Exploring Wikipedia: Identifying productive editor behavior in collaborative systems

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ABSTRACT

Wikipedia has been an incredible success story within the sphere of massive online collaborative systems, generating more than 3.8 million individual articles from more than 16 million registered users since its creation in 2001 [14]. Inherent with this explosion of information from such a broad spectrum of registered users is the increased complexity that comes with identifying productive behavior. In this study, we present a custom dashboard tool we designed to allow for the exploration of Wikipedia users throughout the life of the site, providing a mechanism to quantitatively distinguish behavior between Wikipedia's "elite" users, the administrators, and all other registered users. With this tool, named "WikiVis", Wikipedians can both explore editor behavior across the site as well as the relationships between editors, both to identify highest contributing or most productive users or even to identify the individual patterns of behavior that constitute how the most productive users interact with the site. Through this research, we show that it is possible for Wikipedians across broad levels of experience to distinguish between behaviors exhibited by administrators versus non-administrators, allowing for an immediate and objective evaluation of editor behaviors.

Categories and Subject Descriptors

H.5.2 [**Information Interfaces and Presentation**]: User Interfaces – *Evaluation/methodology*, *User-centered design.*

General Terms

Measurement, Design, Experimentation, Human Factors.

Keywords

Wikipedia, wiki, information visualization, user evaluation, social translucence, online communities, open source, collaboration.

1. INTRODUCTION

Wikipedia, once viewed as utilizing unconventional means of content creation, has become one of the most powerful and vast sources of information available to the greater public. One of the major affordances of Wikipedia is that due to its crowdsourced content, people from broad backgrounds and expertise are able to share professional knowledge and social experiences with others in the community. This sharing has bolstered Wikipedia as a valuable online encyclopedia that facilitates discourse, participation, and connectivity to grow the knowledge base.

Contributors to Wikipedia can be roughly separated into three groups. Wikipedia contributors typically fall into three categories: 1) Anonymous editors, or those who do not have registered accounts on Wikipedia. This group includes any individual who deigns to click the "Edit" link on any of Wikipedia's pages to contribute content or corrections. 2) Registered editors are those who have created a static Wikipedia account and may therefore edit under a uniform identity through time, as well as maintain a known presence with their User and User Talk pages - unique Wikipedia namespaces allowing individual editors to collaborate, question, or share information in a more informal setting. And 3), the final group represents a subset of Wikipedia editors, the administrators. To achieve administrator status on Wikipedia, editors are publicly nominated and then undergo a rigorous Request for Adminship (RfA) process, during which Wikipedian's may ask questions of the potential administrator to better inform communal judgment, as well as openly stating their support or opposition to the nomination [16].

Furthermore, Wikipedia pages are divided based on their purpose and allowance of tasks. The articles that the majority of users view utilize the Main *namespaces*. Attached to these articles are Talk namespaces where predominately power-users, editors and administrators are able to discuss, edit and organize viewable content. Lastly, the pages used for administrative tasks and greater organizational purposes are the Wikipedia namespaces [15]. Figure 1 below describes the complete list of namespaces available to the Wikipedia community.

While many consumers of Wikipedia content focus the entirety of their attentions on the Main (article)

Table 1: List of all Wikipedia namespaces and related IDs.

Wikipedia namespaces			
Basic namespaces		**Talk namespaces**	
0	Main	Talk	1
2	User	User talk	3
4	Wikipedia	Wikipedia talk	5
6	File	File talk	7
8	MediaWiki	MediaWiki talk	9
10	Template	Template talk	11
12	Help	Help talk	13
14	Category	Category talk	15
100	Portal	Portal talk	101
108	Book	Book talk	109
Virtual namespaces			
-1	Special		
-2	Media		

namespace, a broader and disparate spectrum of documents is less visible to the public, allowing for communication between editors, collaboration within topic areas, and providing fertile grounds for creating new content, and policy updates, conflict resolution and settling all manner of disputes that may arise as a result of attempting to collect all the worlds knowledge and disseminate it with a neutral point of view, despite that knowledge having been contributed by millions of users from a wide variety of socioeconomic backgrounds and education levels, and sporting interests as varied as the content within the encyclopedia itself. Considering the varied structure of the site supports the broad manner of collaboration required to create the encyclopedia, an individual's participation within the broad spectrum of namespaces has been shown to correlate positively with those more suitable for administrator privileges, as evidenced by successful RfA nominations [3]. This administrator-type behavior, comprised of contributions that span the entire Wikipedia spectrum, is indicative of those that are not simply creating content or correcting errors, but of users who are discussing topics with other users on their talk pages, of answering questions regarding questionable content asked on article talk pages; of contributing to discussions of Wikipedia policy that will shape the direction the site takes and the nature of the collaboration within it; of resolving conflict and highlighting cooperation to ensure that the neutral point of view so highly regarded is maintained across the broad spectrum of topics and users, and that the style and quality of information remains high and consistent across the entire site.

This introduction has highlighted some of the difficulties inherent in identifying and establishing productive behavior in a massive collaborative environment: allowing for the encouragement of expansive cooperative editing behavior while reducing the negative impact careless edits may have on the site, and facilitation of an open atmosphere where any reader can become an editor and any editor can become an administrator. Thus ensuring that the progression among those ranks is weighted fairly, equitably, and to the greatest benefit of the community as a whole. In the sections that follow we will continue with an overview of the relevant literature, a description of the process we took to design and build the WikiVis dashboard tool and the study design we used to test and validate our hypothesis, followed by an examination of our results and a discussion of implications and direction of future work.

2. LITERATURE REVIEW

Since content generation is not a requirement for using Wikipedia, it may often be overlooked that the created content can be the result of hundreds or thousands of edits on a particular page. There exists a large body of research dedicated to exploring both how collaboration within Wikipedia is executed and towards better understanding how that collaboration can be improved. Previous work by Veigas et al. [12] has visualized the creation of content on pages, showcasing the complex and often conflict-ridden space that results in the easily digestible text most users search for each day. Part of reducing this complexity and keeping Wikipedia organized as a community requires that contributing editors and administrators are vetted at different stages and levels of involvement in the Wikipedia community. Kittur et al. [8] found that with an increase of editors in Wikipedia, administrator involvement in edits decreased from 60% of total edits in 2002 to 10% of total edits in 2006 while actually increasing in the total number of edits per administrator throughout much of that time, highlighting the need for a greater number of administrators to continue to monitor and direct the Wikipedia community. Similarly, Burke and Kraut [3] detail the continued need for more administrators, focusing on the increased variety and sheer number of tasks that administrators are now responsible for due to the movement away from simple content editing given the overall expansion and popularity of Wikipedia. Edits continue to increase in Wikipedia, while a backlog of tasks that require administrator permissions also grows. The RfA process that editors are submitted to before administrator status is granted requires users to be evaluated in terms of how productive and positive they have been for the Wikipedia community. This process is vital to the sustainability of Wikipedia's accurate content and without proper assessment, a poor administrator risks tarnishing the credibility of Wikipedia and demotivating editors who now contribute much of the content on Wikipedia [3,8].

There have been several attempts to visualize behavior in Wikipedia as a collaborative system. Otjacque [11] utilized ellimaps to help answer to relevant questions about the cooperative authoring activities carried out on Wikipedia. Again, Veigas et al. made use of visualizations to

demystify the often convoluted and dense history of editing behavior that occurs on Wikipedia pages.

Beyond the practical considerations of this tool, it is pertinent to remind ourselves of the overarching nature of Wikipedia which requires open and transparent systems in order for the domain to continue to thrive. Social translucence encompasses both the idea that interactions between collaborative systems should be visible to all participants in order to aid and inspire future collaborative efforts, as well as the notion that said transparency of interactions will create feedback within the system, causing reflection, increasing participation, and improving accountability of individual actions within the group sphere [17]. The notion of social translucence typically applies to efforts to make *massive*, *online*, *collaborative* systems more open in terms of how content is created, maintained, and retired, with a direct focus on the connection between the content that is being created and the actual humans who are doing the work of creating it.

Within the realm of social translucence there is already a great amount of work clarifying the field and analyzing its potential contributions to online interactions. From the broader perspective of translucence in the larger online sphere [9], to the more directly related research within our specific problem area [4,5], there is currently much progress being made into the theoretical understanding regarding how we frame online collaboration in massive systems and how that collaboration can foster future development. In addition we have made significant strides towards improving the ways that the science of organizations can be better understood to create collaborative systems that are as close to self-sustaining as possible with an active and participatory user base.

The theoretical approach we aim to take with this project will be largely inductive, or interpretive, grounded in social transparency and collaborative work theory. Ultimately, our goal will be to provide an algorithmically defined and computationally supported inference, allowing primarily Wikipedia administrators, and to a lesser extent Wikipedia editors and consumers, the ability to draw previously unknown connections from the data they have always had access to but have yet to mine in a novel way that presents them with these alternative viewpoints.

2.1 WikiVis – Supporting Social Translucence

As a part of our study we observed that our participants utilized their professional backgrounds, and social experiences to determine if a user exhibited behaviors that supported approval for adminship. While the influences that are a part of this process warrant further examination, the participants' interaction with WikiVis provided a window for us to better visually represent and synthesize large datasets so that administrators can vet RfA candidates and so that editors and non-contributing members may clearly see the metrics that show the positive behaviors that transform a typical user into a contributing member within the Wiki community. WikiVis helps to

elucidate the behaviors of users within the broader Wikipedia ecosystem and the role that WikiVis can play in supporting collaboration, connectivity, and communication in the context of Human to Computer Interaction (HCI) and Human to Human Interaction (HHI).

Considering Wikipedia was created in 2001, the research of the behaviors within the Wikipedia community is quite nascent. In order to better understand how WikiVis can be positioned to support how Wikipedians work and interact within the digital system, our design was informed by Social Translucence research. Erickson & Kellogg [6] argued that there are three primary properties of the "real-world":

1. visibility
2. awareness
3. accountability

These properties are useful in the application of digital systems design to allow participants to make logical and tangible connections through their behaviors and interactions by making their activities visible. From our work we saw that WikiVis complies with the three foundational properties of social translucence in an effort to improve the Wikipedia knowledge base of editing behaviors and potentially influence the motivations of contributions through socially responsible communication and collaboration within this space. These properties can be used as our guiding principles to examine the effectiveness of WikiVis on codifying the crowdsourced editing behaviors within the Wikipedia domain.

2.1.1 Visibility
The four dashboard visualizations of WikiVis: scatterplot, line graph, spark graph, and arc graph, are clearly identified and present intuitive cues that support HCI. This clear visibility provides a multi-dimensional snapshot that is helpful for users, regardless of contribution level or background, to have a better understanding of Wikipedia and the impact of the interactions within the collaborative system.

2.1.2 Awareness
WikiVis promotes awareness for administrators, readers in unique ways. Administrators are more informed by viewing editing patterns of users over time and they can use the dimensions within WikiVis to establish benchmarks and inform the ways that RfA policies are governed and measured. Readers are provided with knowledge on the back-end Wikipedia structure and are provided with context that is beyond the user interface that they typically interact with. By knowing that if they choose to contribute to Wikipedia in the future they have a clear understanding that their editing behaviors may be examined, and they have a better understanding what that examination may entail.

2.1.3 Accountability
The property of accountability is particularly important for editors as WikiVis' metrics clearly distinguishes editors
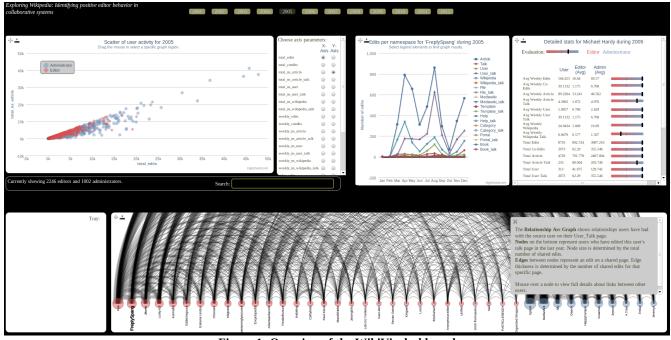
Figure 1: Overview of the WikiVis dashboard

that exhibit positive editing behaviors for adminship approval. While more research is needed to determine if WikiVis influences editing behaviors of users, we can deduce that WikiVis provides tangible information for editors that they may be held accountable for their editing behaviors and because their editing history is public and available to administrators.

3. TOOL DESIGN

In order for users to be able to accurately determine the editing behaviors of Wikipedians, we wanted to build a standalone tool that was both efficient and easy to use. Data was drawn directly from the back-end Wikipedia tool server as well as from a custom built index comprised of

1,438 administrators and 8,944 non-administrator Wikipedia editors. We employed a dashboard view which would allow the users to view and manipulate several aspects of user behavior at once. The interactive dashboard includes a total of four separate interactive graphs in the initial view for the user to see: a scatter plot, a line graph, an arc graph, a spark graph and a tray for saving particular visualizations. An overview of our tool can be seen in Figure 1 above.
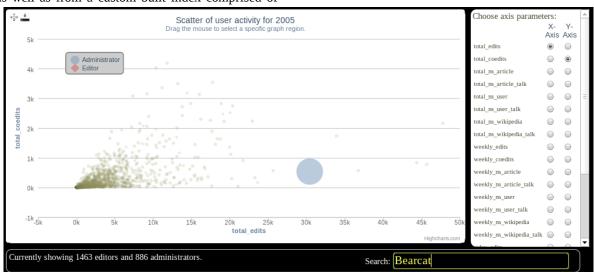

Figure 2: Scatter plot detail. Search terms highlight user in graph within the context of other users. Selecting different axis from the radio buttons on the right will re-draw the graph.
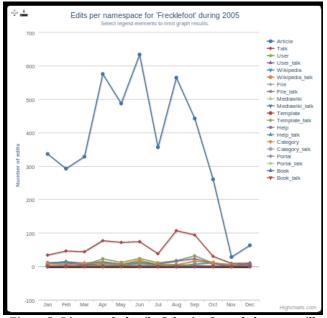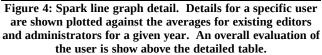
Figure 3: Line graph detail. Selecting legend elements will cause individual lines (representing edits within each namespace) to appear or disappear, and the graph to re-draw to the appropriate scale.

Figure 4: Spark line graph detail. Details for a specific user are shown plotted against the averages for existing editors and administrators for a given year. An overall evaluation of the user is show above the detailed table.

3.1 Scatter plot

The scatter plot is meant for initial exploration of Wikipedia editors. It allows one to see the differences in Wikipedia editors and administrators among a number of different customizable axes. Among these customizations includes looking at users' total edits, total coedits, total articles read, total Talk articles, etc. This plot is meant to be a way to see where an editor is situated among the Wikipedia population of that year based on your choice of criteria. In order to facilitate finding a user within the plot, a search bar has been added, which will identify the user name entered into the search bar (Figure 2). Once the search is complete a larger dot will appear over the identified user allowing for one to not only see where they
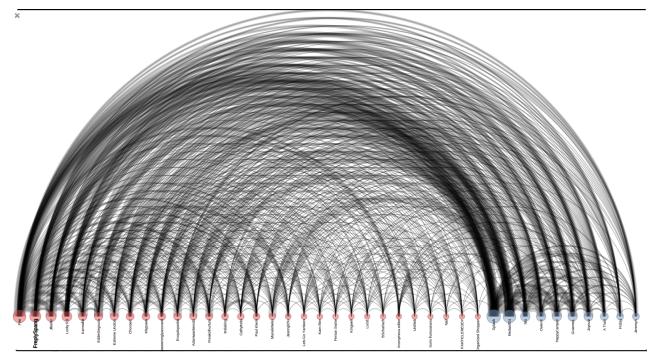

Figure 5: Maximized view of the arc graph relationship detail. Node size is determined by total number of edits for that year, edge size is determined by the total number of shared edits. Mousing over a node brings up detail of each page edited for that user, along with all other users who had similar edits for each page.

MacGyverMagic
   Pages edited:
     Wikipedia:Categories_for_discussion: 8 edits
       Also edited by: Instantnood, Grutness, Juntung, Jiang, Mel Etitis, MacGyverMagic
     Wikipedia:Templates_for_discussion: 18 edits
       Also edited by: Instantnood, Grutness, Water Bottle, Juntung, Trevor MacInnis, Stevage, King of Hearts (old account 2), OldakQuill, FreplySpang, Mysid, Falphin, Rd232, Jiang, Mav, Mel Etitis, SGCommand, MacGyverMagic
     Wikipedia:In_the_news/Candidates: 7 edits
       Also edited by: Instantnood, Pradeepsomani, MacGyverMagic
     Wikipedia:Administrators'_noticeboard/Incidents: 203 edits
       Also edited by: Instantnood, Grutness, Woohookitty, FreplySpang, Formeruser-81, Jmabel, Mel Etitis, MacGyverMagic
     Wikipedia:Requests_for_page_protection: 15 edits
       Also edited by: Instantnood, Woohookitty, Jiang, King of Hearts, Formeruser-81, Mel Etitis, MacGyverMagic
     Wikipedia:Copyright_problems: 36 edits
       Also edited by: Dlyons493, Trevor MacInnis, Woohookitty, FreplySpang, Mysid, Jmabel, Mav, Mel Etitis, MacGyverMagic
     Wikipedia:Files_for_deletion: 8 edits

Figure 6: Detail of the relationship arc tooltip. Detail for all edge relationships for a given user are included, as well as links to users in the arc graph.

are as reference within the larger group of Wikipedians, but also allow for one to click on the user simultaneously updating that users results for the rest of the graphs in the dashboard.

3.2   Line Graph
The line graph is specifically situated to the selected Wikipedian and allows for the user to see which the amount of edits made by this user on each namespace over the course of the selected year (Figure 3). In short, this graph allows for the user to see in what areas of Wikipedia the user most participates in when editing. Within this line graph our tools allows for users to de-select topics not of current interest to them enabling them to focus on the more important editing habits of the user. As described above, Wikipedia editors whose contributions span the broad array of namespaces that make up the site are generally seen to more positively correlate with administrator behavior [3], therefore the ability to quickly

and clearly distinguish between namespace edits remains central to determining an editor's administrator potential.

3.3   Spark Line Details
When building this visualization we wanted the user to be able to explore the data, as he or she has been able to with the last three graphs, but we also wanted to designate a recommendation to the user of the Wikipedian's eligibility for adminship. The spark graph in Figure 4 is the area where we provide overall recommendation of the user. Within this graph we allow the user to see the Wikipedians' individual behavior plotted again the averages of both editors and administrators for various actions (edits, co-edits, etc). In the top left of the graph we also have an overall average indicating whether or not the user's activity falls along the lines of an editor, or an administrator.

3.4   Arc Graph
Like the line graph, the arc graph is also situated to the Wikipedian initially selected from the scatter plot, but still includes other users that that Wikipedians may have interacted with (Figure 5). The goal of the arc graph is to showcase the relationships between the individual Wikipedians and other Wikipedians. The selected Wikipedian is highlighted in bold; the line thickness represents the number of shared edits between users and the node size equals the number of shared edits per node. If one were to mouse over one of the nodes, a separate visual display would pop up listing all of the pages edited by the user and the other users that have also edited the page (figure 6). The detailed relationship view allows a user of WikiVis to explore *exactly* what each of the arcs in the graphs represent – the number of edits on each page, along with the number of edits each related user has made on that page along with all other shared edits. This detail-on-demand allows a WikiVis user to determine fairly quickly where individual users spend most of their time editing, and who they do it with.
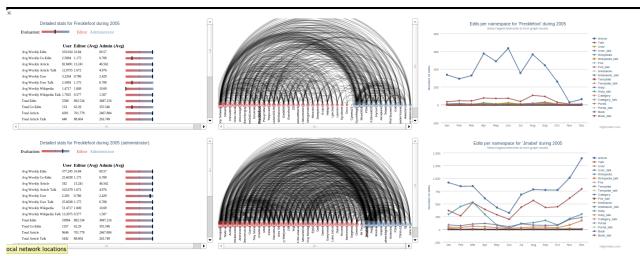

Figure 7: Detail of trellis display. Adding items to the tray allows users to both save them for later as well as view them side by side for easier comparison. All graphs within the trellis display remain interactive.

3.5 Additional Features

Along with these graphs, we have included some extra features for ease of use around the whole dashboard. At the top of the dashboard we provide a list of years to allow the user to easily change the time they wish to view by clicking on one of the options. Each graph also has two icons located in the top left corner of the graph: a maximize icon and a tray icon. The maximize icon allows the user to expand any graph to the size of the full screen. Thus if a user wants to be able to see the graph better they have the option of enlarging it. An example of a maximized graph is the relationship arc diagram shown in Figure 5. Right next to the maximize icon is the tray icon which, when selected, places items in the tray, described further below.

3.5.1 Tray

The tray is the box in the bottom left corner of the dashboard. It is meant to be an easy way to save graphs so that they can be viewed at a later date. When the tray icon is clicked, that particular graph will be placed in the tray with a label that includes what style of graph it is, the year of the graph and the user name. Thus when the user has moved on from the graph, they can easily come back to it by clicking this box in the tray. The tray itself has two capabilities which can be accessed in the top left corner of the tray box. The second icon, signified by a trash canister, allows the user to empty the tray of all its contents. The first icon, the four boxes, allow the users to see all of the graphs within the tray in a side by side full screen view (Figure 7). This allows the users to easily see all of the graphs that they have found to be significant enough to save side by side in a trellis display.

4. USABILITY STUDY DESIGN

4.1 Usability Test

The goal of our usability test, which served as a pilot study, was first, to observe how study participants interfaced with WikiVis and pinpoint areas or pain-points where functionality could be improved, second, to gain insights relating to how scope and presentation of information on WikiVis could be altered for better knowledge acquisition, and third, to observe and understand the interactions and motivations of our particular study participants.

4.2 Protocols

The study was conducted in compliance with University of Washington (UW) Institutional Review Board (IRB) committee guidelines. The UW Human Subjects Review Committee documentation included an application that details the background and purpose of the research, procedures, subject information, and confidentiality of data. In addition we submitted protocols that outlined the pre and post testing procedures, the user test protocol, and the consent form that each participant received at the onset of each research activity.

The study consisted of three primary tasks:

1. A pre-test survey to reaffirm participant suitability for the usability test
2. A scenario designed to lead them through choosing of an administrator and
3. A post-task survey to garner participant reflections on their process and the tool itself

4.3 Participants

Our study consisted of three male participants (n=3) with variable backgrounds. Participant A participated in Wikipedia as researcher and editor with six and fours years of experience, respectively; Participant B as a power-user with ten years of experience; and Participant C is an editor with three years of experience and five years of Wikipedia readership. Participants were recruited through personal networks and requested to be, at minimum, a power-user in the Wikipedia community.

4.4 User Scenario

All testing was conducted within the HCDE PhD shared research lab and each participant utilized the same terminal for each test. Before starting the usability test, each participant was instructed to review the consent template before agreeing to participate in the test. The facilitator provided a 3-5 minute overview of the testing procedures, and the dashboard tool (feature set, panels, etc.) before the participants were allowed to begin the user tasks. The remaining observers took notes during each task. The participants were allowed to ask questions at any point during the test and would think-aloud through the process. The overarching user-task consisted of a user scenario where they were asked to use our interactive dashboard to explore three users in a mock RfA decision process, recommending one of the users for administrator status at the end of the test. The participants were given a series of ten steps, to complete if necessary, to guide their exploration of WikiVis.

The three users chosen for our study participants to explore were selected based upon the median number of total edits amongst all indexed users from 2011. While each of the users had similar characteristics, including an almost identical total number of edits for the year, the first user selected was a current Wikipedia administrator while the following two where merely registered users. The fact that one of the users was a current administrator was hidden from the test participants, so testers had to rely solely on the information available from the WikiVis tool to determine their choice of which of the three test users would be most suitable for a request for adminship. And given that all three users had a nearly identical number of total edits, the user most likely to be the best administrator candidate should not have been an obvious choice.

5. RESULTS

Our sample of participants represented broad perspectives as their level of use ranged from non-contributing consumers of Wikipedia content to editors with 4 years of

experience. Through the use of our dashboard, each participant was able to effectively complete our user test and select the correct user from our scenario for RfA approval – the one user who was actually a Wikipedia administrator, masquerading as a non-administrator – despite all three of the editors given to select from having nearly identical edit counts from the selected year. And even though each participant selected the correct user within the scenario, each participant utilized their own approaches to reach their final decision. This was surprising in some respects due to the fact that the participants' decision making process began from very different starting points regarding an understanding of what behaviors may be suitable for current and future Wikipedia administrators. Through exploration of the WikiVis tool even participants who were not previously aware of the specific nature of how a Wikipedia administrator may interact with the system were able to glean that knowledge and accurately select the correct user in the test.

The insights that were derived from the usability study have supported design improvements for future iterations of WikiVis and have also provided new areas of research for future exploration and study. The core set of recommendations from our research activity can be grouped into the quality components of usability: utility, learnability, efficiency, memorability, errors, and satisfaction. As Nielson stated [8], usability is not a singular, one-dimensional property of a given user interface. By viewing usability through the quality components, we are positioned to better measure, understand, and define the abstract concept of usability with systematic precision.

5.1   Utility
Utility and function of the WikiVis design are intertwined and for our study our research team sought to utilize the user scenario with the "think-aloud" approach to ascertain if the WikiVis feature set supported the achievement of end-user goals. Some of the key concerns articulated were:

1. Legibility of the legends on the visualization graphs needed improvement
2. The relationships within the scatter plot that supported zooming in and out of Wikipedia users difficult to see and access
3. The results in the arc graph that are yielded from the user search needed to be more clearly highlighted
4. The spark graph needed to be 'trayable' so that users

The users noted that the tray feature was extremely useful as it supported the storing and comparison of multiple data points by user and supported comparison of data points across different users. It was also noted that the line graph and spark graph were useful tools for informing RfA decisions because the line graph showed user editing trends across multiple namespaces and the statistical

metrics within the spark graph provide clear quantitative measures for normalizing numbers for comparison. The spark graph was the only visualization that was not trayable in our visualization. All participants desired this to be trayable as it provided an overall look at the user in relation to the specifics gained from other visualizations.

Overall, the participants wanted the legends for each of the graphs to be more clear in organization and graphic representation. This was of particular need in the spark graph. Need for improvement in the clarity of relationships in the scatter plot was also state as the relationships were said to be too difficult to see. Finally, the user in the arc graph need to be highlighted for the study participant to easier see who and what they were comparing. All of the utility recommendations were considered and have been incorporated in the design of WikiVis version 2.0 for further usability testing.

5.2   Learnability
In the examination of learnability, we wanted to glean an understanding of WikiVis' ability to help the users to accomplish basic tasks once they first encountered the dashboard design. First, the transitions between searching for individual users needed to be easier to see. Between searchers the identified users was always repositioned to the center, making it seem as though nothing had been changed. Participants also requested improving transitions between the years of data for Wikipedia as it was quite clunky.

5.3   Efficiency
To address the efficiency of WikiVis, we sought to understand how quickly participants performed tasks once they learned the dashboard design. For all participants, the arc graph was most difficult to understand and use. This was seen in both observations and in direction quotation from the participants. Thus making a need for it to be explicit in use and meaning. In addition, as result of our study we improved upon the search feature to reduce application lag that was a by product of the 'search as you type' feature.

5.4   Memorability
While this study did not fully support exploration into the memorability aspects of WikiVis, we are interested in gaining a better understanding of how casual user might remember how WikiVis functions and how the same user might retain proficiency in its usage over time. To this end it was noted my one participant that the method of search within WikiVis required that the participant remind himself how to search each time. It was also suggested that the use of the search feature could be a bit cumbersome if it is a minimal use tool for a casual user but may not be problematic for an administrator or power user that uses the dashboard on a recursive basis.

5.5   Errors
During the plenary design process, our design team sought to iteratively test WikiVis as new features were included

within the dashboard. Testing was also done to examine browser compatibility, to identify potential resolution issues when viewing on different devices e.g. projectors, monitors and tablets, and timing tests were run as the generation of the data visualizations was heavily reliant upon the ability to query the Wikipedia back-end tool server in real time to populate results quickly. This process of formative testing and assessment helped to eliminate many of the potential user pain points. One error encountered during user testing was the inability of the WikiVis tray to maintain its state through browser reloads, requiring some users to tray the graphics more than once in order to view the comparative data points. This issue was resolved in later iterations of the tool's development.

5.6 Satisfaction

From our usability study we found that our participants not only all decided on the correct user, but also enjoyed using the tool as well for task-based and exploratory purposes. Thus, we have a tool that appears to usable by a range of users and also something that participants can both utilize and learn from. Overall the participants stated they enjoyed using the tool, and liked the aggregate, birds' eye view of the data. One participant stating, "You have a tool that is awesome and I definitely can see it is something that Wikipedians will want to use."

6. CONCLUSION

As stated, one of the primary findings from out usability study is that participants were able to learn to use this tool from a variety of backgrounds. Even our participant with no previous Wikipedia editing experience, with no functional knowledge of what an administrator really does or what they should be doing, was able to put together observations and recognize patterns in the data to create a picture of what an administrator may look like compared to the other choices provided to him. Moreover, this could also potentially lead to more streamlined usage for administrators who know what to look for, and could quickly tray the items that are most related to productive behavior in Wikipedia. This direction was also shown in our usability tests, as current editors were searching for what they knew about productive conduct for administrators in the Wikipedia community.

Wikipedia is growing at an astronomical rate, and if that growth is to be continued and managed in a productive way, if content on the site is to remain consistent, informative, reliable, and unbiased, there must remain a class of Wikipedians capable of tending to administrative duties and ensuring that quality of content. Kittur, et al, showed that, while the number of administrator edits in Wikipedia grew from less than 10,000 in 2002 to 700,000 in 2006, the *percentage* of administrator edits compared to total edits dropped from almost 60% in 2002 to about 10% in 2006 [6]. While that change may be attributed to decreased reliance on administrator provided content as a result of a vast increase in low-contributor content, as the previous work has shown, there will still be an ever-increasing need to ensure that new Wikipedians,

regardless of their contribution levels, are contributing in a manner that most benefits the larger Wikipedia community, and that more experienced Wikipedians are promoted to administrator to ensure that constant balance through incredible growth. WikiVis, we feel, provides a novel and unique means of differentiating between that productive and unproductive behavior, acting both as a learning tool for new editors and an evaluation interface for experienced administrators, and could therefore be a valuable contribution towards maintaining a healthy and thriving Wikipedia community.

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