Working remotely as a new norm: How have people's attitudes toward work from home on Reddit changed over the course of the pandemic?

Yujing Sun

Abstract

Since the beginning of Covid-19 pandemic in the early of 2020, working remotely is encouraged by many companies as a solution to tackle the lockdown policy and potential contagion. Not everyone can smoothly switch to this working style, leaving some problems that employees face when they try to adapt to it. But whether people's attitude could change over time? As the new norm is widely accepted for more than two years, I focus on how do people change their attitude and concerns towards working from home. Using the Reddit posts of r/workfromhome community for over two years, I perform sentiment analysis and topic modeling on the posts to extract the topics and sentiment about working from home. First, I conduct the synchronic analysis on the posts related with work remotely to shed light on the overall attitude and concerns on this new working style. The results show that the overall attitude of WFH on Reddit is positive. The sentiment of different topics is distinct. Then I study the temporal change of the attitude and focus over the course of pandemic. The positive rate of posts is high at the beginning of the pandemic as well as during the first, second and fourth wave of the Covid-19. Also, working remotely is an adaptive process with different attitudes in different stage. These findings could be beneficial to employers and policy makers to recognize that working from home is a complex social issue and then adjust the related policy. For future study, my study has gone some way towards enhancing the importance of performing temporal analysis regrading policy's influence.

Introduction

From "People at Work 2022: A Global Workforce View" report[1], 64% of the global workforce would consider finding a new job if their employer forces them back to office full-time. The result is generated by surveying 32,924 workers in 17 countries in November 2021. It is surprising to see the high reluctance of working in office since people's attitude toward work from home is very complex when they first adopted it in 2020.

The story begins in 2020 when Covid-19 hit the world. This contagious virus has spread widely and caused adverse effects on the economy. In March 13, 2020, President Donald J. Trump declared a nationwide emergency, followed by the social distance and lockdown policy just few days after. Because companies cannot afford the long-term shutdown and stop of production caused by the government policy, they advocate their employees to work from home to continue the business.

Since many people work remotely involuntarily, their ability and attitude toward the work from home are not the same. Those who have higher education and income, or work in information industries have higher probability to work from home (Bartik et al. 2020; Brynjolfsson et al. 2020). Also, females and males have different ability to switch to work from home (Adams et al. 2020). For those who can work from home, this lifestyle causes impacts in different perspectives. Some of the studies show that working from home increases the productivity of the employees since they have less request to break and have better and quieter working environment (Bloom et al. 2015). However, others report a reduced efficiency due to longer communication time and less coaching time (Gibbs, Mengel, and Siemroth 2021). These studies are made by surveying a particular industry or a company. The conflict conclusions reflect the variation of the productivity among distinct companies. The survey could only reflect

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[1] People at Work 2022: A Global Workforce View. URL: https://www.adpri.org/assets/people-at-work-2022-a-global-workforce-view/

small picture of the story.

Work remotely also causes some mental health issues to workers. Feeling stressed is a common phenomenon as people find it hard to adapt to information undersupply, autonomy, unprepared and ill-equipped, potentially longer working hours, and isolation (Carillo et al. 2021; Weinert et al. 2015). However, the existing studies only record the synchronic mental effect instead of the temporal mental effect during the pandemic. When people start to work at home, the boundary between family and work becomes vague, making employees easily switch their roles, but may affecting the efficiency of work (Ashforth, Kreiner, and Fugate 2000). The studies of the co-workers relationship also have divergent results on whether employees think telecommuting hurts their relationship with their co-workers (Fay and Kline 2011; Sias et al. 2012).

All these researches shed light on the influence and people's attitude toward working from home. However, most of the studies are synchronic which cannot reflect the change of attitude and influence. The conflict of some arguments is caused by the different sample or stage of the adaptation. There is no paper focusing on the process of adaptation of work from home over different time period. People's attitude can change with adaptation ability while they get in touch with a new thing for longer time. Since many people are familiar and have experience with this new norm for more than two years, I want to study how have people changed their attitude toward work from home during two years.

In order to have a bigger picture of the attitude of employees who work remotely, I scrape the data from Reddit instead of doing the survey. The advantage of using survey data is that we can get the direct answer that we care about. The problem is the data could only represent a small group of people and some employees are reluctant to tell the truth as they are afraid their opinions could be supervised by their monitors when the survey is initiated by the employers (Brynjolfsson et al. 2020). Considering these potential issues, I use the social media data which has a wider user-based and is easy and cheap to collect. Several studies also take advantages of social media data to

analyze the sentiment and topic during work from home since pandemic (Gottipati et al. 2021; Zhang, Yu, and Marin 2021). These studies choose tweets as their data source. Using Twitter as the data source, however, can cause the problems such as low data quality and data from short period of time (Gottipati et al. 2021). This suggests that Reddit posts within the r/workfromhome community is a more suitable choice for me to detect the change.

Before diving deeper into the data, I have two claims that I want to test about the research question. First claim is related with the sentiment change during pandemic. Barrero et al. conduct survey on more than 30,000 Americans over multiple waves to know whether they think WFH will continue. The result show that people's increased support of working remotely in longer time is associated with the lingering concerns of being infectious by the diseases and the better-than-expected work from home experience (Barrero, Bloom, and Davis 2021). Thus, I hypothesize that people in the WFH Reddit community will tend to be more positive when the Covid-19 is more serious. The positive attitude in different time period is contributed by different benefits brought by working from home.

Second claim is related with change in themes that were discussed within the Work from Home subreddits. Changing to a new workplace or environment is an adaptation process (Bruque, Moyano, and Eisenberg 2008; Niessen, Swarowsky, and Leiz 2010). Since different industries have different rate of switching to work from home, and different people have different adaptation ability of change their habit (Bartik et al. 2020; Brynjolfsson et al. 2020). We know that adapt to telecommute is a process that involves different stages. I hypothesize that people's focus and concentration on work remotely along the process are varied. At first, people are intended to solve the urgent need and issues they face; while their focus change to be more comprehensive and diverse directions such as work-life balance, health issues, attitude about back to office etc.

I apply sentiment analysis and topic modeling on my data. VADER is a popular tool to classify the text into positive, neutral, and negative sentiment. This classifier is

commonly used on social media data (Pano and Kashef 2020; Park and Seo 2018). As for clustering the topics in the corpus, LDA topic modeling is applied by many researchers to find out the different topics within in the text data (Zhao et al. 2011; Low et al. 2020). Beyond analyzing the change of attitude during the pandemic, I first conduct synchronic analysis of the topics and sentiment of each topic on the posts related with working remotely to shed light on the overall attitude and concerns on this new working style. Treated the data from March 13, 2020 to April 14, 2022 as a whole, I find that the overall sentiment of the subreddits is positive. When doing the sentiment analysis on the three-year datasets, the result indicates that the sentiment is different for the different topics correlated with working from home. The objective topics are relatively more positive compared to other posts. In contrast, "back to office", "physical and mental health", "team and coworkers", "life style and work-life balance" and "time management" are relatively negative topics. Those relatively negative topics indicate that people still have trouble on dealing with these issues.

After having an overall understanding about the attitude of telecommuting, I examine the change of the attitude in several ways. First, I find out that the number of posts follow some similar patterns with the number of Covid-19 new cases in the world. From the result of Pearson correlation coefficient, there is no correlation between sentiment of posts and the global Covid-19 new cases. Since the raw number of Covid-19 cases is not a perfect benchmark of the seriousness of the virus as people's acceptation level and the symptom of variants have changed, I mark the four different waves during the process of Covid-19 by the peak of the confirmed new cases using the monthly data. The positive rate is high at the beginning of the pandemic, and in the first, second and fourth waves of Covid-19. To test whether the several peaks of posts positive rate are contributed by different topics, I conduct the topic modeling on the four different periods of time when the posts positive rate is higher than other periods. The finding is a good reference of my first claim.

Second, I find that the topics of working from home within different years are slightly

different. The difference of topics reflects people's reaction and focus as they get in touch with and get used to this new norm. The result is consistent with my second claim that people are intended to solve the urgent need and issues they face; while their focus is changed to be more comprehensive and diverse directions along the time.

The contribution of my study is that it provides evidence of the change of people's attitude and concerns about teleworking during the Covid-19. Contrary to those studies that only focus on the synchronic effect, my study can offer a broader view about people's adaptation pattern. Also, by conducting the observational study instead of doing survey, the result includes wider range of people. Knowing the pattern of employee's adaptation behavior of the new working style and working environment could be a reference of employers to decide the future policy details of working from home. It also provides potential evidence about whether it is feasible to make work remotely a fixed working style that could benefit some kinds of employees.

Literature Review

Telecommuting was introduced by Jack Nilles in 1973, a NASA engineer. He first mentioned this term in his book *the Telecommunications-Transportation Tradeoff*. Since then, the telecommuting or telework becomes rapidly popular with the development of the technology (Allen, Golden, and Shockley 2015). Right now, since the spread of Covid-19 in 2020, more and more companies encourage their employees to switch to this mode. Brynjolfsson et al. conduct a survey using the national sample in the US from April 1-5, 2020 and from May 2-8 2020. The result shows that half of the workers now shift to work from home. Within this half, 35.2% are recently changing to this working mode (Brynjolfsson et al. 2020). Those industries that cannot offer working remotely suffer from greater unemployment rate and lower expected revenue growth (Papanikolaou and Schmidt 2022). Researchers find that most people hold positive attitude toward working from home by analyzing the tweets during the pandemic using sentiment analysis (Gottipati et al. 2021; Zhang, Yu, and Marin 2021). Further study could focus deeper on people's attitude and more complex psychological

feeling that are presented on the social media. This could be a good reference to the policy makers.

Since working from home is an inevitable trend, the researchers want to figure out the effect of telecommuting. There are myriads of literatures about the influence such as efficiency, work-life balance, family involvement, mental health etc. As for the efficiency of working from home, the studies have different concentrations. Bloom et al. finish their study based on a Chinese travel agency Ctrip which has 16,000 employees. The study shows working remotely increases the working performance by 13% of the Call center employees. 9% of the increase is caused by more working hours due to fewer break and sick days. 4% of the increase is caused by a quieter and more convenient working environment (Bloom et al. 2015). However, this is contrary to the research using the data from a large Asian IT services company. The result shows that there is a 18% increase of working hour beside the normal business hour. Meanwhile, the productivity of the workers decreases by 8% to 19% even though the overall output only declines a little. The potential reasons come from the more communication time, higher cost spending on meeting and coordination as well as the less coaching time with their supervisors (Gibbs, Mengel, and Siemroth 2021).

This conflict of the productivity could be partially explained by industries difference. The remote working rate in different industries is different. Working from home is more common among those who have higher education background and income (Bartik et al. 2020). Brynjolfsson et al. also find out that states that have higher employment ratio in the information industries such as management, professional and related industries, have higher probability to work remotely (Brynjolfsson et al. 2020). The proportion of working from home in different industries is consistent among different countries. And those industries with high pre-existing remote rate are having a higher increase of remote working rate (Adams et al. 2020; Carillo et al. 2021). Some researchers state that very small amount of people could work from home in Latin American and Caribbean (LAC) countries. We should help the most vulnerable workers during the

pandemic (Delaporte et al. 2020). By analyzing the trend of working from home, Barrero, Bloom, and Davis predict that working from home could reduce the spending by 5% to 10% in major city centers compared to those days without covid. Also, because optimizing the work pattern, there will be 5% increase of the productivity (Barrero, Bloom, and Davis 2021).

Some of the other findings are related with psychological change and mental health caused by this working approach. Feeling stressed is a common phenomenon among remote workers. Information undersupply, autonomy, and isolation could make workers be stressful when they work from home (Weinert et al. 2015). Carillo et al. get the similar conclusion by testing on 1574 teleworkers in France. They conclude that professional isolation, telework environment, unprepared and ill-equipped, as well as the increased working hour lead to stress among workers (Carillo et al. 2021). In addition, people are more likely to feel lonely, worried, guilty, irritable and other negative emotion when they work at home (Mann and Holdsworth 2003). In contrast, Delanoeije and Verbruggen conclude that those who work remotely report less stress and work-to-home conflict using linear mixed coefficient modelling (Delanoeije and Verbruggen 2020). Also telework is positive related with job satisfaction (Golden and Veiga 2005).

Teleworking also involves the issue that work can interfere with family (WIF), and family can interfere with work (FIW) (Greenhaus and Beutell 1985). When people switch to telework, they are expected higher family responsibility, which increases FIW (Hammer et al. 2005). Also, working from home make the boundary between work and family vague and blur. This makes the change between work and family easier, but makes the maintenance of the boundary difficult, which may affect the work efficiency of the workers (Ashforth, Kreiner, and Fugate 2000). Telework is not only related to the family relationship, but also connected with the co-worker's relationship. On the one hand, coworker liking contributes to the informal communication satisfaction, and job satisfaction. Coworker relationship is an important resource in the teleworking setting

(Fay and Kline 2011). One the other hand, the researchers find that working from home decreases the friendship initiation and maintenance compared to work in the office with face to face relationship (Sias et al. 2012). The further study could be analyzing people's feeling of co-worker's relationship since more advanced and convenient communication technology pops up in recent years.

Discussion about the telework also focuses on the heterogenous effects between males and females. The study shows that within industries, women have less ability to switch to work from home since they have fewer tasks to do (Adams et al. 2020). Besides, there is a positive relationship between women working from home and family-and-work conflict. The possible explanation is our society still have higher expectation on females than males to be responsible to the family care. Thus, even though the females have jobs, they still need to work on most of the family issues. Working from home makes them easier to expose to this conflict, increasing the burden of females (Hammer et al. 2005).

The existing studies show solid and comprehensive findings about the synchronic influences brought by working from home. Few papers document the change of the influence and change of people's attitude. However, people attitude toward WFH is changing. When researchers survey more than 30,000 persons in the US about whether WFH will stick, 20% said fully WFH style will stay compared with the 5% data before the pandemic. The reasons of this include the good experience of WFH, the physical, human capital and technology invest and support of the WFH and the potential risk of being infected (Barrero, Bloom, and Davis 2021). The theory behind this finding is that people's reaction to change workplace or working style is an adaptive process. Their attitude could change over time (Bruque, Moyano, and Eisenberg 2008; Niessen, Swarowsky, and Leiz 2010). Thus, in my paper, I will detect the change of people's attitude toward work remotely on Reddit during pandemic.

Data and model

When talking about the feature of data, it is hard to figure out the demographic information of those who post in the Reddit r/workfromhome communities. But overall, in 2021, 48.9% of Reddit users are based in the United States. Also, as of January 2022, 63.8% of the users are male. According to a February 2021 survey of American internet users, respondents who have higher education background have higher probability to use Reddit. 26% of college background internet users are using Reddit, compared with 9% high school education level internet users. 36% of internet users aged between 18 and 29 years old are using Reddit, showing that the majority of Reddit users are relatively young.[2]

The demographic information of Reddit is consistent with the pattern of those work from home since telecommuting is more common among those who have higher education background and income (Bartik et al. 2020). Beyond that, Reddit data has higher privacy as only the username is displayed and people can post anonymously. That makes users feel more comfortable to express their true feeling. Because people need to join the communities they are interested in first and then post the subreddits, the stricter community rules in Reddit compared with Twitter make people more likely to talk closely related with the topic of that community. Instead, half of the tweets from 24 May 2020 to 20 June 2020 with hashtag #workfromhome are advertisements, which contains many useless information (Gottipati et al. 2021). The length of content is longer, and unique relevant words used are larger in Reddit compared with twitter, giving us more useful information to collect (Choi, Matni, and Shah 2016). Thus, in my research, I choose Reddit data to analyze the effect of working from home.

Pushshift API (application programming interface) is used to get the data from Reddit.

[2] Percentage of U.S. adults who use Reddit as of February 2021, by education level. Statista. URL:
https://www.statista.com/statistics/261776/share-of-us-internet-users-who-use-reddit-by-education-level/

I scrape the posts from r/workfromhome community on Reddit. The data is from March 13, 2020 to April 12, 2022. It covers the whole timeline of the Covid-19 since former President Donald J. Trump declares a nationwide emergency on March 13, 2020 until now.[3] There are 6,180 subreddits from r/workfromhome community during this time period.

Beyond the Reddit data, I also downloaded the Covid-19 Cases data in the US and the global from CDC (https://covid.cdc.gov/covid-data-tracker/#trends_dailycases). Covid-19 data will be used to compared with the volume and sentiment of subreddits.

Several steps are applied to preprocessing the data. As for the sentimental analysis, removing the stop words could affect the result of the sentiment scores, so I didn't modify the text. When doing topic modeling, I remove the stop words using NLTK package's list. I also manually remove some words that have less meanings. Meanwhile, punctuations, numbers, URLs are removed, followed by lemmatization using Spacy package in python. After converting the sentences into vectors, I added bigrams and trigrams into the list. Tfidf model is also used to get rid of some low value words.

Two models are performed to have a better understanding of people's attitudes, feelings, and mental reaction related with working from home. Sentiment analysis aims to detect people's public sentiment on some topics and issues. For those who post on Reddit, some of the posts are talking about statements, while some others contain obvious sentimental feelings that could be positive, negative or neutral. Grabbing the trend of the sentiment difference could give us insights about how have people's emotional attitude about working from home changed. Here, I use lexicon-based sentiment classification that has already built by researchers. VADER (Valence Aware Dictionary and sEntiment Reasoner) is one of the lexicon and rule-based sentiment analysis tools that is specifically attuned to sentiments expressed in social media. NLTK package could load this method without applying labeled data. It automatically considers

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[3] CDC Museum COVID-19 Timeline. URL:
https://www.cdc.gov/museum/timeline/covid19.html

punctuation, emoji, capitalization, conjunctions, tri-gram and then assign positive, negative, neutral, compound sentiment scores to each post. The compound score is calculated by summing the valence scores of each word in the lexicon, and then normalized to be between -1 (most extreme negative) and +1 (most extreme positive) (Hutto and Gilbert 2014). Because Reddit posts are social media data, this method is more suitable for my study compared to other dictionary approaches such as LIWC.

Topic modeling aims to identify people's interest within their posts. Over the pandemic, we can have a clear review of how have the topics changed since people are gradually adapted to this new norm. For the subreddits in r/workfromhome communities, the model could show what are people talking and concerned about with this topic. To conduct this method, I use LDA (Latent Dirichlet Allocation) which is an unsupervised algorithm in python's gensim library. I calculate the coherence scores to find out the best topics number of the model.

Result

Topics	Words
find WFH jobs, interviews & experience for jobs	remote, job, know, wfh, experience, learn, easy, year, thank, position, opportunity, hire
company's requirement & work experience	company, start, want, call, pay, video, stay, however, post, desktop, internet, platform, questions, education, able
technology equipment's issues	use, find, try, desk, new, idea, laptop, like, personal, first, order, monitor, computer, software, pc, recommend, bad
team, coworkers & boss	team, people, tool, email, account, month, share, move, space, update, meeting, coworker, workspace, virtual, chat
make money online & ads	money, online, earn, good, tip, need, offer, survey, sign, really, program, link, bonus, teach, comfortable, enjoy, payment, cash
equipment (desk, chair) & health	free, help, project, well, send, chair, check, list, hope, focus, equipment, become, employer, standing-desk, buy, health, lean

life style & work-life balance	covid, business, live, income, issue, guy, plan, open, love, phone, product, read, setup, together, person, dog, school, state, couple
back to office & physical and mental health	day, office, back, week, productive, minute, tell, support, hard, boss, watch, research, comment, sit, last, end, force, stick
surveys	work, employee, worker, productivity, study, future, rest, distract, audio, problem, speed, sick, resource, member, individual, city
recommendation (lonely, productivity, etc.)	feel, website, life, training, task, recommendation, little, right, many, follow, real, information, struggle, lockdown, fun, social
time management and schedule	time, keep, customer, break, part, schedule, full, manage, music, point, quality, routine, fear, spend, normal, return, habit, game, clock

Table 1: Key words for each topic

Figure 1: The proportion of each topic

Before detecting the change of people's attitude, I first do a synchronic analysis on the posts. In order to know the important topics within the r/workfromhome community, I preprocess the data for the better cluster result. After lemmatizing and vectorizing the text, I add bigram and trigram into the data, as well as delete the stop words. I also create the list of my own stop words that are extracted from the result of

topic modeling and substitute some words with their synonyms. From the LDA model, I get the topic and key words of the subreddits. I compute the Coherence Score of the model to find out the number of topics that is suitable for the texts. I choose 12 topics as the parameter of my final model considering it gives great coherence score.

The Table 1 and Figure 1 show the topics and most relevant words in each topic. I remove the smallest topic here because the texts within that topic don't present a distinct pattern. For the other 11 topics listed here, "find WFH jobs, interviews & experience for jobs" is the largest topic, accounting for 15% of total texts. Most of the discussion within this topic is asking help about finding remote job, self-introducing their previous work experience for advice of remote jobs, and sharing interview information. People also like to discuss the requirement of their company and their work experience during pandemic on Reddit. Asking for or giving recommendation of equipment (such as: desk, chair, headset, software, computers and so on) is another very popular topic among users. Since employees move into online, people also talk a lot about how to build a team online, how to maintain the relationship with coworkers and boss. Meanwhile, work-life balance, life style during WFH, discussion about back to office, healthy problems and time management are the other topics.
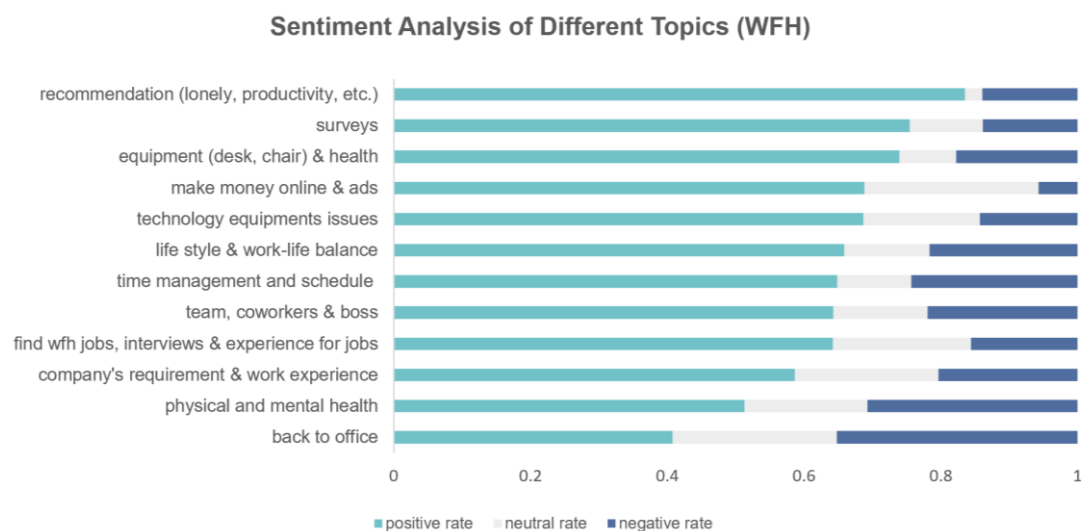

Figure 2: Sentiment analysis for different topics in WFH community

I perform sentiment analysis on each topic to detect people's overall feeling and attitude about different topics. Firstly, I extract the contribution of each topic for every sentence. I assign the topic that has the largest contribution to that subreddit. Then, each subreddit has their domain topic and the percentage of contribution of that domain topic. I only keep those subreddits whose contribution of the domain topic is larger than 20%. I also notice that there is a topic contain content of both "back to office" and "physical and mental health" due to the common word "back". Thus, I manually separate this topic into two topics for further analysis. After that, I create a new dictionary where the keys are the topic's name, and the values are all the subreddits within that topic and whose domain topic's contribution reaches 20%.

The result of the sentiment analysis for each topic in r/workfromhome community is showed in Figure 2. From the result, "recommendation", "survey", "equipment", "make money online" and "advertisements" are relatively positive compared to other posts. In contrast, "back to office", "physical and mental health", "team and coworkers", "life style and work-life balance" and "time management" are relatively negative topics (Table 2). More specifically, the topic "back to office" receives the highest negative rate since many posts are about people's unwillingness and complain of back to office request from their boss. "Physical and mental health topic" also has some negative feedback as people experience the back pain caused by the desk, chairs or unhealthy lifestyle at home, as well as lonely feelings and anxiety. Within the "time management and schedule" topic, the negative comments come from the struggle of managing time during work. People also have problems with work-life balance since work-life boundary is vague and not everyone can quickly get used to it. This shows that not all the people on Reddit could adapt to the work from home pattern well. In terms of cooperation with other coworkers and boss, some employees think telecommuting helps them escape from the meaningless social life, while some think that working online decreases the efficiency of communicate and it is hard to connect with boss. For those positive posts, most of them are some objective contents such as recommendation and advertisements. The result from the sentiment analysis reflects

why people enjoy work from home and what are the issues caused by working from home.

| Topics	Posts
Back to office	"Calling back to office: So they created a policy during the pandemic called choice and responsibility which allows people to exercise their choice in where they want to work as long as they deliver. The program has worked exceptionally well the last two years but now with the pandemic behind us they are asking folks to come to the office a few times a week. They are saying the policy above has two faces where we can exercise our choice but also have to be responsible and they find that many teams fo very well in a face to face setting. This is very disappointing. How do you deal with this?" "Back to the office 😩today: At least it's only 2 days per week. Had a good thing going there for a while. Saved so much money by not driving and going out to lunch. My Covid pup (20 months old) attacked me with kisses when I came home…like I was gone for months." "Been back to a hybrid home/office situation for 3 weeks now and it's just SILLY to have to be back there!……"
Time management	"Any tips for time management when starting to WFH? I find myself going hours without taking a break and then I'm burnt out more than when I worked in the field!" "WFH parents-- any advice on corralling a toddler during work hours: Hello! I am about to start a new job that is totally remote. I have a 1 year old son who is very high energy who will be home with me most days. I'm wondering if anybody has tips or advice on ways to optimize my workspace, keep my son entertained, schedule my day (emails, phonecards, meetings, etc), or just generally set myself up for success in this new role. I'm sure I'm not the only parent figuring this stuff out, so I'd love to know your secrets! TIA!" "If you worked 20 hours a week how would you split the time?"
Mental and physical health	"Back pain from sedentary life style (any tips?): About me: I'm 26 years old and I started two businesses and love my work. However, since I've been working from home for several years, I'm on my computer sitting for ~12-15 hours per day. I've invested into a great work station with great monitors, a herman miller chair, and a nice Uplift desk……Does anyone have any other tips/advice/tricks that they use to be a little more healthy? I get that I work a ton but I really am enjoying what I'm doing." "Single guy… WFH is killing my mental health: I can't do this anymore. I don't even know where to begin looking for a non-remote job in accounting. I can't sit here in my house all day long anymore. Work is really the only place I have ever been able to make friends. I'm in a new city and haven't gotten close to anyone in 1.5 years. I'm fucking over it. I feel like I'm stuck between a rock and a hard place." "How to stop having a full panic attack every time your manager wants to have a meeting?"
Work-life balance	"WORK/LIFE BALANCE: I have been working from home for 5 months now. Although I love all the pros of WFH, I am finding it much harder to find a good work/life balance. I've noticed that I rarely leave the house. I feel trapped and actually a little depressed. I TRY to keep with a routine - walks, home work outs, etc - but find that after work my brain is completely spent and I have no energy to do anything other than sit on my couch and watch mindless TV. What are some things that have worked for you all?" "Moms are finding it tough to manage work-life balance amid Covid-19 crisis: ……" "Trouble with Work Life Balance: So I've been working (9 hours a day) remotely for a year and am having trouble sleeping. I try going to sleep around 11, however, I end up starting work at midnight because I feel like it's better to work on the next day's timecard instead of just lying awake in bed. Does anyone else have this problem? If so, what do you do?"
Team and company	"Team building while working from home.: Looking for advice on how to team build while working from home. We used to be in the office working together (team of about 10) and have lost the team feel since we all are now wfh. We work in healthcare, so a very stressed out group too. Thanks in advance for any advice." "WFH Tip: How to always appear active on Microsoft Teams: ……" "Struggling with the lack of supervision: Although I did some WFH over the last 2 years, I've just moved into a remote position and I'm struggling to adjust. It's a bit of a double whammy, it's my first full time WFH position, and also I'm basically a stand alone member of staff. I over-see a small team who are all fairly self sufficient, part time and WFH as well …… I find I'm getting really easily distracted because I don't have any deadlines or managers following up on me. This is half a rant/half looking for suggestions."

Table 2: Post's example for some topics
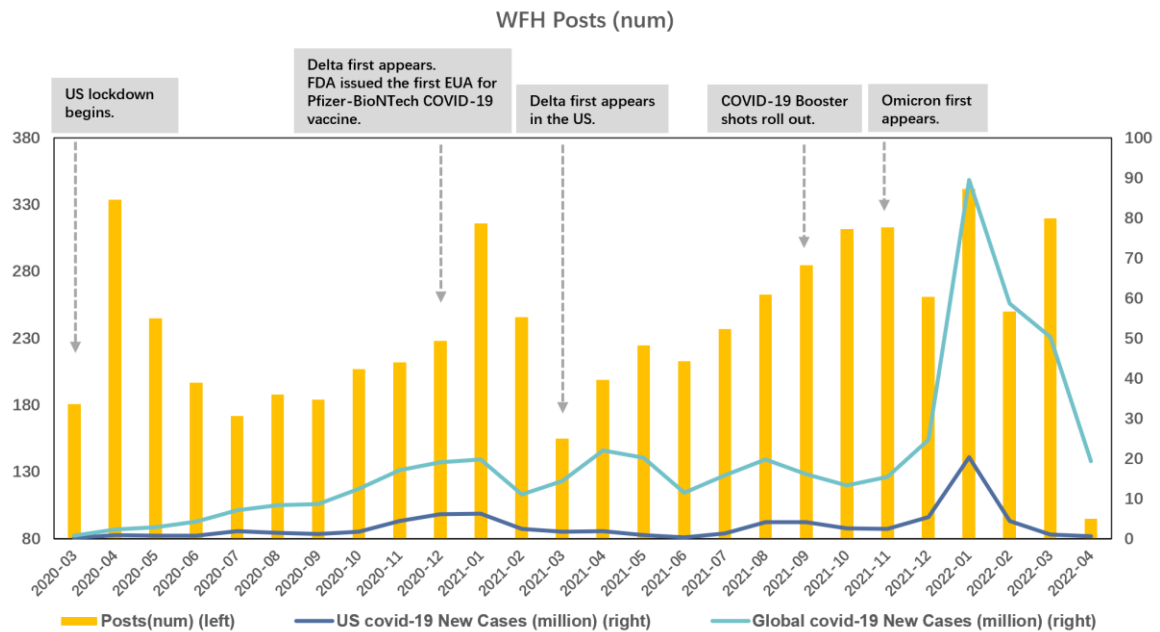
Figure 3: The relationship between post's number and Covid-19 new cases

In this part, I focus on the temporal analysis. Figure 3 shows the monthly number of posts in Reddit's r/workfromhome community and the number of Global and the US Covid-19 cases from March 13, 2020 to April 12, 2022. As we can see from the graph, the number of posts follow some similar pattern with the number of Covid-19 new cases in the world. The correlation between Global Covid-19 new cases and the volume of posts is 0.41 and the correlation between percentage change of Global Covid-19 new cases and percentage change of the volume of posts is 0.51. April 2020, January 2021, January 2022, and March 2022 have the top 4 highest number of posts. Since March 2020, many companies have shifted into work from home policy as the lockdown policy began. The first peak explains people's discussion for firstly adapt to this new working style. The next two peaks happened when Covid-19 new cases reached the peak until that time period. In January 2021, the number of cases reached the first turning point since the vaccine has come out to and was massively promoted to public. There are lots of debates about working remotelyat that time. In

January 2022, Covid-19 new cases dramatically jumped to nearly 90 million as omicron widely spread. The number of posts in r/workfromhome community also reached the top. The recent peak is in March 2022 when the omicron got control and many states relieved their virus control policy such as wearing masks and no dine-in allowed.
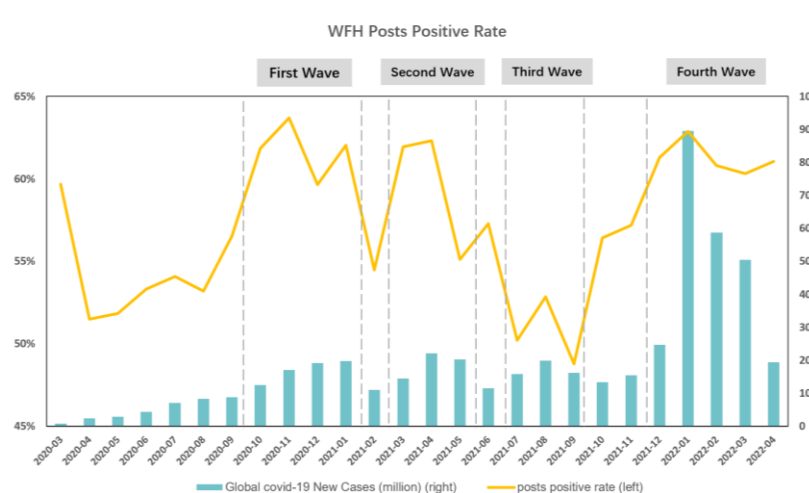

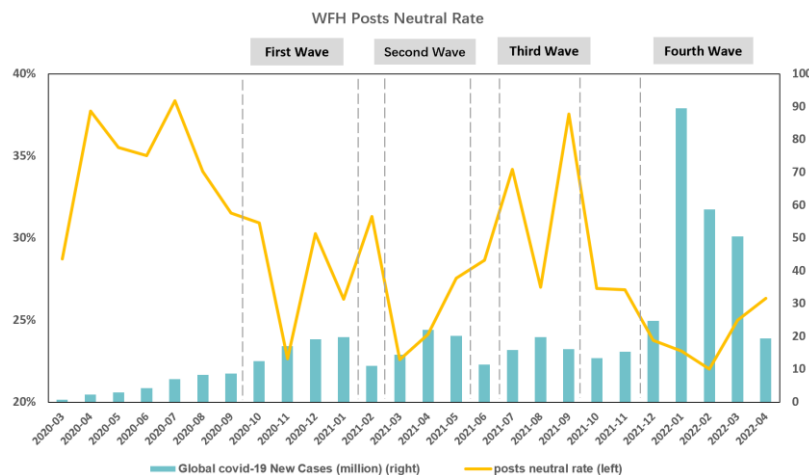Figure 4: The relationship between post positive rate and Covid-19 new cases

Figure 5: The relationship between post neutral rate and Covid-19 new cases
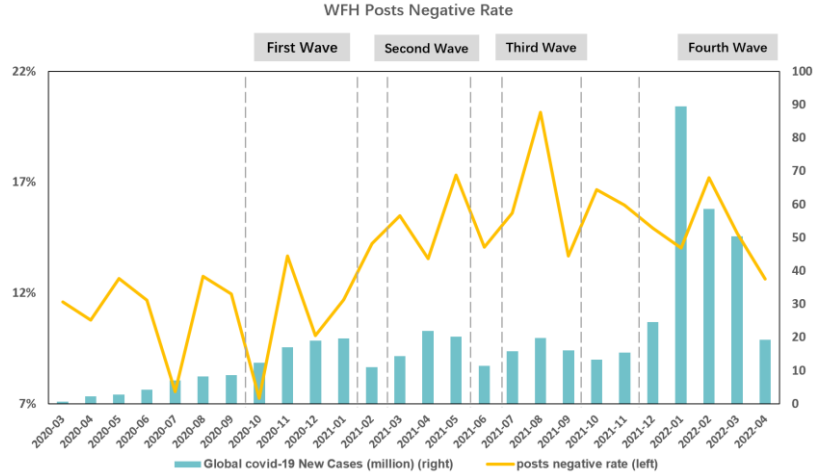
Figure 6: The relationship between post negative rate and Covid-19 new cases

	Correlation (with Global Covid-19 new cases)	p-value
Number of posts	0.413	0.0349
Number of posts (% change)	0.507	0.0208
Posts positive rate	0.454	0.0139
Posts positive rate (% change)	0.149	0.4747
Posts neutral rate	-0.574	0.0009
Posts neutral rate (% change)	-0.095	0.6547
Posts negative rate	0.089	0.1235
Posts negative rate (% change)	-0.041	0.8507

Table 3: Correlation between post's sentiment and global Covid-19 new cases

Then I do the sentiment analysis using the VADER classifier to find out the sentiment of working from home. For VADER classifier, I set the boundary of positive, neutral, and negative posts by the compound score. When the compound score is larger than 0.35, then the post is classified into positive post. If the score is between -0.1 and 0.35, the subreddit is treated as neutral post. In this case, the classification accuracy is relatively high compared with other boundaries I tried. The overall posts positive rate in the r/workfromhome community is 58%, while the neutral rate and negative rate are 14% and 28%. The correlation is showed in Figure 4-6 and Table 3. From the result of Pearson correlation coefficient, there is no correlation between sentiment of posts and the global Covid-19 new cases. Even the correlation between posts positive

rate and global Covid-19 new cases is 45% and the p-value from permutation test is 0.03, but when applying the first order difference to these two data and calculating the correlation, the value is only 0.15 with 0.47 p-value. This means that the change of posts positive rate doesn't have a close relationship with the pattern of global Covid-19 new cases.

Using the Covid-19 cases as a benchmark may not be very meaningful because though the Covid-19 cases increased dramatically since January 2022, most of the cases are omicron which causes mild disease compared to prior variants. Thus, I mark the four waves of Covid-19 in the world by the peak of the confirmed new cases using the monthly data to reflect the timeline of it. The positive rate is high at the beginning of the pandemic, then the rate falls until the first wave of Covid-19. The posts positive rate is relatively high in the first, second and fourth waves of Covid-19. For these four periods when post positive rate is relatively high, I also perform the topic modeling to see whether the positive attitude within these different periods is credited to the same topic. The results show that the positive posts in the first period are mostly related with the excitement and freshness of this new working style, and some tips from those who have experience of telecommuting. The positive posts in the second period are more about Covid-19, work-life balance, family members, and equipment. For the third and fourth period, the positive posts also include some team and company topics. From the change of the topics during these four different periods, we know that the high posts positive rates are brought by different reasons.

The posts neutral rate, which has the similar issue with the posts positive rate, also cannot show the relationship with Covid-19 new cases. The data shows that at the beginning of the 2020, people are more neutral to telecommute compared with the following years. During first, second and fourth wave, the neutral rate drops to the bottom. For the negative attitude toward working from home, posts negative rate is high in the third wave of the Covid-19. Further study could be focusing on why the third wave experiences the highest negative attitude about telecommuting.

2020		2021		2022	
WFH general	0.580	WFH general	0.408	back to office	0.424
find jobs	0.178	office & team	0.256	suggestions	0.222
time management	0.109	work-life balance	0.128	equipment	0.165
equipment	0.038	meeting	0.056	exercise	0.061
investment	0.030	advertisements	0.052	health issue	0.047
team & coworkers	0.027	survey	0.040	other equipment	0.042
technology equipment	0.024	interview	0.035	earn money	0.024
tool	0.013	equipment	0.025	profit	0.016

Figure 7: Topics of different years in WFH community

When evaluating the overall composition of topics across time, the topics have some distinct patterns in different year. There are 2137 posts from March 13, 2020 to December 31, 2020, 3016 posts in 2021, and 1007 posts from January 1, 2022 to April 12, 2022. As the result shows in Figure 7, when I use this model on the posts of separate years, it is hard to detect all the possible topics since the top 1 topic contains about half of the tokens. Even though I change the number of topics, this situation doesn't get better. For the topics beyond the WFH general topic, people in 2020 talk more about finding jobs, time management, and equipment. In 2021, subreddits contain more about office and team, work-life balance, meeting, and interview. During the first four months of 2022, back to office becomes the major topic. Health problems and excises are also commonly discussed by people during this period. Technology and working equipment are the topics that are common during three years. The change of topics reflects the phenomenon that at first, people like to discuss some urgent issue in terms of working from home. As people have some experience of the new working style, their focus is more diverse and personal.

Discussion

The overall attitude of people on WFH in Reddit is positive, showing that most people who switch to work from home enjoy this work style. For the different topics correlated with working from home, the sentiment is different. People are more positive on the relatively objective topics such as "recommendation", "survey", "equipment", "make money online" and "advertisements". But in terms of the relatively subjective topics, back to office, mental and physical health, relationship and communication among coworkers, work-life balance, and time management are some issues that people are having problems with.

The change of posts positive rate of the work from home does not have a close correlation with the change of Covid-19 new cases. After marking the four waves during pandemic, the results show that posts positive rate is high at the beginning of the pandemic, and also during the first, second and fourth wave of the Covid-19. When Covid-19 becomes serious and experience a wave, people are more likely to have positive attitude to that. However, the underlying positive attitude within each of these four periods is quite different, showing that different reasons contribute to people's high posts positive rate over time. The variation of reasons reflects the adaptive process. Employees become positive about some topics such as work-life balance and team work during the later periods, while at first the positive posts are about the person excitement and freshness.

Also, focus and discussion of working from home are changed slightly within different year. In 2020, people mostly discuss about how to change to this new working style immediately, such as how to find jobs, manage time, and deal with the technical issues occurred during the telecommuting. In this stage, the urgent issues are commonly discussed. While in 2021, how to improve the working style and life quality is the adapted version of individual's concerns and problems on Reddit. When the Covid-19 got controlled in 2022, discussion of back to office is brought onto the table. The relatively negative attitude for this topic means that parts of the people

have adapted to this new working style and is reluctant to switch back to office. They enjoy the flexibility and efficiency as well as closing to family.

Since many industries survive during the pandemic as they quickly switch to work from home, this temporary policy that aims to fight with the virus gives people some surprise result (Barrero, Bloom, and Davis 2021). We have already lived with Covid across three years during which people are gradually get used to it. Working from home seems to be a long-term option to many people. The negative attitude of back to office also consistent with the study from Barrero et al which state that high proportion of people agree that working remotely will be a long-term thing. Even though the adaptation is not a sudden change, we can see people's effort to actively react to this change. The process begins with solving some urgent issues such as productivity and communication within the team. Then people try to balance their work and life at the same time to find the best plan. Meanwhile, they consider the health problems and some equipment issues. There is no doubt that if one person cannot adapt to work remotely could cause some mental problems. These findings are close to the result of previous study (Brynjolfsson et al. 2020). The sentiment analysis of different topic using Twitter data also shows the overall positive sentiment (Gottipati et al. 2021). But the study doesn't conduct temporal analysis. They only use the tweets within three months.

The implication of my research is that it detects a relatively big picture of people's attitude toward the work from home new norm since Covid-19. The dynamic model shows how people react to the change and what's the potential problem of this policy. Understanding people's feeling and attitude could help policy makers and companies modify the existing policy and test whether it is possible to widely change to this pattern to solve some social problems. As I find in this study that working from home is an evolution process. People's attitude and performance could be changed, the companies should take actions to help their employees to find their best way by analyzing the problems arisen in the study and providing some solutions to them.

Knowing the current need and attitude of their employees could be more helpful to tackle the change, while having an understanding about the overall evolution process of people's attitude could offer good reference and guidance of many employers.

For those companies first adopt to telecommute, the organization could pay attention to the urgent need, such as how to facilitate the team work and communication, and build the team. The virtual technology and hardware support should be ready all the time. As for the policy towards employees, this could be different for different stage of working from home and among different people. A survey could be important for the managers to understand how their employees react to work from home since not every person has the same adaptation ability. For those who have trouble concentrate during the work hours, the employers could provide clear and detailed time schedule sheet to their team if they suffer from time management issue. Since the vague of boundary between work and life could be a potential problem that increase distraction and decrease efficiency, many companies could also use some tools to measure the productivity of the workers, such as the total number of keyboard events used by Microsoft (https://www.microsoft.com/en-us/worklab/triple-peak-day). The above points are some issues faced by people mostly at very beginning of working from home. For those who have adapted to this working mode, their demand is probably to keep the flexible work style which gives them more freedom and autonomy. The policy of the company should consider and keep up with people's dynamic change.

There still are several limitations of my paper. First, the subreddits include some advertisements which could affect the result of sentiment analysis and topic modeling since many of them are positive. Also, those advertisements don't reflect the opinions of the people's attitude, which could be a noise of topic modeling. Besides, some of the subreddits have some video, pictures or GIF which also reflect people's opinions. For simplification, I remove this kind of data. Deleting this part could lose some important information since more and more people are using GIF, memes, and pictures to reflect their attitude. Second, using the existing VADER classifier cannot

ensure a very high accuracy of the result. The false of classification could affect the result. Even though the classifier itself cannot promise a high accuracy, VADER is commonly used on social media data (Pano and Kashef 2020; Park and Seo 2018). The advantages include it is simple and well understood. The potential improvement is to label the sentiment by myself and feed it into NLP models (eg, BERT model). Using the Reddit community has the representative issue. Even though there is some overlap of users on Reddit and those employees work from home. But the users on Reddit cannot reflect the attitude of all the persons. What's more, people are more likely to share some negative opinions or ask for advice on Reddit instead of sharing how work from home benefits their life since they don't have high motivation to do that. The discussions in Reddit could be more negative compared to the real attitude. Thus, my finding can only represent the opinions on Reddit.

Further study could take advantage of existing image data and explore some other NLP models to improve the result. Also, since the data from social media could not reflect people's all kind of opinions toward working from home, well designed surveys could be a supplement. Using surveys could help us know the demographic and industrial information of employees. The fact is that women are expected to take more responsibility of the family role (Hammer et al. 2005). In this case, working from home could increase the potential workload for some women if they don't set the boundary between work and life clearly. On the other hand, easy access to the family could increase their overall efficiency if they need to do both the works from employers and from family members. Whether working from home helps to relieve or increase gender discrimination also is an important topic to learn. A survey during several stages or years of teleworking is helpful. In addition, scholars could also focus on people's adaptative process to the new working mode and the influence of this during a longer period in the future study.

Conclusion

In order to study how have people's attitude toward working from home changed over

the course of pandemic, I analyze posts within r/workfromhome community on Reddit using sentiment analysis and topic modeling. When conducting the synchronic analysis using three years' data together, the results show that the objective topics are relatively positive compared with these subjective topics. This implies that people on Reddit have some problems with those subjective topics such as work-life balance, physical and mental health, team and company, time management and company requirement.

Then I study the temporal change of the attitude and focus over the course of pandemic. To prove my first claim that people in the WFH Reddit community will tend to be more positive when the Covid-19 is more serious, I apply sentiment analysis on the monthly posts and Covid-19 data. The results show that the positive rate of posts is high at the beginning of the pandemic as well as during the first, second and fourth waves of the Covid-19. The positive attitude in different time period is contributed by different benefits brought by working from home. To test my second claim that people's focus and concentration on work remotely along the process are varied, I perform topic modeling on the posts separately by year. The result is consistent with my hypothesis. At the beginning, people are intended to solve the urgent need and issues they face; as they gradually adapt to it, the topics are becoming more comprehensive and diverse such as talking more about work-life balance, health issues, attitude about back to office etc. These findings could be beneficial to employers and policy makers to recognize that working from home is a complex social issue and then adjust the related policy. For further study, my study also offers a guide about the importance of the temporal analysis when analyzing telecommuting policy's influence.

Data and Code Availability Statement

The code and data that support the findings of this study are available in
https://github.com/macs30200-s22/replication-materials-yujing-syj

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