Managing complexity: Strategies for group awareness and coordinated action in Wikipedia

Michael Gilbert, Jonathan T. Morgan,
David W. McDonald, Mark Zachry
University of Washington
{mdg, jmo25, dwmc, zachry} @uw.edu

ABSTRACT

In online groups, increasing explicit coordination can increase group cohesion and member productivity. On Wikipedia, groups called WikiProjects employ a variety of explicit coordination mechanisms to motivate and structure member contribution, with the goal of creating and improving articles related to particular topics. However, while explicit coordination works well for coordinating article-level actions, coordinating group tasks and tracking progress towards group goals that involve tracking hundreds or thousands of articles over time requires different coordination strategies.

To lower the coordination cost of monitoring and task-routing, WikiProjects centralize coordination activity on WikiProject pages – "micro-sites" that provide a centralized repository of project tools, tasks and targets, and discussion for explicit group coordination. These tools can facilitate shared awareness of member and non-member editing activity on articles that the project cares about. However, whether these tools are as effective at motivating members as explicit coordination, and whether they elicit the same kind of contributions, has not been studied. In this study, we examine one such tool, Hot Articles, and compare its effect on the editing behavior of WikiProject members with a more common, explicit coordination mechanism: making edit requests on the project talk page.

Categories and Subject Descriptors

H.5.3. Information Interfaces and Presentation (e.g., HCI): Group and organization interfaces.

General Terms

Human Factors; Design; Measurement

Keywords

Wikipedia; WikiProjects; Hot Articles; ambient awareness; awareness tools

1. INTRODUCTION

Joey is a bona fide Football hooligan. In the months leading up to the World Cup he has been pouring his energy into every aspect of Football in Wikipedia. But still, there is more work than Joey can complete. He contributes on the talk pages, but how can Joey maintain awareness of the efforts of the distributed team?

In many collaborations, understanding where team efforts are focused and maintaining awareness of the other team members' activities is difficult. Shared awareness is realized through information sharing, common knowledge of group and individual activities, and coordination [4]. Such awareness provides a contextual frame in which individual actors make relevant contributions to the activities of other group members.

Wikipedia includes a variety of means for individuals to affiliate and self-identify with others or with specific topics or goals. One of these mechanisms is WikiProjects. A WikiProject is a page in Wikipedia (distinct from a general article page), facilitating shared collaboration by providing access to project tools, tasks and targets, as well as discussions explicitly focused on group coordination. For a WikiProject, tools can facilitate shared awareness of member and non-member activity alike. How the awareness provided by these tools might motivate and frame project member activities has not been studied.

Like many aspects of Wikipedia the WikiProject Talk pages are an important place for project members and non-members to communicate with each other. By reviewing the project talk page an editor can get a better sense of what other project members are doing. But, naturally, the project talk page cannot provide a complete picture of all project activity.

Several WikiProjects have adopted the "Hot Articles" tool that maintains a ranked list of articles claimed by the project that are experiencing frequent editing activity. The Hot Articles tool is placed on a WikiProject's main page, providing some awareness of the active content most related to the specific WikiProject. But like explicit requests on talk pages, the Hot Articles tool accounts for only a portion of the potential shared group awareness among participants in the overall system. This paper considers how two of these different awareness mechanisms, Hot Articles and WikiProject talk page requests, influence project members' activity.

In the sections that follow we outline the related work, introduce our analysis, and then present our study methods, results, and discussion. We conclude with future work which can be motivated by the current research.

2. TWO KEY AWARENESS MECHANISMS IN WIKIPROJECTS

Understanding awareness has been a long running theme in studies of groups and technologies that support group work. Early work on awareness in the workplace [4] identified key factors that support awareness and argued for understanding awareness as the context that frames the actions of the individual. Individuals maintain awareness in multiple, varied ways. Both [13] and [19] identified means in which activity in social networks may impact *ambient awareness* of one's own context, defined as the ability to maintain weak ties or to infer status through incremental updates in social networks. This ambient awareness provides a lens to more effectively evaluate tools intended to keep group members apprised of project status within voluntary virtual teams.

Research has been conducted on attempts to automate coordination in Wikipedia through the use of bots [3], to increase directed contribution through project member mediated tools [20], to explore how task lists may facilitate the distributed activities of teams of editors [11], and to better understand or visualize conflict in collaborative spaces [1,8,15]. However, there has not been focused research on the potential effects of using automated project-wide tools to increase group awareness by facilitating ambient information exchange.

For this current work, we are focusing on two mechanisms for increasing awareness of activity within the scope of WikiProjects. First, the Hot Articles tool provides project members with a means of both quickly identifying what article pages associated with the project are being edited most frequently as well as providing a high level view of overall project activity. Conversely, article links in posts to project talk pages typically represent an explicit request for some type of action by those affiliated with the project, thereby increasing community awareness of project needs.

In this study we analyze Hot Articles (Figure 1), a tool that provides a simple visualization of the most frequently edited articles within a WikiProject's scope. We investigate whether articles listed on the Hot Articles page elicit more editing contributions than articles mentioned in explicit request for participation on the project's talk page.

3. RESEARCH HYPOTHESES

This current research has been driven by three primary hypotheses, informed by previous research on awareness and online group collaboration. First, as awareness of project member activity on specific articles is increased through that activity being made explicit via the Hot Articles tool, we suggest that an articles' listing via the Hot Articles tool will result in an increased number of total edits by project members. Hypothesis 1a: A*mbient awareness of project activity mediated by project page updates by the Hot Articles tool will increase the total number of edits by project members to the articles linked.* Similarly, we suggest that in addition to total edits, project member awareness of articles attracting the greatest number of edits in the project will lead to a higher number of unique project members who edit the articles that have been linked to – Hypothesis 1b: *Articles listed by the Hot Articles tool will increase the number of unique project members that edit them.*

Second, as previously stated, WikiProject talk pages are frequently a location where coordination work occurs as individual project members post questions about specific articles, seek opinions about ongoing efforts, or ask for assistance with future updates. Given this accepted and active platform for work coordination, we suggest that an article link included in a project talk page discussion post will direct project member efforts toward that article. And to the extent that the linked article was explicitly posted to the project's talk page, we further suggest that the attention paid to that article will be greater than that seen following an article being linked to by the Hot Articles tool – Hypothesis 2a: *Explicit requests to edit articles on project talk pages will elicit more editing activity by project members than those articles presented in an ambient*

Figure 1: The Hot Articles page as it would appear on WikiProject pages that subscribe to the tool. Shown above are pages as ranked on WikiProject Feminism (left) and WikiProject Cats (right).

awareness tool like Hot Articles, measured by total edits by project members to pages linked to on the project talk page. Similarly, we suggest that explicit requests on the project page will direct a greater amount of attention by unique project members to the articles listed – Hypothesis 2b: *Explicit links to articles from a project's talk page will result in an increase in the number of unique editors who edit the articles linked.*

And finally, as previous research has shown how group identification and common bonds with other group members can increase contributions by members [10,12], we suggest that both of the previous hypotheses will be more significant for project members than non-members – Hypothesis 3: *Both H1a & b and H2a & b will be more pronounced for project members than non-project members.*

4. METHOD

One of the primary goals of our study was to evaluate the effectiveness of an automated tool in coordinating the actions of distributed contributors in a massive online system – Wikipedia. To do so, we collected and indexed the complete revision history of every article linked to in a Hot Articles page update for 90 days prior to and 90 days following the activation of the Hot Articles bot for each of the seven projects listed in Figure 2. The 90 day period before and after the Hot Articles bot was activated was chosen to allow us to directly compare within projects the potential effect that such a bot may have on the contributions of project members both before and after the activation date, allowing us to more definitively distinguish between potential confounds. Specifically, we hoped to be able to show that the top 5 articles edited for a period of time would exhibit unique characteristics in the 90 days prior to the bot being activated (the "pseudo" period), when the true state of which articles are currently seeing lots of activity would not be known to project members, and the 90 days following the bot being activated (the "ha" period), when project members could easily ascertain the most highly active articles by simply viewing the project page, facilitating ambient awareness of project state through passive consumption of the project page contents.

4.1 Data Collection

Project details and all pages owned by each project were collected and locally indexed using the Wikipedia Release Version Tools[1]. This data collection yielded a total of 9,961 pages claimed between the seven WikiProjects under analysis, with the minimum number of pages belonging to WikiProject_Cue_sports (818 pages), the maximum belonging to WikiProject_Statistics (2,379 pages), with a mean of 1,423 and median of 1,158 pages per project.
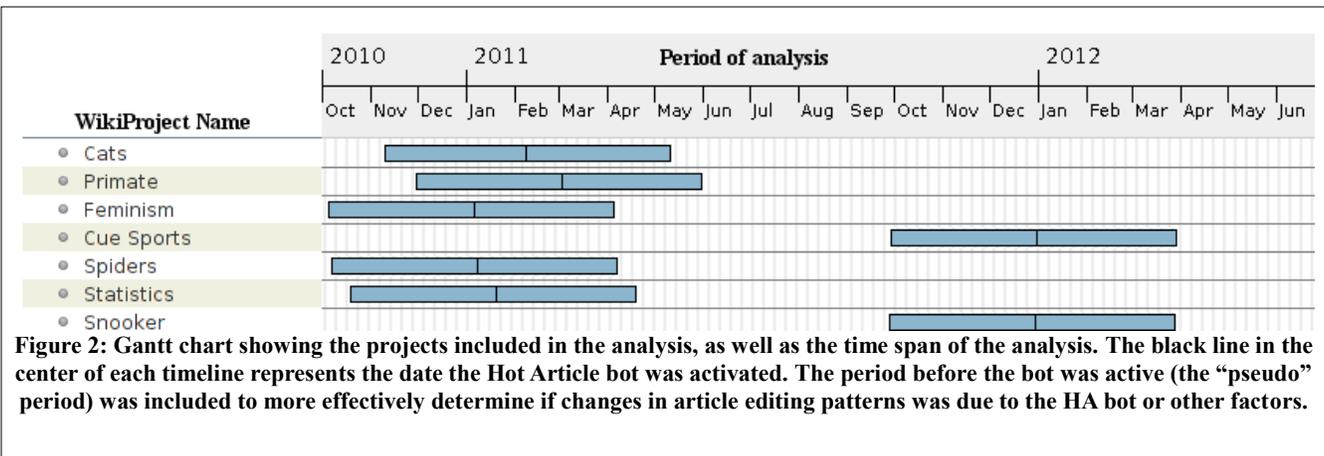
The data collected for H1a & b includes all revisions to the Hot Articles pages for seven WikiProjects (Figure 2), representing all projects that had subscribed to the Hot Articles bot for at least 90 days before the primary data collection period in September of 2012. Each revision represents an automated update to the Hot Articles page for the given project, and will include the list of the top pages for that project as determined by the edit counts over the last seven days. For each page linked to by the Hot Articles bot, edit counts and unique editors were recorded for the seven days prior to and following that link being posted.

Data collected for H2a & b includes all revisions to project talk pages for each of the seven projects under analysis: WikiProject Cue Sports (a project overseeing the varied articles related to sports played with a cue, including 818 article pages); WikiProject Cats (containing articles related to cat breeds, feline disease, and related topics, including 984 article pages); WikiProject Snooker (a cue sport demanding enough attention from editors to deserve its own project, including 1153 article pages); WikiProject Primates (including 1158 article pages related to primates); WikiProject Feminism (including 1455 articles related to feminism, feminist figures and history); WikiProject Spiders (including 2014 articles); and WikiProject Statistics (including 2379 articles regarding statistics, including its history and its practice).

For each post to a project talk page, the actual text posted was parsed to find links to pages belonging to that project. Identified links were similarly indexed to determine the total edit counts and total unique editors that modified that page in the seven days prior to and the seven days following that link being posted. All edits and editors recorded were differentiated by project membership status for that point in time, allowing for a more granular analysis of explicit project membership's impact on project related contributions. The seven day period before and after the link was posted for both the Hot Article and Talk page analysis was selected to determine to what extent the posted link had on the editing behaviors of team members. Data was collected directly from Wikipedia Toolserver[2], allowing full access to the complete revision history to all articles under the purview of the projects under study.

Project members were defined as any editor who added his or her user link to a main project page (e.g., WikiProject Cats) as well as to any other direct descendant of that main project (e.g., WikiProject Cats/Members). If that link was removed at any time

Figure 2: Gantt chart showing the projects included in the analysis, as well as the time span of the analysis. The black line in the center of each timeline represents the date the Hot Article bot was activated. The period before the bot was active (the "pseudo" period) was included to more effectively determine if changes in article editing patterns was due to the HA bot or other factors.

---

1   http://toolserver.org/~enwp10/

2   http://toolserver.org/

between the date that it was added and the current date during the analysis period, membership was assumed to still exist if that user made any edits to the project page during that current analysis period for the current month. All project membership was broken down by month so that granularity of membership could be maintained over the life of each WikiProject. In other words, if User A added her name to WikiProject Cats during month 20 and removed it in month 24, she would be considered a member of that project between the months 20 through 24, inclusive. If she then made edits to the project or project talk pages in months 26 and 28, she would be assumed to be a member for months 20 – 24, 26, and 28, but not for months in which the user link was not present or no edits were made to project pages. If she never added a user link to the project page but still made edits to it, she would not be considered a member of that project. The decision to rely on *explicit* declarations of membership as opposed to *de facto* definitions of membership (in other words, editors active within the project space) was made to more directly qualify the types of members expected to be most actively involved in the maintenance and editing of project and related article pages. These distinctions within project membership allowed us a level of detail with regard to analysis of member versus non-member activity that was required for the subtle types of behavioral distinctions we sought to uncover.

4.2 Analysis

To test H1, revisions to the top five most edited articles were recorded for the 90 day period preceding activating the Hot Articles bot to 90 days following the bot's activation, allowing us to analyze editing activity before Hot Articles was activated to provide a baseline for comparison. Edits to the top five articles for each project were calculated on a rolling seven day average (three days in the case of Cue sports), matching the revision information that would have been displayed by the Hot Articles bot on each of the project pages. For each of the articles listed by the Hot Articles bot during the analysis period, we recorded all revisions for the seven days prior to and following that article's listing (again, with three days in the case of Cue sports to match the data recorded and displayed by the actual Hot Articles page), distinguishing between edits by project members and non project members to inform analysis for H3.

For H1, collected measurements included 1,152 updates to the Hot Articles pages by the Hot Articles bot across all seven projects, yielding a total of 5,760 links to article pages during the analysis period. A total of 43,138 editors edited one of the articles listed in the Hot Articles page in the seven days prior to or following being listed, for a total of 193,523 total revisions recorded during the analysis periods for all projects.

To test H2, we collected all revisions to the project talk pages for each of the above projects during the 90 day analysis period following the launch of the Hot Articles bot. As stated above, a project's talk page is where much of the coordination work typically takes places, with editors discussing issues relevant to the status of the project, including requests to coordinate work activity. For each of these revisions to the project talk pages, the actual text of the revision was analyzed for links to any article pages claimed by that project, a pattern frequently followed when an editor wishes to direct attention to a specific article within the project. Edit counts were then recorded for each of the articles linked to in the project talk page, once again for the seven days prior to and following the link being posted (three days in the case of Cue sports to maintain parity with the earlier analysis), again distinguishing between edits by project members and non project members.

Data collection for H2 yielded 579 revisions to project talk pages across all projects, with 701 editors editing a page linked to in a talk page revision that was a member of the current project in the seven days prior to or following that link being posted, for a total of 2,018 total revisions recorded during the analysis periods for all projects.

5. RESULTS

The results of our analysis, summarized in Figures 3 through 6, are split by hypothesis and described below.
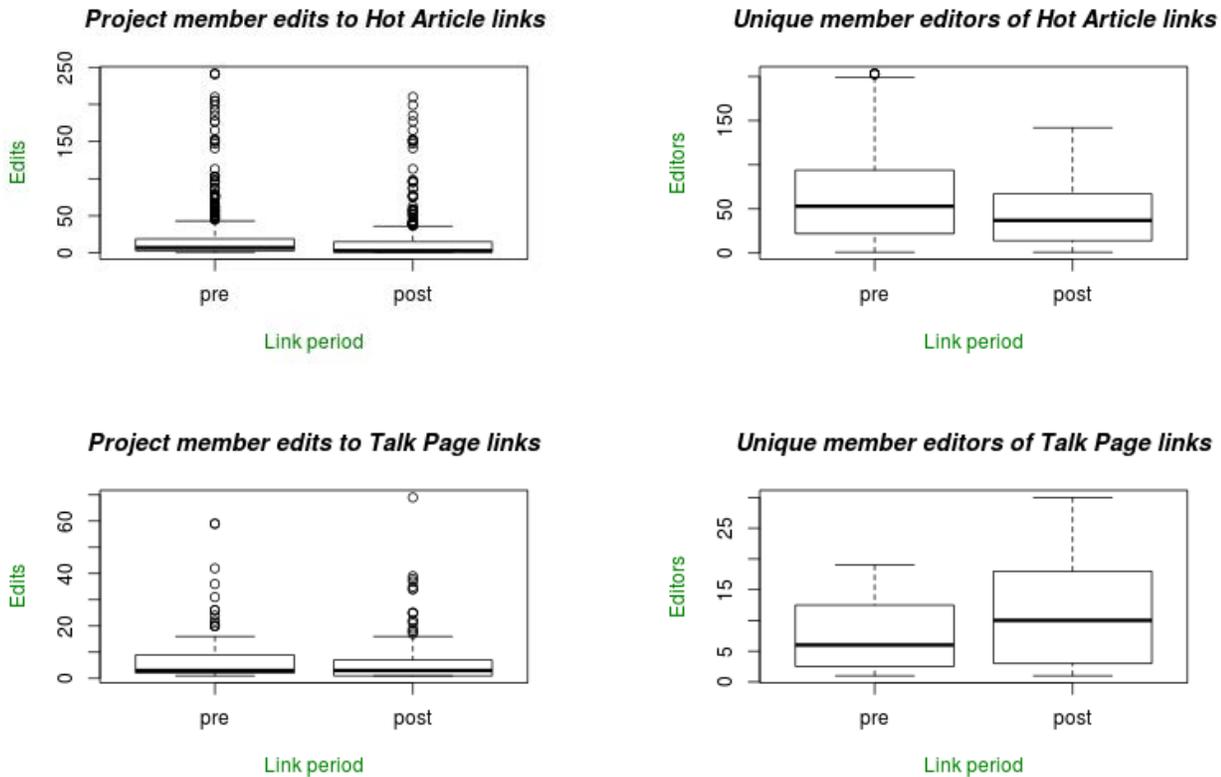
Hypothesis 1a: *Ambient awareness of project activity through automated updates to the Hot Articles page will increase the total number of edits by project members to the pages linked.*

To test this hypothesis, we compared edits to articles linked by the Hot Articles bot by project members in the seven days (or three, in the case of Cue Sports) immediately preceding and following the link being added to the Hot Articles list for each project. A two group t-test comparing project member edits to Hot Article links in the period before and after a link was posted to the Hot Articles list showed that the Hot Articles link had a marginally significant impact on the total number of edits by project members to the linked pages (t=-1.8243, df=911.616, p=.06843). A two group t-test comparing project member edits to articles listed by the Hot Articles tool in the pseudo condition (the 90 days prior to the date the Hot Articles bot was actually activated) with member edits to articles in the active condition (the 90 days following the activation of the Hot Articles bot) for the seven day period following a page achieving Hot Article status (the post period) was not significant (t=-1.5143, df=739.583, p-value=0.1304). Edit counts in the pseudo and active conditions exhibited similar editing patterns, indicating that the links placed on the project page in a Hot Articles list did not have a significant impact on the total edit counts to linked articles by project members.

Hypothesis 1b: *Ambient awareness of project activity through automated updates to the Hot Articles page will increase the number of unique project members that edit the pages linked.*

To test this hypothesis, we compared the total number of unique project member editors in the seven days immediately preceding and following the link being added to the Hot Articles list. A two group t-test comparing unique project members editing linked Hot Articles lists showed that the Hot Articles link was significant, but not in the hypothesized direction (t=7.1569, df=1128.142, p=1.484e-12, mean unique editors before the link was posted: 65.15881, mean unique editors after the link was posted: 46.32947), indicating that there are generally a greater number of unique project member editors *before* an article is posted to the Hot Articles list than after. A two group t-test comparing unique project member editors in the pseudo condition versus the active condition in the seven days following a link being posted was also not significant (t=0.1207, df=819.84, p=0.904).

Prior to an article reaching Hot Article status, it would be expected that its total edit counts and unique editors may shoot up and then regress to the mean shortly after being posted (or, in the case of the pseudo condition, simply reach a peak of edit counts compared to all other articles), and such a pattern would be in line with our hypothesis if the proportion of total edits and unique editors increased between the pseudo condition and the active condition. However, this predicted behavior was not seen for H1a & b. In both cases the means between the active and pseudo conditions in the seven days following a link achieving Hot Article status did not differ significantly. The means of active versus pseudo edits after a link was posted were 14.93968, 18.67519, and the means of active versus pseudo unique editors after a link was posted were

Project member edits to Hot Article links

Unique member editors of Hot Article links

Project member edits to Talk Page links

Unique member editors of Talk Page links

Figures 3 - 6: Means box plots of total edits to Hot Article and Talk Page links and Unique editors to those links. The link period (pre or post) defines the period when project members made the edits – either in the seven days prior to (pre) or following (post) the time when the link was posted.

46.32947, 46.02302.

Hypothesis 2a: *Explicit requests to edit articles on project talk pages will elicit more editing activity by project members than ambient awareness, measured by total edits by project members to linked pages.*

To test this hypothesis, we first compared the total number of edits to article links posted in project talk page discussions by project members for the seven days immediately prior to and following the link being added to the talk page. A two group t-test comparing the total edits counts before and after a link was posted to a project talk page showed that the talk page link did not have a significant impact on the number of total edits to the linked page (t=.1806, df=53.271, p=.8573), indicating, somewhat counter-intuitively, that linking to an article page from a project talk page did not have a significant impact on the amount of attention (as measured by an increase in edits) to the page that was linked.

To compare the impact of the Hot Articles bot links with those posted to a project talk page, a two group t-test was done between the number of edits to links posted in the Hot Articles list to the number of edits to links posted to project talk pages, both in the seven days following the link being added. This test proved significant (t=3.0068, df=99.675, p-value=0.003342, mean of edits to Hot Articles links: 14.93968, mean of edits to talk page links: 8.00), although again not in the hypothesized direction. Links posted in Hot Articles lists received a greater number of edits on average than links posted to the project talk pages.

Hypothesis 2b: *Explicit requests to edit articles will result in an increase in the number of unique editors that edit the pages linked.*

To test this hypothesis, we compared the total number of unique project member editors in the seven days prior to and following the link being added to the project talk page. A two group t-test comparing the number of unique project member editors to links posted to project pages in the seven days following the link being added show that links on the project page had a marginally significant impact on the number of unique editors to those pages (t=-1.9519, df=61.768, p=.05549). Links posted to project talk pages may thus potentially increase the number of unique editors to those pages.

To compare the impact on the number of unique project members who edit linked pages between Hot Articles bot links and links placed on project talk pages, a two group t-test was completed. This test compared unique editors between the number of unique editors to Hot Articles links and talk page links, both averaging unique members for the seven days prior to a link being posted. This comparison showed that the difference was significant (t=14.9355, df=204.336, p-value < 2.2e-16, mean of unique editors to Hot Articles links: 46.32947, mean of unique editors to talk page links: 11.24324), although again not in the hypothesized direction. On average, a greater number of unique project members edited pages linked to by the Hot Articles bot than pages linked to on project talk pages in the period following the links being posted.

Hypothesis 3: *The effects for both Hypothesis 1a & b and*
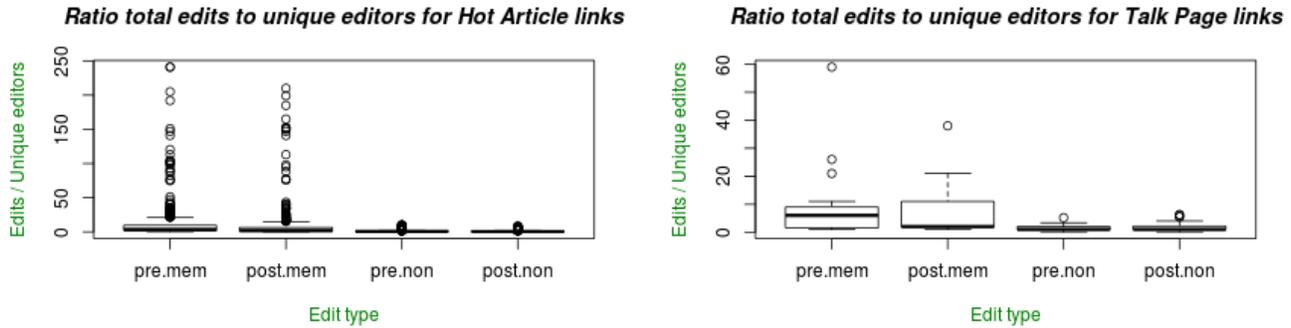
Figures 7 - 8: Means box plots of ratio of total edits to unique editors for both edits to articles posted by the Hot Articles bot (left) and edits to articles posted to project talk pages (right). The edit type defines both the period when the edits was made ("pre" or "post", either in the seven days prior to or following the link being added), and whether the edits was made by a project member ("mem" or "non").

Hypothesis 2a & b will be more pronounced for project members than non-project members.

To test this hypothesis we compared the ratio of total edits by unique editors between project members and non-members across both the post and pre periods (Figures 7 and 8). For H1, a 2x2 analysis of variance was completed within all projects in which edit ratio of articles linked to by the Hot Articles bot was the dependent variable, and Type (the seven day period prior to or following the article being posted on the Hot Articles page), and Member (whether or not the user editing the article was a project member) were fixed factors. Results were not statistically significant, resulting in (f=.276, p=.5992). For H2, a 2x2 analysis of variance was completed within all projects in which edit ratio of articles linked to in project talk page posts was the dependent variable, and Type and Member were the dependent variables. The results of this comparison were marginally significant (f=2.341, p=.127). These results indicate that there is a potential distinction between edits by members or non-members to articles linked to in project discussion pages, but that distinction is not significant in the case of articles linked to by the Hot Articles bot.

6. DISCUSSION

In summary, our findings show that while an article's listing by the Hot Articles bot had a marginally significant impact on the amount of edits that article received and the number of unique editors contributing to it, that impact was not significantly different from edit counts and unique editors in the period before the Hot Articles bot was active. In other words, the bot may not be accountable for the editing behavior observed (retaining the null for H1a & b). Similarly, we found that edits to articles posted on project talk pages and unique editors of those articles showed only a marginally significant increase (in the case of unique editors), and further that edits and unique editors increased more significantly in the case of articles listed by the Hot Articles bot than direct request, indicating that direct requests for article editing may not be the most effective means of driving further contribution (retain the null for H2a, partial support for H2b). And finally, we found partial support for H3 in that project membership does seem to be a distinguishing feature of edits by project members versus non-members in the case of links posted to project talk pages, but not in the case of links posted by the Hot Articles bot.

Limitations

There are a number of limitations to the current study that should

be addressed in future work. First, there is some debate whether shared awareness tools motivate contributions in a group. Our study assumed that the awareness of article editing activity that would be generated by Hot Article bot lists would motivate project members to pay attention to and edit those articles. This assumption was based on previous research showing that knowledge of group activity and group identification can be an effective motivator to drive future collaboration [20]. However, others have offered contrasting theories that may better explain the behavior we observed, which was counter to our expectations. Research by Sproull and Moon into prosocial behavior in online settings [14] suggests that increased visibility of potential tasks may cause editors to deem those tasks as *less* attractive. Such editors may instead prefer to contribute to work in which greater impact can be made due to fewer prior contributions. If potential contributors behave in both the way we expected and in this contrary manner, that it may be that the framing of information in awareness tools either increases or decreases further group participation. For instance, highlighting articles that have been newly added to a project as opposed to those that have experienced the most recent activity may be a more effective means of coordinating activity among group members.

Second, it is also possible that the nature of articles posted to project talk pages are not strictly comparable to those that are most frequently linked to by the Hot Articles bot. For instance, hot articles currently posted to the WikiProject Cats main page include two examples of animals (Bobcat and the American Lion), one animal known in popular media (Lil Bub), one well known fictional cat (The Cat in the Hat), and one animal related location (Animal shelter). Links posted in this project's talk page at the time of this study include mainly pages that do not currently exist (Brazilian Royal, Ceylon (cat), Karelian Bobtail, etc.), and pages that are potentially less popularly recognized by contributors (articles on the breeds Scottish Fold and Sacred Birman, for instance). This imbalance in the kinds of articles being linked to and their potential connections to knowledge held by the broad editing community may confound direct comparisons to some extent. To address this potential imbalance a more experimental approach may be effective. In such an approach, qualitatively similar articles would be linked to from different points to more effectively highlight distinctive editing patterns between project members and non-members.

Finally, the lack of a highly significant result for H3 calls into question the very notion of how membership can be defined in

online contexts. Following an approach used by previous researchers, we defined membership as including all users who had placed their own user link on a project page or membership sub-page, including those who had at one point had a user link and continued to edit project pages or article pages underneath the scope of that project after the user link was removed. If this explicit declaration of membership is unable to differentiate between the collected efforts of contributors to project pages and the articles claimed by those projects, it is possible that a more activity-based operationalization of membership will be required to effectively highlight the nuances between behaviors of explicit members, active participants, and passing contributors. Our primary means of analysis for this study was based on identifying explicit project members, but a more granular approach to membership would provide additional perspective on what types of tools may be most beneficial for different types of project members. It may also provide better insight into what strategies are engaged in by members to coordinate activities at the group level. WikiProjects, after all, are defined as a "group of contributors who want to work together as a team to improve Wikipedia" [17], not as the task or topic that a group is focused on. Accordingly, we are investigating new techniques to define and determine membership in a more robust manner within and across projects.

Implications for Design & Future Work

Varied explanations are possible for the relative success or failure of an automated awareness tool like Hot Article lists to motivate group activity in a coordinated manner. It may be that coordinated group activity does not follow from such an awareness tool in general. Or, it may be that such a tools can be effective, but not in the timeframes we used to structure our study. Alternatively, it may be that such a tool approach might be more effective for coordinating group activity if it was better tuned to display different or more granular information (e.g., that if Hot Article lists displayed edits distinguished between project members and non-members it may work better, etc).

While initial results show limited promise for this automated tool to enhance ambient awareness in a manner that would better coordinate the actions of distributed contributors, our results must be tempered by the nature of the automated tool chosen to analyze. Namely, that it is possible that the increase in editor behavior after an article is listed as a Hot Articles is a phenomenon of the activity that lead the article to be listed in the first place, independent of the article's position on the Hot Articles page. To address this possibility future work will include a qualitative analysis of the articles that saw the most significant Pre to Post changes in editing activity to more accurately ascertain the specific motivations behind those increased contributions, detailing a trace ethnography [6] of the most active editors within our data set.

Insofar as a potential increase in editing activity may be attributed to the article's appearance on a Hot Articles list, a few possibilities exist that may have influenced editing activity. Social proof, for instance, suggests that in ambiguous social situations individuals may take on the activities most prominent around them with the understanding that other contributors have a different or more accurate set of knowledge driving their actions [16]. Thus ambiguity in contributor systems has the capacity to prime individual participants to increase their awareness of available tools intended to motivate them to contribute in the most productive manner, e.g., Hot Articles. Another possibility is that increased awareness of articles that are experiencing the greatest amount of activity could lead to increased contributions to those articles due to a sense of common identity [12]. This may be possible because contributions that are in line with the rest of the group that an individual contributor identifies with lead a contributor to identify with that group more intensely, thereby solidifying their position in the group and justifying their continued participation.

Further, while making users' actions visible to other users can increase group activity, it can also lead to conflict. Wikipedia editors sometimes exhibit territorial behaviors around articles they feel a sense of ownership over [1,8]. Tools that facilitate awareness that an article is being edited can both create new conflict and revive dormant conflicts among editors who are interested in that article. WikiProjects often claim thousands of articles within their area of interest, and WikiProject members may perceive themselves as experts in their topic area. Projects also work to protect the work their members have done on articles from other editors. This suggests that WikiProjects, like Wikipedia editors, may feel territorial about the articles they create and maintain, indicating the potential for automated tools to clarify those boundaries between subject areas and to direct editor motivation towards topics most relevant to that individual.

Finally, while initial data suggests the possibility that automated tools promoting ambient awareness of project activity can successfully coordinate editor action, there is still work that can be done to more fully understand the specific mechanisms through which this coordination occurs. Automated tools intended to increase visibility and motivate contribution should successfully target the population they intend to impact. This is in keeping with Kraut and Resnick's observation that "the selective presentation of tasks can create implicit requests for action, and the better targeted are those implicit requests, the more effective they will be," [10]. A tool like Hot Articles that is not ideally effective now could become so if tuned to more accurately correspond to the needs of its intended population. For instance, if a tool similar to the Hot Articles bot were deployed that, beyond simply displaying project articles ranked by total edit count, also displayed information relevant to the provenance of the editors who made those contributions, it might more effectively coordinate activity than the tool as it is currently deployed. Previous research has shown [2,10] that by more accurately directing the message of automated tools towards a specific target population, motivation can be effectively influenced to increase contributor efforts. This suggests the potential for a future comparative study, contrasting the Hot Articles tool with an analogous tool that offered greater granularity of information, such as distinguishing between hot articles edited by project members and non-members, or weighting the list order to reflect edits by the most active contributors to project articles. Yet another comparative study might selectively include non project related articles in a hot articles list to experimentally test prior assumptions.

6. CONCLUSION

Many WikiProjects use goal-setting mechanisms like collaborations of the week [20] or explicit requests to focus member attention on particular articles. However, the Wikipedia interface does not facilitate easy awareness of activity around WikiProject-claimed articles. Instead, monitoring article activity and tracking improvements to article quality at the project level is often done by hand, or with the assistance of auxiliary automated tools created by community members, such as Article Alerts, External Watchlists, task trackers, and Hot Articles.

Automated tracking tools are often held up as effective mechanisms for assisting with group task-management, change awareness and goal-tracking. However, no previous studies have determined whether the tracking tools used by WikiProjects are as effective at motivating member participation as explicit project-level goal-

setting or individual requests for help. In this study we explored how one such automated tool, Hot Articles, has had limited impact on the editing behavior of WikiProject articles by project members. The extant of this impact should be explored further, however. In future work, this research might compare the effectiveness of fully automated bottom-up, emergent applications utilizing ambient awareness to trigger motivation or coordinate activity with the more manual means of coordination frequently at work in online collaborative spaces.

7. ACKNOWLEDGMENTS

8. REFERENCES

[1] Birnholtz, J., & Ibara, S. (2012). Tracking changes in collaborative writing: edits, visibility and group maintenance. Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work (pp. 809–818). New York, NY, USA: ACM. doi:10.1145/2145204.2145325

[2] Beenen, G., Ling, K., Wang, X., Chang, K., Frankowski, D., Resnick, P., & Kraut, R. (2005). Using social psychology to motivate contributions to online communities. Journal of Computer-Mediated Communication, 10(4), 00–00. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1083-6101.2005.tb00273.x/full.

[3] Cosley, D., Frankowski, D., Terveen, L., & Riedl, J. (2007). SuggestBot: using intelligent task routing to help people find work in wikipedia. IUI '07 Proceedings of the 12th international conference on Intelligent user interfaces. Retrieved from http://dl.acm.org/citation.cfm?id=1216309.

[4] Dourish, P., & Bellotti, V. (1992). Awareness and coordination in shared workspaces. Proceedings of the 1992 ACM conference on …, (November), 107–114. Retrieved from http://dl.acm.org/citation.cfm?id=143468

[5] Forte, A., Kittur, N., Larco, V., Zhu, H., Bruckman, A., & Kraut, R. E. (2012). Coordination and beyond: social functions of groups in open content production. Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work, 1–10. Retrieved from http://dl.acm.org/citation.cfm?id=2145270

[6] Geiger, R., & Ribes, D. (2011). Trace Ethnography: Following Coordination through Documentary Practices. System Sciences (HICSS), 2011 44th, 1–10. doi:10.1109/HICSS.2011.455

[7] Gutwin, C., Penner, R., & Schneider, K. (2004). Group awareness in distributed software development. Proceedings of the 2004 ACM conference on Computer supported cooperative work - CSCW '04, 72. doi:10.1145/1031607.1031621

[8] Kittur, A., Suh, B., Pendleton, B., & Chi, E. (2007). He says, she says: conflict and coordination in Wikipedia (pp. 453–462). ACM Press. Retrieved from http://dx.doi.org/10.1145/1240624.1240698

[9] Kittur, A., Pendleton, B., & Kraut, R. E. (2009). Herding the cats: the influence of groups in coordinating peer production. WikiSym '09 Proceedings of the 5th International Symposium on Wikis and Open Collaboration. Retrieved from http://dl.acm.org/citation.cfm?id=1641321.

[10] Kraut, R. E. & Resnick, P. (2012). Building successful online communities: Evidence-based social design. Cambridge, MA: MIT Press.

[11] Krieger, M., Stark, E., & Klemmer, S. (2009). Coordinating tasks on the commons: designing for personal goals, expertise and serendipity. CHI '09 Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 1485–1494. Retrieved from http://dl.acm.org/citation.cfm?id=1518927

[12] Ren, Y., Kraut, R., & Kiesler, S. (2007). Applying Common Identity and Bond Theory to Design of Online Communities. Organization Studies, 28(3), 377â□"408. Doi:10.1177/0170840607076007.

[13] Skeels, M., & Grudin, J. (2009). When social networks cross boundaries: a case study of workplace use of facebook and linkedin. Proceedings of the ACM 2009 international conference on Supporting group work. Retrieved from http://dl.acm.org/citation.cfm?id=1531689

[14] Sproull, L., Conley, C., & Moon, J. (2005). Prosocial behavior on the net. The social net: Understanding human behavior, 139–162. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.114.809&rep=rep1&type=pdf

[15] Viégas, F. B., Wattenberg, M., & Dave, K. (2004). Studying cooperation and conflict between authors with history flow visualizations. Proceedings of the SIGCHI conference on Human factors in computing systems (Vol. 6, pp. 575–582). ACM. Retrieved from http://dl.acm.org/citation.cfm?id=985765

[16] Wikipedia. Social Proof. http://en.wikipedia.org/wiki/Social_proof.

[17] Wikipedia. Wikipedia:WikiProject. http://en.wikipedia.org/wiki/Wikipedia:WikiProject.

[18] Wikipedia. Wikipedia_talk:Purpose. http://en.wikipedia.org/wiki/Wikipedia_talk:Purpose.

[19] Zhao, D., & Rosson, M. (2009). How and why people Twitter: the role that micro-blogging plays in informal communication at work. Proceedings of the ACM 2009 international conference on Supporting group work (GROUP'09), 243–252. Retrieved from http://dl.acm.org/citation.cfm?id=1531710

[20] Zhu, H., Kraut, R., & Kittur, A. (2012). Organizing without formal organization: group identification, goal setting and social modeling in directing online production. Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work. Retrieved from http://dl.acm.org/citation.cfm?id=2145204.2145344.