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## An Exploration of Wikipedia Contributions in the Era of COVID-19

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## An Exploration of Wikipedia Contributions in the Era of COVID-19

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## ABSTRACT

With the declaration of COVID-19 as a pandemic by the World Health Organization (WHO) declared COVID-19 a pandemic. With the public health concerns, and associated emergency measures, the lives of many came to a grinding halt. Whether due to stay-at-home orders and lockdowns, or quarantines, many were required to change their day-to-day way of life overnight. This not only changed the mechanical activities performed daily, such as driving to the office, going out to a restaurant, or attending a party, but this also changed the resultant implications of the utility we received from those activities. Utility theory posits that individuals choose what activities to perform based on some utility function, where the utility satisfies some need. As these activities to meet existing needs were disrupted, we seek to use this as an opportunity to explore how contribution in open-source communities changed, specifically the English Wikipedia. We utilize a natural experiment methodology, centered around COVID Pandemic, and explore contribution patterns before and after the pandemic. Our project will contribute to the understanding of IS during unusual times, specifically in the context of open source communities that rely on volunteer time and effort.

**Keywords:** Wikipedia, Open-Source Communities, Pandemic, COVID-19

## INTRODUCTION

On March 11, 2020, the World Health Organization (WHO) declared COVID-19 officially as a pandemic. The events surrounding this event changed the way many lived their day-to-day lives, whether temporary (e.g. quarantines) or longer term (e.g. working from home). Wikipedia is the online open-source encyclopedia that anybody can edit. Within this project, users can fill a variety of roles, including unregistered reader, registered editors, administrators and bureaucrats to name a few. Wikipedia's success is related to the contributions of these volunteers. Research has explored a number of aspects of the Wikipedia project including new members and their likely contributions (Halfaker et al., 2011), how the members collaborate to achieve consensus (Hepp et al., 2007; Viegas et al., 2007), how editors resolve conflicts (Kittur et al., 2007), and how value is created and destroyed overall in Wikipedia (Priedhorsky et al., 2007). All of these elements have in common, that they require volunteer participation in the project. This leads to one of the most prevalent lines of research in Wikipedia, what makes users contribute, and how long will they remain active in the project (Goldman, 2009; Ingawale et al., 2009; D. Zhang, Prior, et al., 2012). Once an editor has made a significant enough contribution, to the project, they may seek an election to be promoted to the administrator role. Research on administrator promotions have explored the relationship between a user's size of contribution to the overall Wikipedia projects, and their likelihood of being promoted to a privileged *administrator* position within the community (Burke & Kraut, 2008; Collier, et al., 2008; Kordzadeh & Kreider, 2016; Kreider & Kordzadeh, 2015). As a user moves into an administrative role, their contributions to the project are no longer just edits to encyclopedia articles, but blocking disruptive users, and deleting inappropriate articles, and preventing articles that currently under dispute from being modified, playing an additional role in identity of the project. Follow up research has explored continued contributions of administrators (Kreider, 2019). Regardless of the role, or the action, Wikipedia relies on volunteers to make it successful.

With the onset of the COVID-19 pandemic, many of the lives of those who have or would contribute to the project were drastically changed. Between January 9<sup>th</sup> 2021, and April 7<sup>th</sup> 2021, there was more than 100 "emergency" measures to prevent the spread of COVID-19 including states of emergencies, lock downs, closures of public venues, restaurants and schools and stay-at home/safer-at-home/healthier-at home orders, with major events listed in table 1 below.

Date	Event
January 9 <sup>th</sup>	WHO announces “Mysterious Virus”
January 21 <sup>st</sup>	First US COVID-19 Case
January 23 <sup>rd</sup>	First Reported Quarantine (Wuhan China)
February 3 <sup>rd</sup>	US Declares Public Health Emergency
March 11 <sup>th</sup>	WHO Declares COVID-19 a pandemic
March 19 <sup>th</sup>	First US state issues “stay at home” or similar order (California)
April 7 <sup>th</sup>	One of the last states to do so issues a “stay at home” or similar order (South Carolina)

**Table 1: Major events in the COVID-19 Timeline**

Here, just a little over a year after COVID-19 was declared a pandemic, we are just now seeking a path to return to normal. This research seeks to explore how this disruption to day-to-day life, whether from quarantine, stay-at-home orders, loss of job, or other pandemic related complications relates to contribution to the Wikipedia project. Specifically, we seek to address the following research questions.

RQ1: How are events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) related to general contributions in the English Wikipedia project?

RQ2: How are events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) related to general administrative contributions in the English Wikipedia project?

RQ3: How are events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) related to negative (vandalistic) contributions to the project?

RQ4: How are events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) related to new account registrations?

RQ5: How are events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) related to newly blocked accounts?

We look to the original theories specified in existing Wikipedia contribution research to better understand them in the context of the pandemic. This study will utilize a form of natural experiment, using March 11<sup>th</sup> as the central date. Exploring approximately a year before, and a year after this date, we will utilize the publicly available logs on Wikipedia to gather information about user’s contributions before, and after the pandemic. This research hopes to explore the role that Pandemics may play on contributions to open-source environments, and how it may differ from traditional models of user contributions to the project.

## LITERATURE REVIEW

Our literature review will explore research around contributions to Wikipedia/open source communities, as well as research on human behavior during pandemics. Open source communities are subject to suffering from the free-rider problem, where only a few users contribute overwhelmed by those who use it and do not pay a “fair share” (Zhang & Zhu, 2011). One of the major themes in Wikipedia related research explores this question, and seeks to understand why users choose to contribute to the project? From a functionalist psychology perspective, we perform specific because they serve a specific function or purpose. Using this perspective, Rafaeli and Ariel (2008) identify four common reasons users contribute: expressing Values: such as altruistic concern for others, utilitarian: receiving rewards from an external environment, social adjusting: performing certain actions may lead to “fitting in” better and knowledge acquisition: may learn a new, or exercise an existing knowledge, skill or ability. Another motivation for contributors is a desire to publish true facts about the world, similar to the goals of the scientific community (Forte & Bruckman 2005). In their research, they build on the work of Woolgar and Latour (1986) on what motivates publishing scientists. They find that a focus on providing positive indicators of engagement in desirable communities and avoiding focus on “tiers” of privileged users contributed to long term contributions. These specific examples are consistent with the broader findings that contributors find the environment has positive values and rewards such as Values – *reputation, community, reciprocity, altruism and autonomy* and Rewards - *accomplishment, collectivism, benevolence* (Kuznetsov, 2006). Given this initial knowledge on contributions, a strong connection to activity theory and theories on legitimate peripheral participation emerge (Bryant et al. 2005). In this context, users contribute to Wikipedia for Accomplishment – e.g. the feeling of completing something valuable and/or important; Protective – e.g. feeling less lonely; Values – e.g. recognizing the importance of helping others and being altruistic; Career – e.g. activities that have the potential to enhance a career, such as connecting with a new contact; Reputation – e.g. build a sense of identity connected to your contributions within the project; Social – e.g. social activity with those who are close to you who contribute to Wikipedia; Understanding – e.g. gaining new knowledge/perspective; Utilitarian – e.g. receiving some sort of reward from the environment; Fun – e.g. it is enjoyable/fun to contribute to Wikipedia and Ideology – e.g. supporting the idea of “Free information”.

Within these motivating factors, contributors lead to different levels of contribution. Should the overall level of contribution fall too low, due to lack of oversight and coordination, the system is expected to enter a state of *information poverty* and *quality skewness* (Zhu et al., 2020). Thus, understanding what contributes to long term of continued contribution is also important. While Wikipedia has millions of articles, approximately 10 percent of the authors are responsible for ninety percent of the content (Ortega et al., 2008). Of the users that choose to contribute long term, it is often motivated by the opportunity to contribute to new “exogenous” articles that can attract “Attention both in terms of consumption and generation” (Zhu et al., 2020). Zhang and Zhu (2011) explored the statistics of user contributions, and found that once a user starts contributing to Wikipedia, their average lifetime is 53 days. After a contributors first contribution, there were two critical phases during which they continued their contributions or stopped, between 0-2 weeks and 8-20 weeks, resulting in a scenario when there an increasing number of authors with a small number of contributions. Additionally, they explored the primary causes that users ceased to contribute, and these included career, health or family. Among the users that choose to continue to contribute to project at appropriate levels, they may decide to run for the elected position of *administrator*. Wikipedia *administrators* are granted special permissions that give them additional control over the project, including deleting articles, blocking users, and editing high profile pages to name a few. Within the Wikipedia community less than .001% of users are administrators. Using logistic regression, Kreider and Kordzadeh (2015) and extended by (Kordzadeh & Kreider, 2016) explore what activities users need to perform to acquire community trust, exploring factors such number of contributions and total length of their time contributing to the project. They found that the overall magnitude of contribution to the project in terms of number of contributions, social contributions (via talk pages) and activities that signaled trustworthiness (e.g. activities demonstrating openness and transparency such as using edit summaries) were the most likely to be selected for this role.

Pandemics changes the way the world around us operates. Within a short period of time, new emergency measures, safety protocols, and other related alterations alter our routines. In research exploring how individuals behave during such events, Götze et al. (2020) utilized the big five dimensions of personality to understand likelihood of

appropriately sheltering in place. They found that the openness to experience, conscientiousness and agreeableness dimensions of personality predicted higher rates of “sheltering in place”. As individuals sought to deal with the stressful conditions surrounding COVID-19 Cherian et al. (2020) found two broad approaches to handling COVID-19 Related stress: constant worry – resulting in anxiety and blocking it out – being completely unaware. The impacts of this have led to negative outcomes such as a negative impact on mental health, lack of support systems and lack of entertainment/boredom.

## METHODOLOGY

Methodologically, Wikipedia is well suited for a natural experiment, a form of quasi-experiment where the “treatment” is not initiated by the researchers, but is a significant enough “natural event” that it can be interpreted as an intervention. In this type of quasi-experiment, the natural event can be interpreted as a treatment to draw inference before and after the event (Cook et al., 2002). The natural experiment approach has been used in a number of studies on Wikipedia (Gallus, 2017; Zhang et al., 2019; Zhu et al., 2020). The Wikipedia project is ideal for such a natural experiment as nearly every contribution to the project is date and time stamped, recorded and publicly available, making analysis on either side of an event possible.

Given that within, Wikipedia contributors during normal times may contribute for a number of factors, some more prominent ones included such as sense of accomplishment, social interaction with other editors, building a reputation, and gaining knowledge/understanding. However, once a user starts contributing, a majority will stop due to issues such as work or family, potentially due to the fact that “utility” from the project was gained elsewhere. As social distancing, lockdowns, and quarantines resulted in significant disruption to many in terms of their day-to-day routines from which they gained utility, we draw the following hypotheses.

H1: The events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) will result in a general increase in contributions to the English Wikipedia project

H2: The events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) will exhibit an increase in general administrative contributions in the English Wikipedia project

- Functionalist psychology perspective specifies that we, “...perform certain activities because they serve one or more functions (Rafaeli & Ariel 2008).”
- Many of these functions related to career, socialization and belongingness were disrupted via COVID, and ALSO were common motivations for contributing to Wikipedia
- Users may seek other sources of those “functions” via returning to Wikipedia

H3: The events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) will result in a general increase in new account registrations.

- Boredom and lack of social activity were two major reported issues during lockdowns.
- Wikipedia’s barrier to entry is low (easy to get started)
- Positive benefits from other sources were reduced or removed

H4: The events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) will be positively related to negative (vandalistic) contributions to the project

- Users may act out negatively to reduce or avoid stress/blow off steam

H5: The events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) will be positively associated with newly blocked accounts?

- An expected increase in administrative tasks (such as blocking vandalist users)
- An expected increase in vandalistic activity

A Bayesian Structural Time-Series model (Brodersen et al., 2015) will be used to analyze the data. This method allows for the modelling of time-series data with a predetermined cut point in order to test if there is a significant change in the outcome after the cut point. Visually inspecting the data, certain other events not closely related to the cut point resulted in significant anomalies in the data. We chose to end our data collection near the end of the year, December 20<sup>th</sup> 2020. For H1 and H3 the Wikimedia REST API was used to capture the data pertaining to user the number of user contributions, new account registrations. This data was gathered as total number of operations occurring in each month. For H2, pertaining to admin activities, no endpoint was available to aggregate information pertaining to the activities performed by administrators, whether standard contributions or privileged actions such as preventing pages from being edited via protection. Within Wikipedia, page protection enables an administrator to lock a page from editing for a variety of reasons, including encouraging discussion during a dispute, or preventing current contentious articles from being vandalized. Protection actions are generally for a fixed period of time, during which, no additional protection actions are performed on a page. We have chosen to use the privileged protection action as a surrogate measure for administrative activity as it is privileged in that only administrators can perform it, and is easy to perform when the need arises. To gather this information, a custom program was written in Python that assessed each protection operation before and after the natural intervention point, and determined what month and year the action occurred. These were aggregated into total counts of privileged protection operations occurring monthly. For H4 and H5, pertaining to vandalistic activities and blocks, the Wikipedia block log was used. This log reports all block operations performed by administrators, along with their description for being blocked. Specifically, for H4, block entries with a description that indicated vandalism as the reason for the block were aggregated across the period. Finally, for H5, the entire log of user blocks was assessed and aggregated, regardless of the description stated. The collected data was then analyzed using the Causal Impact package in R (Brodersen et al., 2015)

## RESULTS

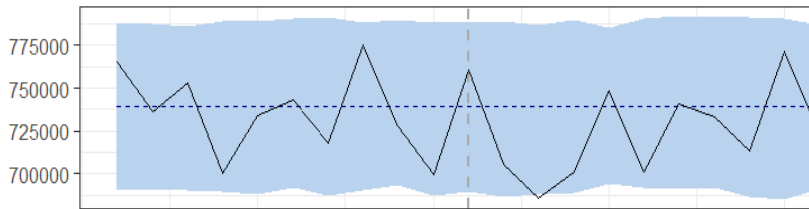
Our five hypothesis, tested using the Bayesian Time Series model with the date COVID-19 was declared a pandemic as the cut-point, and exploring the twelve months before and nine months after the event are reported below in Table 2.

	Estimate (95% CI)	p-value
H1: Edits - Anonymous Users	-2% (-5%, 0%)	0.040
H1: Edits - Registered Users	10% (7%, 13%)	0.001
H2: Administrative Contributions	4% (-15 %, 2 4%)	0.338
H3:New User Registrations	-3% (-10%, 4 %)	0.225
H4: Blocked Users	3% (-10%, 15 %)	0.343
H5: Vandalistic Activity	4% (-26%, 31 %)	0.392

**Table 2: Summary of Results**

For H1, *the events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) will result in a general increase in contributions to the English Wikipedia project*, we broke contributions down into those made by anonymous users, and those made by registered users. When exploring the edits non-registered (anonymous)users, shown in Figure 1 below, during the post-intervention period, the response variable had an average value of approx. 722.26K . In the absence of an intervention, we would have expected an average response of 739.50K. The 95% interval of this counterfactual prediction is [719.82K, 759.66K] . Subtracting this prediction from the observed

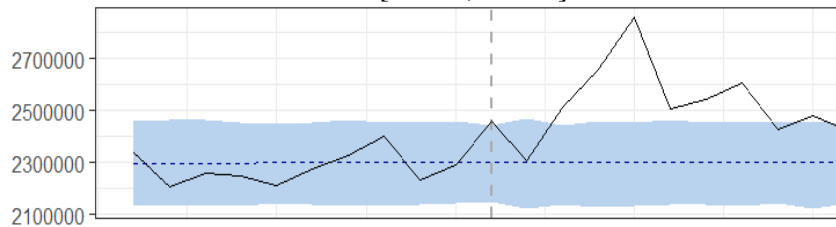
response yields an estimate of the causal effect the intervention had on the response variable. This effect is -17.24K with a 95% interval of [-37.40K, 2.44K] .



**Figure 1: Number of Edits by Anonymous Users before and After the COVID-19 Pandemic Announcement**

Summing up the individual data points during the post-intervention period, the response variable had an overall value of 8.79M. Had the intervention not taken place, we would have expected a sum of 7.22M. Had the intervention not taken place, we would have expected a sum of 7.40M. The 95% interval of this prediction is [7.20M, 7.60M] . The above results are given in terms of absolute numbers. In relative terms, the response variable showed a decrease of -2%. The 95% interval of this percentage is [-5%, +0%] . Practically, we observed a noticeable decrease in the number of edits from anonymous users immediately following March 11th, 2020. Additionally when considered across the entire time span of the analysis before and after the announcement there was a statistically significant sustained change in the number of anonymous edits.

For contributions by registered users during the post-intervention period, the response variable had an average value of approx. 2.53M. By contrast, in the absence of an intervention, we would have expected an average response of 2.30M . The 95% interval of this counterfactual prediction is [2.23M, 2.36M] . Subtracting this prediction from the observed response yields an estimate of the causal effect the intervention had on the response variable. This effect is 0.23M with a 95% interval of [0.17M, 0.31M] .



**Figure 2: Number of Edits by Registered Users before and after the COVID-19 Pandemic Announcement**

Summing up the individual data points during the post-intervention period, the response variable had an overall value of 25.33M. By contrast, had the intervention not taken place, we would have expected a sum of 22.98M. The 95% interval of this prediction is [22.28M, 23.64M] . The above results are given in terms of absolute numbers. In relative terms, the response variable showed an increase of +10%. The 95% interval of this percentage is [+7%, +13%] . This means that the positive effect observed during the intervention period is statistically significant and unlikely to be due to random fluctuations. Practically, this indicates contributions from registered users saw a noticeable increase in the number of edits. When you consider the remainder of the year after the pandemic announcement, there is a significant sustained increase in the number of edits made, shown in Figure 2 above.

For H2, that *the events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) will exhibit an increase in general administrative contributions in the English Wikipedia project* during the post-intervention period, the response variable had an average value of approx. 2.92K. In the absence of an intervention, we would have expected an average response of 2.82K. The 95% interval of this counterfactual prediction is [2.26K, 3.39K].



Subtracting this prediction from the observed response yields an estimate of the causal effect the intervention had on the response variable. This effect is 0.10K with a 95% interval of [-0.47K, 0.66K].

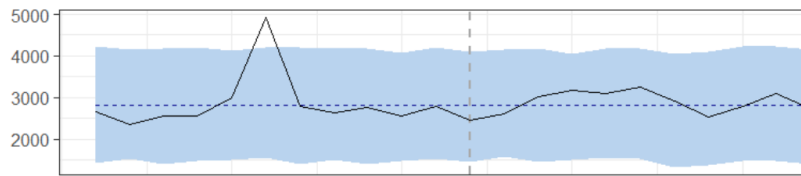


Figure 3: Number of Admin (Protection) Operations Before and After the COVID-19 Pandemic Announcement

Summing up the individual data points during the post-intervention period, the response variable had an overall value of 29.21K. Had the intervention not taken place, we would have expected a sum of 28.19K. The 95% interval of this prediction is [22.63K, 33.93K]. The above results are given in terms of absolute numbers. In relative terms, the response variable showed an increase of +4%. The 95% interval of this percentage is [-17%, +23%]. This means that, although the intervention appears to have caused a positive effect, this effect is not statistically significant when considering the entire post-intervention period as a whole.

For H3, that *the events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) will result in a general increase in new account registrations* when exploring new user account registrations during the post-intervention period, the response variable had an average value of approx. 140.04K. In the absence of an intervention, we would have expected an average response of 143.81K. The 95% interval of this counterfactual prediction is [133.59K, 154.87K]. Subtracting this prediction from the observed response yields an estimate of the causal effect the intervention had on the response variable. This effect is -3.77K with a 95% interval of [-14.83K, 6.45K].

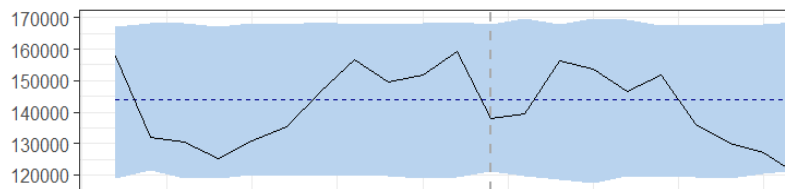
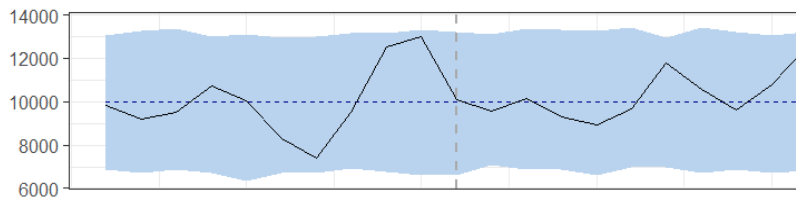


Figure 4: Number of New Account Registrations Before and After the COVID-19 Pandemic Announcement

Summing up the individual data points during the post-intervention period, the response variable had an overall value of 1.26M. Had the intervention not taken place, we would have expected a sum of 1.29M. The 95% interval of this prediction is [1.20M, 1.39M]. The above results are given in terms of absolute numbers. In relative terms, the response variable showed a decrease of -3%. The 95% interval of this percentage is [-10%, +4%]. This means that, although it may look as though the intervention has exerted a negative effect on the response variable when considering the intervention period as a whole, this effect is not statistically significant across the entire time period explored. Practically, we observed that immediately following the pandemic announcement, there appears to be a slight decline in new user registrations. This was then followed by a brief increase, however this change is not sustained over the remainder of the year following the cut point.

For H4, that *the events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) will be positively related to negative (vandalistic) contributions to the project*, during the post-intervention period, the response variable had an average value of approx. 10.28K. In the absence of an intervention, we would have expected an average response of 9.99K. The 95% interval of this counterfactual prediction is [8.73K, 11.33K]. Subtracting this prediction from the observed response yields an estimate of the causal effect the intervention had on the response variable. This effect is 0.29K with a 95% interval of [-1.05K, 1.55K]. Summing up the individual data

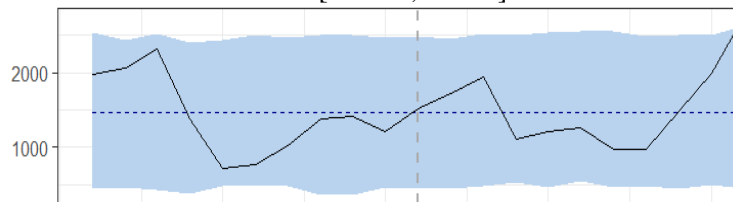
points during the post-intervention period (which can only sometimes be meaningfully interpreted), the response variable had an overall value of 102.81K. Had the intervention not taken place, we would have expected a sum of 99.90K. The 95% interval of this prediction is [87.34K, 113.27K].



**Figure 5: Amount of Vandalistic Activity Before and After the COVID-19 Pandemic Announcement**

The above results are given in terms of absolute numbers. In relative terms, the response variable showed an increase of +3%. The 95% interval of this percentage is [-10%, +15%]. This means that, although the intervention appears to have caused a positive effect, this effect is not statistically significant when considering the entire post-intervention period as a whole. Practically, we observed a decrease in the amount of vandalistic activity immediately following March 11th, 2020 was observed. This decrease is not sustained across the entire year following the announcement and there is no significant change in the amount of vandalistic activity detected across the entire period, shown in Figure 5 above.

For our final hypothesis, H5 *the events related to the COVID-19 pandemic (Such as quarantines, lockdowns, etc) will be positively associated with newly blocked accounts*, during the post-intervention period, the response variable had an average value of approx. 1.54K. In the absence of an intervention, we would have expected an average response of 1.47K. The 95% interval of this counterfactual prediction is [1.08K, 1.92K]. Subtracting this prediction from the observed response yields an estimate of the causal effect the intervention had on the response variable. This effect is 0.06K with a 95% interval of [-0.38K, 0.46K].



**Figure 6: Number of Blocked Users Before and After the COVID-19 Pandemic Announcement**

Summing up the individual data points during the post-intervention period, the response variable had an overall value of 15.37K. Had the intervention not taken place, we would have expected a sum of 14.72K. The 95% interval of this prediction is [10.78K, 19.16K]. The above results are given in terms of absolute numbers. In relative terms, the response variable showed increase of +4%. The 95% interval of this percentage is [-26%, +31%]. This means that, although it may look as though the intervention has exerted a positive effect on the response variable when considering the intervention period as a whole, this effect is not statistically significant. Practically, an immediate slight decrease in the number of blocked users is observed following the pandemic announcement, however this change is small and not sustained over the remainder of the year.

**DISCUSSION**

Of our five hypotheses, only H1 was supported. Despite the lack of support for H2-H5, observation of the data provides interesting results that warrant further exploration. In the case of H1 pertaining to contributions to the project, a statistically significant change was seen for the remainder of the year following the announcement, whether via registered or anonymous users. This is consistent with existing literature that shows that significant events result in a general increase in contributors and contributions to the project, and from this, many will contribute only for a short while but some will go on to be long term contributors (Zhu & Muchnik, 2020).

However, other ways users contribute to the project either positively or negatively, such as registering for accounts, performing administrative actions, being blocked, or performing vandalistic activities did not see statistically sustained trends over the period under investigation. In these remaining hypotheses which were not supported, small trends were visually observed immediately following the COVID-19 pandemic announcement, with slight decreases noted for hypotheses 2 through 5. While these results were not statistically significant across the time range investigated, this can occur when there is a lack of control variables or the time range investigated is too long, which we believe is the case here. Additionally, the short-term dips observed were in the opposite of our hypothesized direction. We interpret this to mean that users gained utility from making legitimate contributions to the core knowledge of the project via edits during the events that occurred during the COVID-19 Pandemic. However, negative activities such as vandalism and the associated blocking of accounts, while not statistically significant, visually showed immediate decreases in the time following the announcement. This may indicate that those performing negative activities no longer found the value they did prior to the announcement, however, eventually returned to normal levels of negative activity. The one surprising finding is that there was not an increase in administrative activities. As administrators represent users who have dedicated the significant time and effort to the project to gain community trust, and passed scrutiny during the Request for Adminship (RFA) election (Kreider & Kordzadeh, 2015), they would be the most familiar with what activities were available to be completed on Wikipedia. This finding could be the result of the data used as a surrogate measure for administrative actions on the project, performing activities related to article protection. Future research can and should explore the administrative contributions to the project more holistically. Even though H2-H5 were not statistically significant, we feel this is an area that warrants further investigation utilizing a smaller pre and post-intervention period.

## CONCLUSION

The Wikipedia project has been (and is still) an extremely successful project that relies on volunteers for success. Volunteers Contribute because it provides utility/satisfies a need and these needs are often related to concepts such as accomplishments, reputation and social the “utility” that Wikipedia provides can often be achieved via other mechanisms and COVID-19 disrupted much of this. Our research explores whether users increase contributions during such conditions, and the nature of those contributions. We found that immediately surrounding the date the WHO declared COVID-19 a pandemic, the data showed a visually observable short-term change in the traditional patterns of contributions to the project. In terms of contributions to the project, we found that this trend was maintained in the post intervention period and was statistically significant. However, despite the visually observable change pertaining to new user accounts, administrative actions, vandalism and blocked account, these were not found to be statistically significant when the remainder of the year following the COVID-19 pandemic announcement was considered. This is likely due to length of the timeframe explored post treatment. Future research could further explore this phenomenon using a smaller time frame to better understand the immediate effects of this type of event. Additionally, understanding how these types of events alter shorter term contribution patterns may open the door to better understand how to optimize these short-term changes in contribution patterns to better maintain the active contributor community Wikipedia needs to prevent following into information poverty and skewness (Zhu & Muchnik, 2020). This research has a several limitations. First, the post treatment period was selected to minimize significant extraneous events that resulted in outliers in the observations, specifically late 2020, early 2021. This time frame gave us 9 months of data to analyze, however, does not explicitly consider other known events that occurred within the time-frame that could provide a more accurate understanding. Additionally, several of the measures used were surrogate measures, such as number of protection actions performed by administrators. Administrative contributions to the project can be varied, and may not always be privileged actions such as page protections. Future research may look into how different categories of administrative contributions changed during the COVID-19 pandemic. Finally, this research only explores the English Wikipedia. As COVID-19 was a global event, understanding how different Wikipedia projects across languages and cultures changed during the COVID-19 pandemic is seen as a fruitful line of research that can shed light on how different cultures responded to the COVID-19 pandemic in the context of volunteer based communities such as Wikipedia.

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