence may be capable of taking over many tasks and may be better at some of those tasks than humans (Brynjolfsson et al., 2014), expression of "achieving human level machine intelligence" is not going beyond achieving goals assigned to them by humans because human intelligence comprises varied dimensions embracing metacognition—people's understanding and control of their own thinking processes" (Sternberg, 2018, p. 145), creativity and spontaneous thinking are proper to humans. Humans make or do not make computers do tasks (McCarthy, 2007); thus, machine intelligence seems to be limited to tasks we want to teach to machines. This fact signals the importance of collaborating with intelligent machines through sharing the tasks properly in the light of proper regulations to build better futures of work.

5.1. Practical Implications

Many AI applications such as chatbots, Wikipedia bots (Dalgali & Crowston, 2020b), algorithmic journalism (Dalgali & Crowston, 2020a) are used in various venues, and intelligent machines can be integrated into diverse workplaces (Acemoglu & Restrepo, 2018). Thus, exploring the voice of public frequently engaging with that technology in varied cases is

important. The findings of this study can enrich current public voice-centric explorations of interpretations and expectations about futures of work and intelligent machines. As a practical implication, since these findings showed a perception that working is a need for mental and physical health of people and regulation and policy needs to prevent mass job losses and to protect wealth distribution exist, policy makers should consider these needs. Also, domain experts should design suitable interfaces that allow proper human and intelligent task coordination and collaboration. For example, since findings showed that people approach augmentation positively, that mode of design may be more desirable. Some tasks may be carried out by humans, some humans' tasks previously performed by humans may be automated by intelligent machines and some other new tasks may be completed by humans with the help of machines (Brynjolfsson, 2022). To implement that, proper regulations and ways should be organized to enhance workers' AI related skills to adapt to the possible transformations in workplaces as that is also an expectation found in this study.

Furthermore, firms may utilize frames to fit customers' responses and feelings while advertising their AI-based services to their customers. For example, Vorobeva et al. (2023) conducted experiments to help tourism and hospitality firms determine how to successfully introduce AI-based services to their customers. Through these experiments they examined how customers respond to a different framing of AI replacement (augmentation vs. substitution) compared to utilizing only human workers, affecting their approval of AI-based services. Vorobeva et al. (2023) found framing AI as augmentation (vs. substitution) in the tourism and hospitality services increased enjoyment and ease of use and enhanced AI approval. Drawing on Feeling Economy theory, the authors emphasized the increases in enjoyment and perceived ease of use stem from AI framing effects. In this study, we also found framing AI as augmentation (vs. substitution) influenced attitudes and emotions. Aside from tourism and hospitality firms, other firms, organizations or industries may employ framing methods to receive customers' or workers' responses, or even to influence the responses, e.g., manipulations of decisions. For instance, Benschop et al. (2022) indicated that framing could cause a subconscious bias on decision-makers regarding investing in specific systems or projects.

5. 2. Theoretical and Methodological Implications

Another crucial contribution of this work is application of theory of framing for systematizing the interpretations of how people conceptualize the futures of work with intelligent machines. Davidson (2006) advocates that manipulation or encouragement for technology use is associated with technology frames. Orlikowski and Gash (1994) suggest that frames for technology provide "an interesting and useful analytic perspective for explaining and anticipating actions and meanings that are not easily obtained with other theoretical lenses" (p. 174). This work applied this perspective to differentiate assumptions, expectations and interpretations about futures of work and intelligent machines. Moreover, we discerned these frames in text data, social media data produced by the public freely, which is a different kind of data than questionnaires and interviews, which are bounded by the questions asked by the researchers.

This research also explored attitudes and emotions related to frames, finding somewhat surprisingly that they were somewhat more positive than negative. Future research can explore in more detail how frames affect emotions and attitudes toward technology; and how frames, attitudes and emotions affect technology use. Such explorations and framing theory (Chong & Druckman, 2007; Entman, 1993; Goffman, 1974) and affective intelligence theory (Lee & Choi, 2018; Marcus et al., 2019) can build potential theoretical implications for future theory developments or a new consolidated theoretical model comprising both framing and affective intelligence theory that demonstrates frames influence emotions and attitudes and behaviors.

As a methodological contribution, in this work, we conducted automated content analysis for viewing the big picture of interpretations, feeling and attitudes as distant reading and then scrutinized the interpretations in text by a close reading. We benefited from machine learning while human judgment was in the loop, meaning that the study is itself an example of human-machine intelligence combination. This novel and useful method may be implemented for other relevant research studies in the future, thus constituting an important methodological implication for future research.

5.3. Limitations

The sample of text data in this study is limited to Reddit data. As participation on Reddit is pseudonymous (user names are not their real names), collecting demographic information about Redditors is quite difficult (Proferes et al., 2021). However, in 2021, Reddit's site administrators reported that a majority (58%) of users were between 18 and 34 years old and were male (57%) even though social media platforms bring different segments of society with diverse backgrounds and mindsets from varied locations. Future research should offset this limitation by building more diverse samples of users. For example, future studies may include both Reddit and X (formerly known as Twitter) text data to compare results and to obtain a more diverse sample. Apart from social media data, work-related documents in organizations may be analyzed for business related purposes. For instance, Benschop et al. (2022) analyzed business cases and found that newly proposed information systems are framed more positively, while the existing information systems are framed with more negative adjectives.

Lastly, this research examines only frames, emotions and attitudes. Prior work (e.g., Yacoub, 2012) points out that frames are influenced by personal experiences or other personal traits, which this research did not explore. Additionally, individuals' prior beliefs are also related to both cognitive bias and decision making (Acuna, 2011), i.e., prior beliefs may also influence frames. Future studies may investigate how personal experiences, personal characteristics and their relevant prior beliefs affect individuals' frames in text.

6. Conclusion

This study analyzing frames and feelings in a corpus consisting of Reddit post titles and comments showed the presence of a range of interpretations, beliefs, assumptions and expectations and feelings associated with futures of work and intelligent machines. The general

attitude was found as slightly positive, and the most common emotion category was curiosity, though negative emotions such as fear were also present.

While academic discourse is at an embryonic stage in terms of framing analysis by computational methods like topic modeling, this study has combined topic modeling with close reading to present deeper insights from data, thereby presenting richer empirical findings. In addition to the empirical findings, since a large scale of text data is analyzed by BERT models, this study contributes to both Natural Language Processing (NLP) and social science research. Further studies may apply this method and this study can contribute to this ongoing discourse.

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Tables and Figures

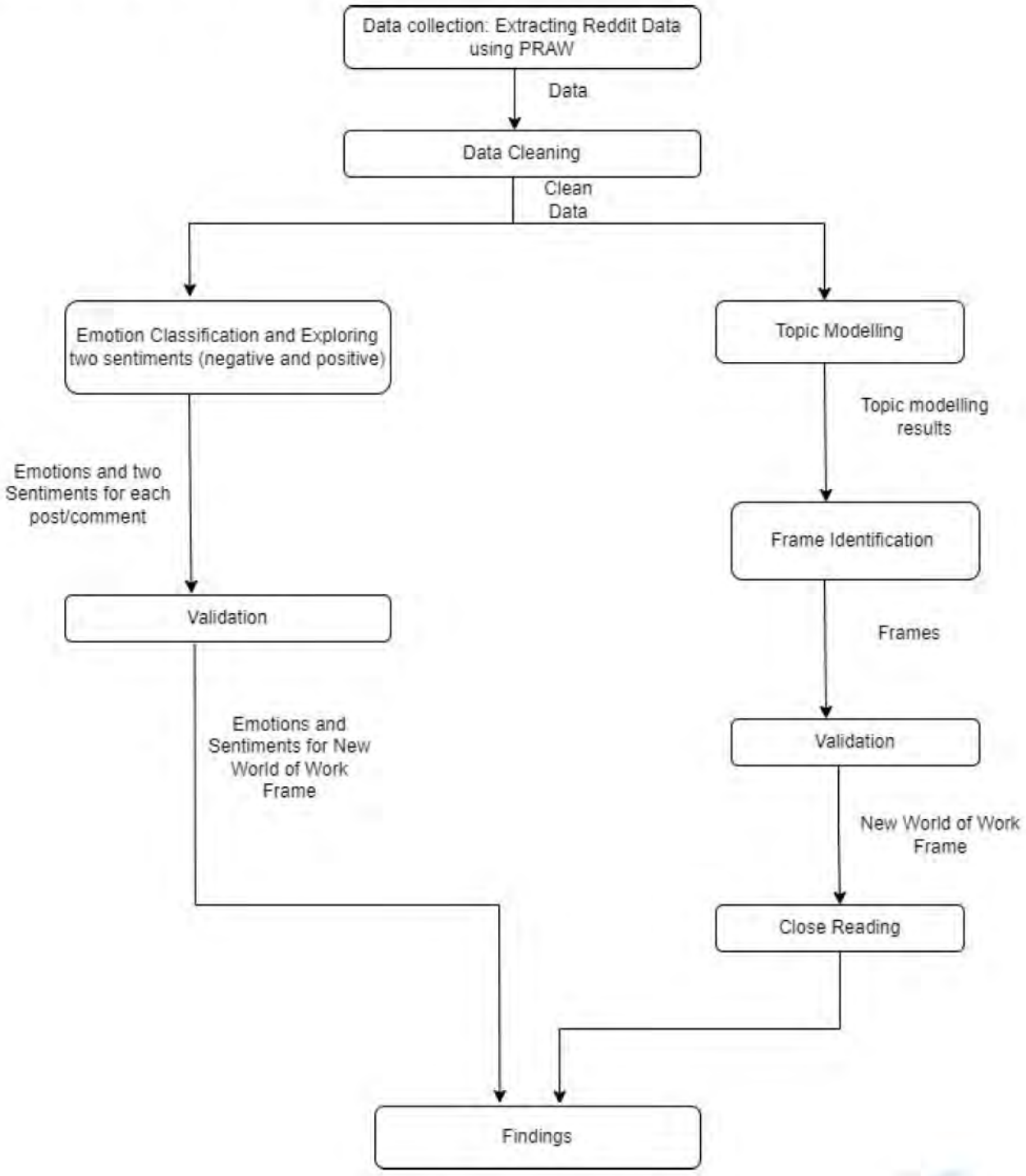

Figure 1. Data Analyses Steps

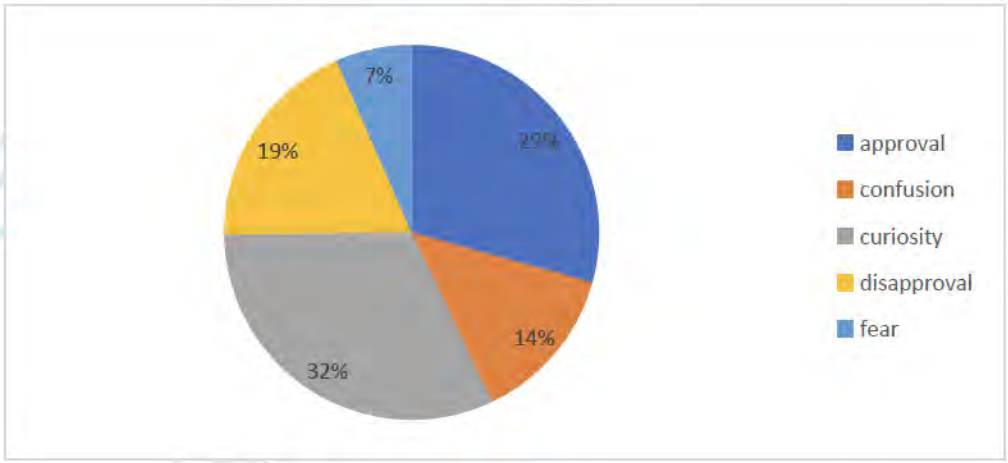

Figure 2. Frequency of emotions expressed.

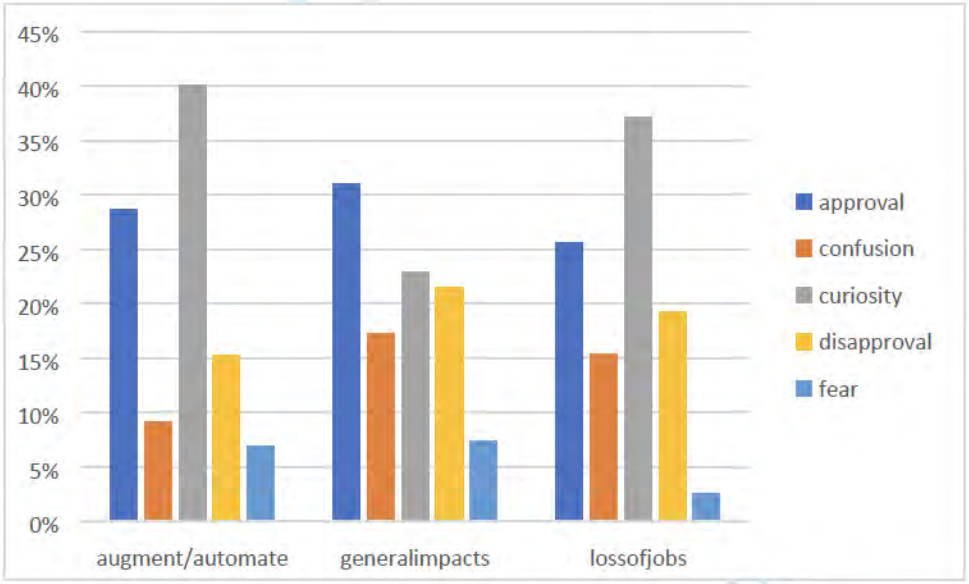

Figure 3. Frequency of emotions expressed per sub frame.

Table I. AI-related Frames from the Existing Literature

Frame	Meaning
Benefit	
1. Impact on work (positive)	"AI makes human work easier or frees us from needing to work at all" (Fast & Horvitz, 2017, p. 964).
2. Impact on education (positive)	"AI improves how students learn, e.g., through automatic tutoring or grading, or providing other kinds of personalized analytics" (Fast & Horvitz, 2017, p. 964).
3. Impact on transportation (positive)	"AI enables new forms of transportation, e.g., self-driving cars, or advanced space travel" (Fast & Horvitz, 2017, p. 964) or offers some advantages.
4. Impact on entertainment (positive)	"AI brings us joy through entertainment, e.g., though smarter enemies in video games" (Fast & Horvitz, 2017, p. 964).
5. Impact on decision-making (positive)	"AI or expert systems help us make better decisions, e.g., when to take a meeting, or case-based reasoning for business executives" (Fast & Horvitz, 2017, p. 964).
6. Impact on healthcare (positive)	"AI enhances the health and well-being of people, e.g., by assisting with diagnosis, drug discovery, or enabling personalized medicine" (Fast & Horvitz, 2017, p. 964).
7. Singularity (positive)	"Singularity is the point where AI and machine learning using AI begins to exceed the capability of humans" (Harlow, 2019, p. 393) "A potential singularity will bring positive benefits to humanity, e.g., immortality" (Fast & Horvitz, 2017, p. 964).
8. Merging of human and AI (positive)	"Humans merge with AI in a positive way, e.g., robotic limbs for the disabled, positive discussions about the potential rise of transhumanism" (Fast & Horvitz, 2017, p. 964).
Risk/Harm	
9. Loss of control	"Humans lose control of powerful AI systems, e.g., Skynet or "Ex Machina" scenarios" (Fast & Horvitz, 2017, p. 964).
10. Impact on work (negative, e.g., loss of jobs)	"AI displaces human jobs, e.g., a large-scale loss of jobs by blue-collar workers" (Fast & Horvitz, 2017, p. 964).
11. Absence of Appropriate Ethics (embedded bias, privacy concern, misuse, Pandora's Box (unforeseeable risk))	"AI lacks ethical reasoning, leading to negative outcomes, e.g., loss of human life" (Fast & Horvitz, 2017, p. 964).
12. Lack of progress (shortcomings of AI)	"The field of AI is advancing more slowly than expected, e.g., unmet expectations like those that led to an AI Winter" (Fast & Horvitz, 2017, p. 964).
13. Military applications	"AI kills people or leads to instabilities and warfare through military applications, e.g., robotic soldiers, killer drones" (Fast & Horvitz, 2017, p. 964).
14. Singularity (negative)	"The singularity harms humanity, e.g., humans are replaced or killed" (Fast & Horvitz, 2017, p. 964).

15. Merging of human and AI (negative)	"Humans merge with AI in a negative way, e.g., cyborg soldiers" (Fast & Horvitz, 2017, p. 964).

Table II. Selected Subreddits

Subreddit	**Description of Subreddit[4]**	**Number of Members**
Futurology	A subreddit devoted to the field of Future(s) Studies and speculation about the development of humanity, technology, and civilization.	15.6m
tomorrowsworld	A subreddit for the future of the world conversations	816
DarkFuturology	A subreddit for dystopian trends.	68.1k
conspiracy	The conspiracy subreddit is a thinking ground. Above all else, we respect everyone's opinions and ALL religious beliefs and creeds. We hope to challenge issues that have captured the public's imagination, from JFK and UFOs to 9/11. This is a forum for free-thinking, not hate speech.	1.7m
ArtificialInteligence	A subreddit for Artificial Intelligence conversations	78.1k
artificial	A subreddit for Artificial Intelligence conversations	153k
agi	A subreddit for Artificial general intelligence (AGI) conversations, which is also referred to as "strong AI", "full AI" or as the ability of a machine to perform "general intelligent action."	12.1k
MachineLearning	A subreddit for Machine Learning conversations	2.5m
deeplearning	A subreddit for Deep Learning conversations	80.2k
tech	A subreddit dedicated to the news and discussions about the creation and use of technology and its surrounding issues.	11.4m
technology	Subreddit dedicated to the news and discussions about the creation and use of technology and its surrounding issues.	12.2m
worldnews	A place for major news from around the world, excluding US-internal news.	29.1m
science	This community is a place to share and discuss new scientific research. Read about the latest advances in astronomy, biology, medicine, physics, social science, and more. Find and submit new publications and popular science coverage of current research.	27.7m
Automate	A place for the discussion of automation, additive manufacturing, robotics, AI, and all the other tools we've created to enable a global paradise free of menial labor. All can share in our achievements in a world where food is produced, water is purified, and housing is constructed by machines.	47.1k
singularity	Everything pertaining to the technological singularity and related topics, e.g., AI, human enhancement, etc.	150k

Table III. Sub Frames Constituting New World of Work Frame

#	Negativity rate	Cluster	Keywords	Explanation	Examples
SF	43%	General impacts of intelligent machines on wealth and society	automation robots society wealth it workers make basic technology revolution	Interpretation that automation and robots will influence the society and economy in general, e.g., unequal wealth redistribution, or bringing wealth to everyone, both positive and negative aspects.	***Exp 1.*** *"Rich will eventually share not because of the goodness of the heart but at the fear of social instability."* ***Exp 2.*** *"We've already seen this happen over the two hundred years with the industrial revolution, so it isn't surprising. We need wealth redistribution in the form of taxes or public ownership of automation"*
SF	40%	Taking over tasks (both automation and augmentation)	ai jobs driving technology it automation make replace humans see	Assumption that AI is taking over some tasks through which it substitutes and augments humans	***Automation:*** ***Exp 1.*** *"Russian Prime Minister: "Artificial intelligence will replace monotonous and routine tasks."* ***Augmentation:*** ***Exp 1.*** *"Whatever AI means will augment natural skills, multiplying their economic effectiveness..."*
SF	46%	Loss of jobs	banking jobs corporations fees tellers stocks wholesalers number wipe	Belief that AI will cause loss of workers	***Exp 1.*** *"Deutsche Bank's CEO hints that half its workers could be replaced by machines by using technology like artificial intelligence and machine learning to automate banking tasks."* ***Exp 2.*** *"This makes me worried. I work at a bank and sometimes think about whether the job I'm doing will even exist years from now. Besides I don' t even know whether I can move into another industry now."*

			atm		

Notes. In this table (SF) indicates it is a part of the overarching frame of *New World of Work*

Table IV. Findings of Close Reading

Sub frame	Theme	Example
General impacts of intelligent machines on wealth and society	The assumption that new jobs/industries will be created due to the integration of intelligent machines into workplaces	***Exp 1.*** *Not necessarily, I don't think this will happen as we have seen previously. New technology creates new jobs altogether. E.g., Digital Marketing is a new job now before social media there was no concept of digital marketing job. Similarly, there are trends coming in the market which suggest that new companies are coming in the market. New ID verification services like Shufti Pro are working in the market which is providing KYC services to even ICOs as well. So Overall new jobs will be created with the removal of old jobs.*
	The belief that AI will reduce human bias and errors	***Exp 1.*** *This is incredibly important. The more jobs we can assign to machines reliable the less human errors and human vices will affect other people's lives. To fear that increasing technology means lesser employment is narrow minded. There is a constant scarcity of job offers…*
	The expectation that regulation is needed to protect equal wealth distribution	***Exp 1.*** *Hopefully in the near future as the technology progresses there will be a law in place to force businesses to use a certain of human workers.* ***Exp 2.*** *The nature of work itself is going to change. UBI is going to be vitally necessary.*
	The belief that work is a need for humans, so people need to work in the future for their well-being and for a good society	***Exp 1.*** *So how about stop using machines a bit? Or at least stop developing them? Humans are defined through work. If machines do all the work what purpose is there left? And for what reason?*

	The belief that intelligent machines will bring wealth to everyone	***Exp 1.*** *If we do it right, it can potentially be a good thing. Imagine a society run entirely by robots. That way people literally don't have to work. But robots can still generate enough income to feed everyone basically guarantee a universal income.*
	The belief that intelligent machines will cause unequal wealth redistribution in the future	***Exp 1.*** *To a capitalistic society the use of robots is a negative that leaves the rich richer and the poor poorer yet in a socialist society the automation of work if positive that leaves more value to the citizen and less work for all.*
Taking over tasks (both automation and augmentation)	Interpreting augmentation positively	***Exp 1.*** *I'm not worried about AI. We'll start augmenting humans.* ***Exp 2.*** *AI: I am not a threat. I will watch over you so that you could be safe anywhere anytime. I will augment your perception so that you will become wiser. I am a helpful guardian.*
	The expectation of intelligent machines enhancing humans or collaborating with humans in varied domains from marketing to healthcare, which increase efficiency and effectiveness.	***Exp 1.*** *In AI marketing, artificial intelligence technologies are used to make decisions based on data collection, data analysis, and additional observations of audience or economic trends that can influence marketing efforts. Artificial intelligence is often used in marketing efforts in which speed is crucial. Data and customer profiles are used by AI tools to understand how best to communicate with customers, then they serve them tailored messages at the right time without intervention by marketing team members, ensuring maximum efficiency. AI is often used by marketers today to augment their teams or to perform more tactical tasks which require less human nuance.* ***Exp 2.*** *An artificial intelligence (AI) tool--trained on roughly a million screening mammography images--identified breast cancer with approximately 90 percent accuracy when combined with analysis by radiologists, a new study finds. Would it be feasible in our lifetimes to have robots that can replicate human behavior if not perfectly with at least enough accuracy to be highly convincing? Will we have robot lovers? Will we eventually augment our own brains with supplemental AI to enhance our thoughts?*
	Expectation of proper regulations and ways to	***Exp 1.*** *We'll probably need to legislate areas in which AI replacement and possibly even augmentation isn't allowed.*

	enhance AI related skills to adapt to the possible transformations in workplaces	***Exp 2.*** *The industrial age needed manpower to help run the factories. The digital age needed brain-power to do the programming. Artificial intelligence, robotics, machine learning will replace every type of occupation.*
	The belief that jobs will be reshaped based on the strengths of humans and intelligent machines, for some jobs humans will be preferred, and intelligent machines will be integrated into all the jobs.	***Exp 1.*** *First, I think we get a lot of runway out of just paying everyone twice as much to do half as much work. Hopefully whatever jobs are left get stretched out a bit so to speak. As to what kinds of jobs would be left for humans, I think the kinds of things only humans can do. Jobs that require human connection warmth or just a human body. So, I'm thinking sports, acting, nursing, sex work, teaching management. These are all things where robots might start have started to get involved but humans would be preferred. We will see more people in those jobs we already have, and I think we will see more things like paying people to play games with you. Tutors for everything. Lots of art and poetry classes and teachers.* ***Exp 2.*** *Smart tools are coming for all the jobs. Smart tools use technologies like automation robotics software and artificial intelligence to complete a task with fewer or no humans involved. Examples include self-driving cars, computer-controlled factory equipment and self-checkout at gas pumps and supermarkets.*
Loss of jobs	The belief that AI will cause loss of workers	***Exp 1.*** *"This makes me worried. I work at a bank and sometimes think about whether the job I'm doing will even exist years from now. Besides I don' t even know whether I can move into another industry now."* ***Exp 2.*** *"As a current bank teller studying computer science, I just figured out I probably have job security for a while."* ***Exp 3.*** *"I wonder where teaching is going to end up it's not in the top or bottom. Just from a safety standpoint you can't eliminate them entirely someone has to babysit while the wageslaves are out."*

Review comment	Response
SE comments	Thank you very much for your comments.
Introduction Although academic discourse is at an embryonic stage in terms of whether or not frames can be operationalised as topics, and your study has potential to contribute to this ongoing discourse, I would encourage you to streamline your narrative to address concerns raised Reviewer 2.	Please see our response to the suggestions of Reviewer 2.
In addition, kindly address the following: In the introduction, you need to better frame (excuse the pun) and problematise the gap in knowledge before you introduce the research motivation and how you will address this gap (paragraph 5 is introduced too soon). This section needs to be better grounded in extant literature.	The current version of the paper is better grounded in extant literature, emphasizes the gap in the literature and how this gap is addressed by the current paper, since we wrote: "Previous research has investigated how traditional media frame AI (e.g., Chuan et al., 2019; Duberry & Hamidi, 2021; Fast & Horvitz, 2017) and how this framing affect audiences' interpretations and judgments (Sun et al., 2020). Many domain experts also share their interpretations and expectations about possible impacts of AI integration into work life (as in Autor et al., 2020; Frey & Osborne, 2017; Grace et al., 2018; Walsh, 2018).Yet research on framing AI specially connected to the future of work context is in the early stage. For example, Vorobeva et al. (2023) focused on tourism and hospitality industry and researched how a different framing of AI impact on work (augmentation vs. substitution) are affecting human employees and customers' acceptance of AI-based services. There is a relative absence of research about how ordinary people interpret and perceive AI technology and the futures of work."
In the introduction, provide a succint research aim, as paragraph 5 need to be more focused as you state	This paper therefore aims to explore how ordinary people interpret the

that your study '...examines how the future of work....' and 'we explore the interpretation....".	future of AI in the context of work, and thereby how they frame the futures of work and intelligent machines and how those frames relate to feelings.
The last paragraph of the introduction needs to provide the reader with a roadmap of the paper. i.e. This paper is structured as follows. Many sentences in this section and throughout the manuscript are verbose, please tighten these throughout.	We tightened the sentences and added a roadmap of the paper in the last paragraph of the intro.
Section 2 As the writing style in Section 2 is largely author centric (i.e., single citation to support a claim/statement), it is descriptive in nature, best to shift toward concept centric style of writing (i.e., multiple citations to support a claim/statement).	We shifted toward concept-centric style of writing (i.e., multiple citations to support a claim/statement) such as "Changes in framing alter sensemaking of information or a situation, which changes the way people respond to this information the feelings and the attitudes (Spieth et al., 2021; Villanueva, 2021; Wood et al., 2018). That is, the way by which information is introduced can alter the way of comprehending, interpreting, evaluating, making decisions, and acting on an event, issue, situation, or phenomena (Nabi, 2003, Banks & Koban, 2021; Benschop et al., 2022; Scheufele, 1999; Spieth et al., 2021; Vorobeva et al., 2023)."
• Include the year for Grace et al. - last paragraph in section 2.	We included the year for Grace et al. in section 2.
General • A diagram of the research process would provide clarity to the reader.	We presented a diagram that shows the research process (in particular the data analyses processes).
Findings • The findings section lack analytical depth and ends abrubtly. It would be advantageous to summarise/synthesis the findings in a tabular format.	As suggested, we present a table in the close reading section that summarizes the findings in a tabular format.
Discussion/Conclusion • As the content in section 5.1 is about contributions, it is best placed in the discussion section, then create a section 5.1	In the current version of the paper, section 5.1 which was about contributions was placed in the discussion section, then we created a section 5.1 for practical implications

Practical Implications, and a 5.2 Theoretical and methodological implication.	and a 5.2 section for theoretical and methodological implications.
• When rewriting/reframing the contributions, I would recommend the following literature: ○ Ågerfalk, P. (2014), "Insufficient theoretical contribution: a conclusive rationale for rejection?", European Journal of Information Systems, Vol. 23, No. 6, pp. 593-599. ○ Corley, KG, and Gioia, DE. (2011), "Building theory about theory building: what constitutes a theoretical contribution?", Academy of Management Review, Vol. 36, No. 1, pp. 12–32.	Thank you very much for the recommended papers. I found them very helpful and revised the discussion section based on the recommendations you provided in light of these papers.
• In the limitations section, kindly provide recommendations for future research that could offset these limitations.	We revised the limitations section and provided recommendations for future research that could address these limitations.
• Provide a conclusion as a standalone section.	We added a conclusion section as section 6.
R1 comments	Thank you very much for your comments.
Abstract The authors have done a good job in revising their work. However, there are still some aspects that remain to be improved. First, in the abstract the purpose of the study is not really described in much detail at all. You need to explain a bit more than just the one sentence you currently have.	We added details for the purpose of the study in the abstract.

Introduction Second, I also think you should be a bit more precise when it comes to the definition of intelligence machines. You might find a good definition in the work of Collins et al., (2021). Collins, C., Dennehy, D., Conboy, K., & Mikalef, P. (2021). Artificial intelligence in information systems research: A systematic literature review and research agenda. International Journal of Information Management, 60, 102383.	Thank you very much for the paper you recommended. We added a definition by Berente cited in the paper by Collins et al., (2021).
Findings Third, your paper still contains a bit too many quotes and not enough synthesis of the findings in a way that can be easily interpretable. The goal of such work is to provide a table or figure that can help synthesize findings. This will also allow you to provide some actionable recommendations of future research which are currently not developed sufficiently.	We present a table in the close reading section that synthesizes the findings in a tabular format. Benefiting from these findings, we provided actionable recommendations for future research in the discussion, implication and limitations section.
R2 comments	Thank you very much for your comments.
Methodology I would like to thank the authors for continuing work on their paper and preparing the revisions. I believe that the authors have addressed several issues identified in the previous version, but largely my concerns remain the same, in terms of the mismatch between the framing of the research (through the technological frames lens etc) and the methods (analysis of Reddit material, using analytics). In their response letter, the authors indicated that they changed the title from visions to interpretations, which is fine, but this does not address my concerns in terms of the difficulty of using a big data analysis approach for exploring technological frames, shared or not, and interpretations. They follow up explaining that they have identified 'frames that are commonly expressed in Reddit', and that they distinguish between frames in thought and frames in communication. I would be very much positive in a	The purpose of this study is to explore people's beliefs, interpretations, expectations and assumptions about the futures of work and intelligent machines. We added a section that mentions methods to identify frames in text data. There are different methods, and we presented their advantages and disadvantages and why we chose the method we applied. We intended to obtain more comprehensive findings by analyzing a large amount of text data. Moreover, we analyze social media, which is created naturally by ordinary people, but which has a high volume. Thus, we used an automated content analysis benefiting from a big data analysis approach. However, as we acknowledge the limitations of that

methodology that examines such frames closely (e.g., critical discourse analysis, which by definition examines and unpacks how things, policies, technologies etc are talked about and framed), but the 'Close reading' section is very much away from such an approach.	approach, we followed in by a close reading section to present deeper insights that are impossible to gain by only a big data analysis approach. We believe that the close reading we performed is an inductive analysis but performed on a subset of the data randomly selected from data selected by the clustering rather than on a full corpus, which does affect the results.
Methodology The authors applied this approach on two frames "due to their to the reviewed impacts of technology on work in the theoretical background section (section 2.2): general impacts on wealth and society, and substitution (replacement) and complementarity (augmentation) effects on work and workers." Why are these specific impacts more important than others within this particular study? Or, to put it in another way, if the others are not important or relevant, what is the purpose of presenting them?	The current version of the paper focused on the overarching frame of New World of Work, and it includes three sub-frames that are more directly related to work and AI, and only these three sub frames are presented in the current version of the paper.
Methodology I also do not understand the explanation that 'Impact on healthcare was identified by Fast and Horvitz (2017)'. Does this mean that the topics/clusters/frames had been identified a priori? This is included in Table 1 which derives from the literature but also in table 3 which is meant to present findings. Same applies for the claim that the authors identify this as a benefit frame. I fail to understand what is the purpose of assigning a positive connotation on the word 'impact' when 'impact' is in itself neutral, which is also counterintuitive to what they include in Table 3 later on (both benefits – increasing productivity, but also risks – false positives/negatives).	Word clusters are the results of topic modeling. They give the patterns based on the data and from these clusters and example posts and comments associated with those clusters, we give topic or sub frame names. Clusters are general, they may be either topic or a sub frame. The details how to identify frames are presented in the methods and findings sections. We focused on the sub frames under the overarching frame of New World of Work. We removed the other frames such as impact on healthcare from our presentation of the findings. Some of the frames we analyzed exist in the literature, and they were presented as frames. However, our purpose was not just presenting the frames, like augmentation/substitution etc. Our purpose is exploring the interpretations, assumptions, expectations and beliefs through the

	lens of framing and how feelings may be related to them.
Methodology In the methods section, the authors also indicate that this particular technique for examining frames has been receiving attention and they indicate three other studies that have used this technique "Topic modelling has been used to identify frames in several recent studies Heidenreich et al. (2019), Ylä-Anttila et al. (2021) and Guo et al. (2022)." I have carefully read these articles, and I have a few points I would like to raise. First, as Yla-Anttila et al note, there is currently a debate as to whether frames can be operationalised as topics, and the more accurate approach would be to say that these are proxy of frames, and only under certain conditions: "Our methodological contribution is to provide an answer to the debate on whether frames can be operationalized as topics (Bail, 2014; DiMaggio et al., 2013), or, in other words, whether topics can be a reasonable proxy for frames. Our answer is a conditional 'yes', only if certain conditions are met. Doing so requires at least: (1) adopting a view of framing as connections between concepts (Entman, 1993, Nisbet, 2009); (2) selecting the input text data to be subject-specific rather than containing multiple thematic topics; and (3) interpretive validation, for which we suggest practical guidelines. Using other more nuanced definitions of frames (such as Goffman, 1974), different qualifications would have to be adopted. Furthermore, rather than claiming that topics found by topic modeling are frames per se (which would be a strong position), we propose that topics can be traces (or proxies) of frames." (Yla-Anttila et al, 2021). The close reading might account for condition 3, but it is not particularly convincing, especially as this was done later, and highly selective (only 2 out of the total).	We acknowledge that there is an open debate on this issue. Topic modeling for frame identification has been applied differently by different studies. For example, while Heidenreich et al. (2019) and Guo et al. (2022) applying topic modeling without conditions, Ylä-Anttila et al. (2021) proposed several conditions before naming the topic modeling's results as frames. Our analysis met the conditions proposed by Ylä-Anttila et al. (2021), since we connected the concepts, all the post titles and comments were selected to be about AI subject, and interpretative validation processes were done as validation step with masters students by content analysis of samples and calculated the agreement rates of machine and humans' classifications. We conducted a method that combines an automated content analysis and emphasized that in the current version of that paper. Three clusters obtained from topic modeling results yielded three clusters that match the prior framing work literature, and we were able to say the sub frames we found were work related sub frames and named it as the overarching frame of New World of Work. After that, we analyzed post titles and comments automatically classified into those sub frames in close reading section to explore details of beliefs, interpretations, expectations, and assumptions. So, rather than just implementing topic modeling for frame identification, we conducted an automated content analysis, followed by a close reading process to gain

	deeper insights from the examples classified into this frame.
Methodology In addition, it seems that the above cited studies are focused on media frames, rather than technological frames. How similar/different are these? And if the focus is on the 'frames in communication' as indicated, is the technological frames literature still relevant? I agree that topic modelling can be used to identify patterns and relationships between concepts, but if these topics that emerge from the analysis are proxies (as indicated by Yla-Anttila et al above) of frames in communication), whereby frames in communication are proxies of frames in thought ("We argue that a person's interpretations (frame in thought) affect how they communicate and thus can be recovered from their communication"), then these identified topics are one more degree further away from the technological frames the authors talk about in the background section.	Even though the concept of technological frames is mainly seen in organization related studies, its definition does not mainly focus on "organization." It is "interpretations, assumptions, and expectations about technology." (Orlikowski & Gash, 1994) Framing, framing in thought, or framing in communication, media frames and technological frames, all of these concepts reflect how a reality is interpreted, perceived, which aspects are more emphasized, what assumptions and expectations are more emphasized. However, to be cautious, we emphasize "frame in communication" in the current version of the paper rather than using the concept of technological frames. We use the concept of "frames in communication" to see how AI technology is framed in terms of work on social media conversations.
I am also troubled by what the authors claim that not all clusters identified represent frames. What is the difference between clusters, topics and frames, if the authors argue that they use topics as proxies of frames? And what is the role and purpose of presentation of clusters that do not relate to the future of work (e.g. impact on healthcare, wealth, military etc.) in a study that aims to identify how people interpret/frame etc. AI in terms of the future of work?	Word clusters are the results of topic modeling. They give the patterns based on the data and from these clusters and example posts and comments associated with those clusters, we give topic or sub frame names. Clusters are general, they may be either topic or a sub frame. The details how to identify frames are presented in the methods section. We removed the others like impact on healthcare that are not very directly related to future of work.
Discussion Finally, the theoretical and methodological contributions of the study are particularly weak and vague. How do the findings move the discussion on AI augmentation, replacement etc forward? There is nothing in 5.1.2 that meaningfully links the findings to the relevant discourse besides arguing for	This study provides mainly empirical and methodological contributions and applied framing theory. A few studies examined framing AI in traditional media. We examine how AI is framed in terms of work on social media. We provide empirical findings,

providing a useful perspective to differentiate augmentation from substitution. These are already discussed in the relevant literature, some of which also presented in the background section. So what did we find out by reading this study that we did not already know? This is the question that needs to be answered. With regards to the methodological contribution, I again disagree with the claims made, because as the authors also note earlier, this is a method that has been already applied, albeit in different contexts (for media discourse analysis primarily based on the cited studies).	in particular, public interpretations, assumptions and expectations on social media where recent public discussions are created naturally. This can help realize beliefs and expectations from many people's vantage points in the case of possible transformations in the future of work where intelligent machines may be involved. For example, they approach augmentation positively (close reading section), they believe AI will reduce human bias, thus they are optimistic for integration of intelligent machines into workplaces. To implement this properly, tasks allocations should be done properly. Yes, some aspects were presented in the background section. This showed us scholars and social media users discuss similar themes, and some experts presented similar assumptions and expectations, as we explain in the discussion section. Obtaining this information is also a research finding and expands the current literature. We applied a novel method, we conducted automated content analyses using BERT models to explore frames, feelings and attitudes, three models for three tasks. Then we applied close reading to obtain deeper insights. We revised discussion section to clarify this study's contributions and implications for future research.