

# “How should I go from \_\_\_ to \_\_\_ without getting killed?” Motivation and Benefits in Open Collaboration

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## ABSTRACT

Many people rely on open collaboration projects to run their computer (Linux), browse the web (Mozilla Firefox), and get information (Wikipedia). While these projects are successful, many such efforts suffer from lack of participation. Understanding what motivates users to participate and the benefits they perceive from their participation can help address this problem. We examined these issues through a survey of contributors and information consumers in the Cyclopath geographic wiki. We analyzed subject responses to identify a number of key motives and perceived benefits. Based on these results, we articulate several general techniques to encourage more and new forms of participation in open collaboration communities. Some of these techniques have the potential to engage information consumers more deeply and productively in the life of open collaboration communities.

## Keywords

Wiki, geowiki, open content, consumer, contributor, motivation, benefits

## 1. INTRODUCTION

Some of the most successful web sites and software products result from open collaboration processes; notable examples include Wikipedia, Open Street Map, Linux, Apache, Mozilla Firefox, and OpenOffice. Despite this success, open collaboration systems face significant problems and unresolved issues. For example, 1,594 Wikipedia articles were marked as needing expansion in March 2011 alone,<sup>1</sup> 31% of SourceForge open source software projects are abandoned before a first release [33], and 87.4% of collaboratively made animations on the site Newgrounds,<sup>2</sup> a popular user-generated

<sup>1</sup>[http://en.wikipedia.org/wiki/Category:Articles\\_to\\_be\\_expanded\\_from\\_March\\_2011](http://en.wikipedia.org/wiki/Category:Articles_to_be_expanded_from_March_2011)

<sup>2</sup><http://www.newgrounds.com>

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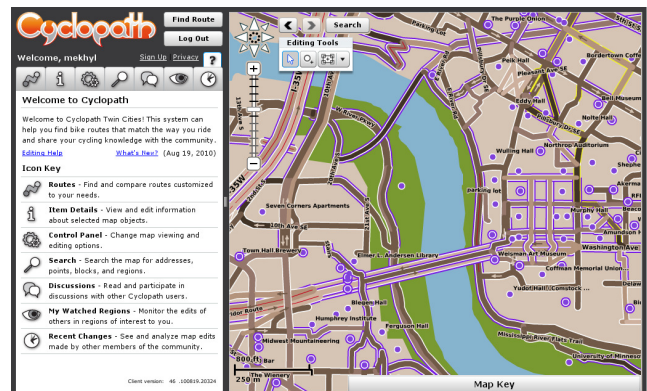


Figure 1: The Cyclopath geographic wiki. The right side of the interface is the map which shows roads, points, and regions with highlights if they have annotations. The left panel is used for a number of associated functions including editing properties of the item currently selected in the map.

content Flash game and animation site, are incomplete [17].

Much recent research has addressed these issues, with a major focus on identifying factors that motivate people to participate in open collaboration systems [11, 15, 21, 23]. Other key research issues include how users may transition to become contributors [2, 26], how users' initial participation correlates with their subsequent participation [24, 25], and gender imbalances in participation [1, 14].

Our research addresses these issues in the context of Cyclopath,<sup>3</sup> a geographic wiki for bicyclists in the Minneapolis / St. Paul metropolitan area of the United States. Cyclopath is an effective platform for research on open collaboration [28, 25, 27, 32, 18]. It supports a range of types of participation. It has an active but modestly sized user community, which makes it more typical than a huge and wildly successful system like Wikipedia. And since we maintain the site for research purposes, we have access to behavioral data that enable a broader range of analysis than is usual.

The research we report here investigates differences in participation motives and perceived benefits between Cyclopath contributors (editors) and consumers (readers). Our research is organized around three questions. We state them

<sup>3</sup><http://cyclopath.org>

and briefly preview key results.

**RQ1. Registration.** *Why do Cyclopath users register for (join) the community?* Contributors and consumers differed in their motives. Contributors were most likely to say that contributing to the community was precisely why they joined, while consumers were most likely to say they joined to get bicycling information.

**RQ2. Benefits.** *What personal benefits do consumers and contributors believe they receive from their participation? And how do consumers and contributors believe that their participation benefits the relevant community of interest?* Consumers and contributors cite similar personal benefits from their participation (notably, getting bicycling routing information). However, the two groups saw their participation as offering quite different benefits to the broader community.

**RQ3. Motives.** *Why do contributors began contributing? Why do they continue contributing?* The most common reason for users to begin contributing was to fix a specific problem they noticed; the most common reasons for ongoing contribution were to benefit other cyclists and the broader cycling community.

Our findings suggest general techniques to increase participation in open collaboration systems, both active contribution and enhanced forms of participation by information consumers.

The remainder of the paper is organized as follows. We first survey related work in the context of our research questions and then give briefly describe Cyclopath. We then describe the data we analyze and our research methods, followed by a detailed discussion of our results. We then discuss the implications of our results and then conclude with a brief summary.

## 2. RELATED WORK

Several lines of research are closely related to our work: studies of what motivates people to contribute to open collaboration communities, studies of the role of the information consumer in online communities, and techniques to elicit more participation in such communities.

**What Motivates Contribution?** Since open collaboration communities exist and have value solely because people choose to add content, the issue of what motivates people to volunteer their time and effort is crucial. Much research has examined this issue, with most of it focused on open source software (OSS) and Wikipedia.

Lakhani and Wolf [13] surveyed OSS developers, identifying motivations such as intellectual stimulation, desire to improve programming skills, and adherence to the principles of open source software. Hars and Ou [11] took a similar approach and distinguished internal and external motivations, where external included both future rewards and personal need. Nov (2007) did a survey of Wikipedia editors that showed that fun and adherence to the principles of open source were leading motivations, and that the fun motivation was correlated moderately positively with higher self-reported participation. In contrast to OSS studies, career-oriented motivations were not common [21]. Oreg and Nov (2008) surveyed Wikipedia editors and open source contributors, finding differences in motivations between the two

domains and uncovering relationships between psychological dispositions and motivations [23].

Lampe et al. [15] studied the Everything2 online encyclopedia and creative writing community. They identified a range of theory-derived motives and surveyed Everything2 users concerning their motives, use of the site, and intentions for future use. Important motives included the entertainment gained by using the site, a sense of “belonging” to the site, and deriving value from providing information to the site.

Suhonen et al. [30] studied Kassi, a Finnish social exchange site where users can request and perform favors and give, trade, or sell goods. Users often said they came to the site “just for fun”, and more frequent users said they added information to help others and because of general reciprocity toward the community.

We observe that studies in different domains have found different factors to be the strongest motivations for contribution. Therefore, from a theoretical perspective, a study in a new domain (geographic editing) can help to extend prior results and build a basis for generalization. From a practical perspective, the motives for contribution that we identify can serve as the basis for techniques to encourage more contribution, including leading some information consumers to begin contributing.

**What about Information Consumers?** “Lurkers” in online communities were traditionally invisible and often unvalued: after all, if they didn’t *do* anything, why did they matter?

Nonnecke and Preece [20] did early research on lurkers, attempting to quantify them and understand how their presence influenced the dynamics of discussion groups. Subsequent research has identified specific ways that lurkers add value, for example by propagating information about or gained in a community to others outside the community [19, 31] and by serving as an audience that motivates activity of active participants [7].

Preece and Schneiderman describe a spectrum of types of participation in a community, where readers (consumers or lurkers) may become contributors and then collaborators and leaders [26]. Consumers thus also have value as *potential* active participants.

Our research further quantifies the role of consumers in open collaboration systems. How are they different from and similar to contributors in their motives for participation and in their perception of the benefits they receive from and give to the community? The answers we found to these questions enable us to suggest new ways for information consumers to participate more fully in open collaboration systems.

**How Can We Get More Participation?** As we come to understand what motivates people to participate, a next logical step is to use this knowledge to create system designs to elicit increased participation. A number of researchers have drawn on theory and empirical results to create and evaluate such systems. Nearly all of these systems have focused on eliciting active contribution. For example, Ling et al. [16] and Harper et al. [10] developed and evaluating techniques to get users to edit movies in MovieLens; these techniques were based on social science theories of goal-setting, collective effort, and social comparisons. Cosley built on similar theories to create mechanisms to get MovieLens users to edit movies [5] and Wikipedia editors to edit specific articles that needed work [6]. And Priedhorsky et al. [27] developed and

evaluated techniques to get Cyclopath users to enter ratings and do geographic editing.

The only work we know of that attempted to elicit more consumption was that of Harper and colleagues [9]. After trying to get users to post messages in a discussion forum (active contribution), they concluded that it might be more effective to first get users to read interesting content in the forum, which might eventually lead them to post messages themselves. This idea and technique are consistent with the transition from consumer to contributor described by Preece and Schneiderman [26].

Our results suggest a number of general techniques for eliciting active contribution and other forms of participation in open collaboration communities.

### 3. CYCLOPATH

Cyclopath is a geographic wiki designed to support the information and routing needs of bicyclists in the 7-county Minneapolis / St. Paul metro area. It was launched in May 2008 and by July 2011 had over 2,500 registered users.

Since Cyclopath is a geographic wiki, users can edit the geometry and topology of the transportation network (roads and trails), monitor changes made by other users, view the diff between two revisions, and revert problematic revisions. Users also can add points of interest, enter their personal bikeability ratings of trail and road segments, add tags and text notes, and write discussion messages. These activities comprise *contribution* to Cyclopath. A revision on Cyclopath consists of multiple edits. For example, a user might edit two points and add three tags before hitting the save button. In that case, the user has saved one revision with five edits.

Users can request routes, browse the map, and view the details of trail and road segments and points of interest. These activities comprise *consumption* in Cyclopath.

Cyclopath has an active user community. As of July 2011 users had made over 11,000 revisions and entered over 73,000 ratings, 30,000 tags, and 3,770 notes. Three editors alone have each made over 10,000 edits. Users have requested over 88,000 routes. Each day during the peak of riding season (roughly April through September), about 15-20 users login and another 100-150 visit anonymously, collectively issuing 150-200 route requests.

Cyclopath is run by the GroupLens research lab and, as per our user agreement, we have access to the entire Cyclopath database for research. The logs store consumption activity as well as contribution histories, usernames as well as IP addresses. Access to these data enable our research.

## 4. DATA & METHODS

In this section we outline the data we used for our research and the methods we used to collect and analyze the data.

### 4.1 Data

The data we analyzed comes from two sources, a web-based survey of Cyclopath users and behavioral data captured in Cyclopath system logs.

**Survey.** We designed a survey to investigate different aspects of Cyclopath usage and behavior as well as related information. We included questions about bicycling habits, social media usage, and printed bike maps, among other topics. 28 of the 61 questions were open-ended, and the rest

were multiple choice, ranking, or selection questions.

In March 2010, we emailed a message to all registered Cyclopath users ( $\approx 2,100$  at that time) with a link to the survey and also posted a link to our Twitter stream. Of the 402 people who took the survey (in whole or part), 342 identified themselves as Cyclopath members. However, we were able to link only 290 respondents to Cyclopath accounts, so our analysis in this paper deals only with this subset of 290. Further, since subjects were not required to answer any questions, the number of responses for any give question varies. We report the number of responses for each specific question as appropriate.

**Behavioral Data.** Cyclopath logs a significant amount of behavioral data about users. We store information about viewing, route requests, edits, ratings, and more. This information includes username, IP address, timestamp, and information specific to the data type. Like much of our other research, for this paper, we only looked at the data for registered users, and, more specifically, only for survey participants. The data for this paper was gathered from a database dump on March 17, 2011.

### 4.2 Behavioral Analysis

To maximize the data available for analysis, we first applied the technique from [25] to “de-anonymize” actions performed by the 290 respondents from the survey. This technique enables at least some edits done by registered users before they registered or when they were not logged in to be associated with their login id.

We next processed the Cyclopath usage logs to segment users into consumers and contributors. We also segmented contributors based on amount of contribution. We did this since prior research shows large differences in behavior between casual and power editors in both Wikipedia and Cyclopath [24, 25]. We report results of the detailed segmentation where interesting.

There are 153 **Consumers**, who have made no edits and saved no ratings. There are 137 **Contributors**, who either have made edits, saved ratings, or done both.

### 4.3 Survey Analysis

While several of the survey questions we analyzed were multiple choice questions, we also analyzed five open-ended questions. We chose to analyze these questions because they provided information about users’ motivations and perceived benefits from participation that we needed to answer our research questions. The five questions were:

Why did you register for Cyclopath?

How do you feel the cycling community has benefited from your use of and contributions to Cyclopath?

How do you feel you have benefited from using and/or contributing to Cyclopath?

Why did you start editing Cyclopath?

Why do you contribute to Cyclopath?

The three authors coded the responses to the questions. We generally used a grounded theory approach in our analysis. First, we independently coded all 5 questions. Then we mutually decided on a set of standard codes (for each question), based on our individual codes. We coded a set of 20

answers as a group to ensure we had the same definitions for the codes. Then we independently coded all five questions using the standard sets of codes and mutually agreed upon coding standards.

The codes were all agreed upon prior to forming hypotheses (although we collapsed several codes that were used very infrequently into more common codes later in the analysis).

For each of the questions, we calculated Fleiss’ Kappa for exact agreement. This is a strict standard. For example, if two coders used the code “routing” and a third used “routing” and “general knowledge” this would not be considered agreement. Nonetheless, the values we obtained still all were in the range that indicated “moderate to substantial” agreement: (1) “Why did you register for Cyclopath?” = .62, (2) “How do you feel the cycling community has benefited from your use of and contributions to Cyclopath?” = .68 (3) “How do you feel; you have benefited from using and/or contributing to Cyclopath?” = .70, (4) “Why did you start editing Cyclopath?” = .59, and (5) “Why do you contribute to Cyclopath?” = .71.

The Fleiss’ Kappa scores demonstrate that our coding was reliable. However, for the analyses we report below, we believed it was reasonable to consider that a code applied to a response if a majority of the coders, i.e., at least 2 of 3, agreed on it.

## 5. RQ1. REGISTRATION

We present our analysis and results concerning how motivations for registration on Cyclopath differ for consumers and contributors.

### 5.1 Registration Motivation

**Analysis.** As noted above, we coded and analyzed respondents’ answers to the question “Why did you register for Cyclopath” to get at their motivations for participating. We wanted to identify the main motivations and see whether motivations differed for consumers and for contributors. Table 1 summarizes the coding results.

Code	Consumers	Contributors
Find routes	27 (23.48%)	26 (18.57%)
Edit	12 (10.43%)	34 (24.29%)
Customization	16 (13.91%)	17 (12.14%)
I like it	11 (9.57%)	15 (10.71%)
Misc	12 (10.43%)	11 (7.86%)
Not Sure	14 (12.17%)	5 (3.57%)
Required	5 (4.35%)	9 (6.43%)
Ideology	6 (4.35%)	7 (5%)
Get general knowledge	8 (6.96%)	5 (3.57%)
Benefit Cyclopath	4 (3.48%)	5 (3.57%)
Testing	0 (0%)	6 (4.29%)
Num. Applications	115	140

**Table 1: Coding results for the survey question “Why did you register for Cyclopath?”** The table shows the number of responses to which each code was applied (using the 66% agreement rule). Multiple codes could be applied to each response; thus we report the total number of code applications for subjects in each participation category. 255 codes from 217 distinct survey respondents are shown.

We also used a Fisher’s Exact Test to see whether any

of the differences between the responses of consumers and contributors were significantly different. The answer was yes ( $p = .047$ ). Follow-up tests for equality of proportions show that there was a significant difference specifically for the Edit code ( $p = 0.007$ ).

As previously mentioned, we also broke down some of the answers by the level of contribution. We looked at Low, Medium, and High contributors. The Low Contribution group had 63 users with a total of 1-19 combined edits and ratings. The Medium Contribution group had 45 users with a total of 20-199 combined edits and ratings. The High Contribution group had a total of 29 users with over 200 combined edits and ratings. Table 2 shows how these levels of contributors differed in their answers to this same question. (Other codes were not interesting.)

Code	Low	Medium	High
Find routes	14 (24.56%)	9 (16.98%)	3 (10%)
Edit	8 (14.04%)	14 (26.42%)	12 (40%)
Customization	13 (22.81%)	2 (3.77%)	2 (6.67%)
Nam. Applications	57	53	30

**Table 2: Additional results for the survey question “Why did you register for Cyclopath?”** The contributors in this table are divided into low, medium, and high contribution groups.

**Results.** We next explain each of the codes briefly and discuss interesting response patterns.

**Find Routes.** The most common reason cited to register for Cyclopath was to find bicycle routes. This is no surprise: getting routing information is the main purpose of the site. Some responses emphasized finding routes in new parts of the regions: “*To find routes to parts of town where I’m not used to riding.*” Others noted that they needed routing information because they were new to the area: “*New to the Twin Cities, wanted to find out how to get to bike trails...*”

There was an interesting pattern of responses: the more one contributed, the less one cited “Find Routes” as a reason to join Cyclopath. While not significant ( $p = .2$ ), this pattern interested us as we now wonder if people who became contributors *came to the site with this intention* rather than developing this intention after consuming information for awhile. This is consistent with prior research [24, 25] and analysis presented in our third research question below.

**Edit.** The second most popular reason for joining Cyclopath was to edit, i.e., to contribute information to the system. The response pattern here is almost precisely the opposite as that for “Find Routes”: the more one contributed, the more one cited “Edit” as a reason to join. The difference is significant ( $p = .02$ ).

Individual responses that we coded as “Edit” illustrate interesting nuances:

*“In order to add locations to the map like restaurants.”* This response identifies a desire to add useful “points of interest” to the map. Previous research shows that this is a common initial editing pattern [18].

*“To edit things under a user name rather than an IP address...”* This response suggests a desire to for one’s edits to be visible, perhaps to gain a reputation, another factor that can motivate contribution to open collaboration systems [23].

“to edit the map focusing on NE minneapolis.” This response notes interest in editing in a particular region. This suggests two factors identified by the *collective effort model* [12] as promoting participation in group activities. (1) Caring more about the outcome of the group activity, e.g., the Cyclopath map: specifically the respondent cared about the region and wanted it well represented on the map. (2) Believing that one has a unique contribution to offer: specifically, the respondent may have felt that he/she was the only Cyclopath member who had the interest and ability to edit this region.

“So I could add an established dirt path bypassing a sometimes dangerous and busy highway intersection to get onto a bike trail.” By adding this dirt path, the respondent benefited all Cyclopath users, as well as him or herself directly: all users could get safer routes.

**Customization.** The third most common for joining Cyclopath was what we coded as “Customization”, essentially a desire to save system settings and personal preferences to customize the user experience: “...to save riding preferences for better routes”. As with “Find Routes”, this reason was cited more frequently by consumers and low contributors than medium and high contributors.

**I Like It and Ideology.** A number of respondents expressed general support for the concept of Cyclopath:

“I thought it was a much-needed service for cyclists in the Twin Cities.”

“It was obviously an amazing tool. It was an easy sell, and it seemed to be engineered correctly – that is, it appeared to work.”

And a few others mentioned general support for the notion of an open content resource for bicyclists; we coded these responses as “Ideology”.

There were no systematic differences between consumers and contributors in citing these reasons. However, prior research has found that agreement with the open collaboration ideology can be a significant motivator of contribution to a system [11, 21].

**Remaining codes.** The remaining seven codes were either rare, not particularly interesting, or both. “Misc” covered vague and uncategorizable responses, “Not Sure” covered cases when respondents said they were not sure why they registered, “Required” covered cases where a respondent said that a feature they wanted to access required registration, “Get General Knowledge” covered responses that referred to a general desire to obtain bicycling knowledge, “Benefit Cyclopath” covered responses of the form “I wanted to help Cyclopath”, and “Testing” referred to cases where a respondent said they just wanted to try things out.

**Additional Analysis.** Despite these observations, contributors and consumers differed greatly in the extent to which they registered to use Cyclopath. Beyond our coding analysis, 67% of all route requests came from anonymous users (who we were never able to deanonymize), while 96% of all edits were made by registered users (who were deanonymized).

**Summary.** Our analysis of reasons why people joined Cyclopath revealed one major finding: contributors and consumers tended to cite different reasons, although the least

prolific group of contributors actually was more similar to consumers. The reasons cited by contributors are similar to those identified in prior research on other systems, e.g., Wikipedia and open source software projects. Thus, our results help to deepen and generalize prior work.

We found that differences in motives between tiers of editors can also emerge, indicating that different motives can sometimes be tied to the number of edits a user makes.

## 6. RQ2. BENEFITS

In this section, we examine the ways that subjects said they personally benefited from Cyclopath as well as the benefit they believe the bicycling community received from their use of and participation in Cyclopath.

### 6.1 Individual Benefit

Research on volunteerism suggests that if volunteers do not perceive benefits for themselves, they are less likely to continue volunteering [22]. Since participation in open collaboration communities is a form of volunteerism, we wanted to examine whether Cyclopath users did were able to articulate individual benefits from their participation and what those benefits were. As before, we also wanted to see whether consumers and contributors responded differently.

**Analysis.** Table 3 summarizes our coding of respondents’ answers to the question “How do you feel you have benefited from using and/or contributing to Cyclopath?”. While the table suggests a few differences between consumers and contributors (e.g., in how much they said that finding routes was a benefit they received), these differences look relatively modest. Indeed, a statistical test confirmed that there were no significant differences in the responses (Fisher’s Exact Test,  $p = .23$ ).

Code	Consumers	Contributors
Routing	84 (59.15%)	86 (58.5%)
Safety	19 (13.38%)	14 (9.52%)
No benefit	13 (9.15%)	9 (6.12%)
Ride Attitude	7 (4.93%)	11 (7.48%)
Bicycling Community	6 (4.23%)	7 (4.76%)
Misc	3 (2.11%)	8 (5.44%)
Riding Habits	3 (2.11%)	9 (6.12%)
General knowledge	7 (4.93%)	3 (2.04%)
Num. Applications	142	147

**Table 3: Coding results for the survey question “How do you feel you have benefited from using and/or contributing to Cyclopath?”** The table shows the number of responses to which each code was applied (using the 66% agreement rule). Multiple codes could be applied to each response; thus we report the total number of code applications for subjects in each participation category. 289 codes from 223 distinct survey respondents are shown.

Before going into a detailed analysis of the responses, it is helpful to point out two important differences between Cyclopath and many other open collaboration systems:

**Cyclopath does not need user input for routing.** While prior research shows that user edits resulted in demonstrably better routes [27], user input is not required for routing. Cyclopath falls back on an

objective metric to compute routes when user ratings are not available [28], and even these routes are quite good. Therefore, users benefit from the system even without user contributions.

**Contributors may benefit directly from their own contributions.** In many cases, contributions to open collaboration systems do not directly benefit the contributor. If one edits a Wikipedia article to add new information, the editor by definition already knows that information, so he/she is not learning anything new about the topic of the article. The individual benefits that may be gained are indirect, e.g., reputation among one’s fellow editors. However, in Cyclopath, the edits made by a user (including entering personal bikeability preferences) may directly influence the routes that user receives. (Cyclopath is like a recommender system in this respect.) We have observed that users sometimes enter ratings or edit the map immediately after receiving a route because there are aspects of the route they do not like; they edit to get a route that matches their preferences.

**Results.** The most common type of personal benefit that Cyclopath users identified from their participation in the system was that they gained knowledge that helped them become better bicyclists. We coded a number of more specific reasons within this rubric.

**Routing.** By far the most common benefit cited was improved bicycle routing, such as finding better routes, finding routes more easily, and finding routes in unfamiliar areas:

*“I have found a better and faster route for my commute.”*

*“It helps me get the feel for a ride before I go out to physically ride. It also helps me figure out what route would be best.”*

*“Tips on routes to take through neighborhoods I’m not very familiar with... what roads to avoid, what streets allow for faster commute, etc.”*

*“I’ve quickly learned how to find “child-friendly” bike routes to different locations.”*

**Safety.** Safer routes are an important special case of “better” routes. While Cyclopath makes no explicit claim to produce safe routes, it tends to compute routes that use more bike trails, bike lanes, and quiet streets (rather than busy roads), which users consider more safe.

*“I’ve discovered new routes that have made getting around easier, faster and safer.”*

*“It’s like having an advisory panel of people who bike more than I do to ask “hey how should I go from \_\_\_ to \_\_\_ without getting killed?””*

Further, some users have added notes warning about dangerous areas: *“This area is quite dangerous, especially as one comes down the hill from Warner Road. There is a low spot in the paving where the trail curves that accumulates sand and detritus. At least two serious accidents requiring ambulance rides have happened at the exact spot.”*

**Ride Attitude and Riding Habits.** Some respondents also mentioned a change in their attitude toward bicycling,

typically that they were more confident cyclists or had more fun:

*“This is a great service that helped me commute more confidently via bicycle.”*

*“The routes are locally focused and fun to use.”*

Similarly, others mentioned that the additional knowledge they had gained helped them to ride more or ride to new destinations:

*“I commute more often by bicycle and share routes with friends.”*

*“I’ve found a few new places to ride, and had fun editing too.”*

**Bicycling Community.** A few users said that they benefited by feeling more connected to the bicycling community: *“I feel good about it. I like to help my community and this is just another way of doing so.”*

**Summary.** Our analysis showed that consumers and contributors cite similar individual benefits from participation in Cyclopath. And the most commonly cited benefits were that they gained new knowledge that helped them become better bicyclists. In this context, we observed that Cyclopath differs from many open collaboration systems since all users benefit without any user contributions required, and that user contributions may benefit the contributor directly.

## 6.2 Community Benefit

**Analysis.** When we coded the responses to the question “How do you feel the cycling community has benefited from your use of and contributions to Cyclopath?” we found clear differences between consumers and contributors, as shown in Table 4. A statistical test showed that these differences were significant (Fisher’s Exact Test,  $p < 0.001$ ). Follow-up tests for equality of proportions show that there were significant differences specifically for No Benefit and General Knowledge codes ( $p < 0.01$  in both cases).

Code	Consumers	Contributors
No benefit	50 (47.62%)	29 (26.13%)
Better navigation	17 (16.19%)	30 (27.03%)
General Knowledge	3 (2.86%)	26 (23.42%)
Spread the word	17 (16.19%)	5 (4.5%)
Bicycling Community	8 (7.62%)	9 (8.11%)
Misc	5 (4.76%)	7 (6.31%)
Safety	5 (4.76%)	5 (4.5%)
Num. Applications	105	111

**Table 4: Coding results for the survey question “How do you feel the cycling community has benefited from your use of and contributions to Cyclopath?”** The table shows the number of responses to which each code was applied (using the 66% agreement rule). Multiple codes could be applied to each response; thus we report the total number of code applications for subjects in each participation category. 216 codes from 194 distinct survey respondents are shown.

**Results.** Consumers’ most common answer was that the cycling community received “no benefit” from their participation – this accounted for nearly about 47% of all responses.

For contributors, on the other hand, as their level of contribution increased, stating that the bicycling community received no benefit from their participation decreased.

Instead, contributors said that the bicycling community benefited through “Better Navigation” and better “General Knowledge” about bicycling.

*“I imagine there are other cyclists who travel to the landmarks I’ve tagged, who use the routes I’ve marked. I’d like to think I’ve made their rides just a little easier.”*

*“Shared some fun things and expanded tags to make more locations searchable.”*

*“Slight improvement in the understanding of the St. Anthony Park neighborhood.”*

Consumers did articulate a benefit to the cycling community, although not of the type we had anticipated. 15% of consumers (as well as 5% of contributors) said that they told others about Cyclopath, coded as “Spread the word”. Thus, more members of the general bicycling community benefited from the useful knowledge available from Cyclopath: *“I have shared Cyclopath with other bikers and bladers (I use it for blading routes, too), and it has opened up new routes and opportunities for biking/blading to places to which we otherwise might have driven because we didn’t know how to get there by bike...”* Spreading the word is consistent with the role of “active-lurker-as-propagator” [31].

**Summary.** Consumers and contributors gave very different responses when asked how their participation in Cyclopath benefited the Cycling community. The most common response for consumers was that there was no benefit. However, they did identify an interesting and unexpected benefit, namely that they told others about Cyclopath and thus increased the number of cyclists who benefited from the system. Contributors, on the other hand, were able to articulate benefits to the community as a direct result of their participation. This is important since believing that one’s participation in a group effort (like an open collaboration community) matters to others motivates continued participation.

## 7. RQ3. MOTIVES

We examine the motives that contributors offered to explain their initial and subsequent participation in the system.

### 7.1 Motives for Contribution

Three survey questions are relevant to understanding the motives of contributors: (1) “Why did you register for Cyclopath?”, (2) “Why did you start editing Cyclopath?”, and (3) “Why do you contribute to Cyclopath?”.

**Analysis.** Only users who actually had contributed to Cyclopath were asked the second and third questions, while all users were asked the first question. Since we analyzed responses to the first question above, we do not discuss it further here.

Table 5 summarizes the reasons contributors started to edit and the reasons gave for contributing.

**Results.** When we analyzed the responses to these two questions, we found that the answers were generally quite similar, and thus we ended up with nearly the same set

Code	Start	Contribute
Fix Problems	30 (37.04%)	0 (0%)
Benefit Cyclopath	17 (20.99%)	23 (28.05%)
Benefit Others	17 (20.99%)	22 (26.83%)
Ideology	8 (9.88%)	20 (24.39%)
Benefit Self	5 (6.17%)	9 (10.98%)
Misc	4 (4.94%)	8 (9.76%)
Num. Applications	81	82

**Table 5: Coding results of the survey question “Why did you start editing Cyclopath?” and “Why do you contribute to Cyclopath?”** The table shows the number of responses to which each code was applied (using the 66% agreement rule). Multiple codes could be applied to each response. 81 codes from 71 distinct users are shown for the former question, 82 codes from 63 distinct users are shown for the latter.

of codes for the two questions. There was one major exception, however. The most common reason users gave for beginning to edit was to fix a problem they observed with the site content. Users never cited this as a general reason for contributing.

We next describe and illustrate each of the response codes except for “Misc” which included vague and uncategorizable responses.

**Fix Problems.** Contributors mentioned two different types of problems that caused them to start editing: missing information and incorrect information.

*“There weren’t many notes on the roads in my neighborhood and I wanted to put in more information.”*

*“Some point of interest were off by a block, so I moved them. Some notes were outdated, i.e. road construction being finished, and the note still said it was under construction.”*

**Benefit Cyclopath.** Some contributors explained that they were motivated to help Cyclopath. We included in this category specific statements about improving the site’s content as well as general statements about benefiting the Cyclopath community. Users sometimes mentioned reciprocity as a reason to contribute (this is a form of group-generalized exchange [3, 8]). A few quotes serve to illustrate this category:

*“It didn’t work very well. I wanted it to work better. I figured if there were others like me that collectively we could make it much better.”*

*“I felt I had good stuff to share with other cyclists using cyclopath - especially since I’ve found good stuff entered by other people!”*

**Benefit Others.** Some contributors explicitly cited helping others as the reason they contributed or started to contribute. In some cases contributors mentioned explicitly that they believed they had unique knowledge that would benefit others.

*“Used my personal knowledge of conditions to make notes such as connections and barriers for other bicyclists.”*

**Ideology.** Consistent with previous research, a number of users gave ideological explanations for why they contributed, citing either approval of the open content approach of Cyclopath or identification with the bicycling community.

*“Love the Wiki-inspired idea of collective knowledge & correction.”*

*“Because of the sense of solidarity and contributing to a collective project. The idea that, as cyclists, we’re really “all in this together” in terms of using an alternative—and often marginalized—form of transit.”*

**Benefit Self.** Not surprisingly, some (although not many) contributors offered self-oriented reasons for contributing: *“To have it give me better directions on the routes I expected to use.”* A fair number of users said they contributed to benefit both themselves and others: *“It makes my routes more accurate and helps others find routes in an area they may not be very familiar with.”*

**Summary.** We identified different motives that led user to begin contributing to Cyclopath and that led to continued contribution. We next state design implications based on the findings for this and our other research questions.

## 8. IMPLICATIONS

Our results suggest a number of techniques to enhance participation in open collaboration communities. The techniques cover both active contribution and several types of enhanced participation by information consumers.

**Active Contribution.** The motives for contribution offered by Cyclopath users suggest general, empirically based techniques to enhance contribution (e.g., editing articles in Wikipedia or answering questions in StackOverflow).

- **Fix Problems.** Highlight potential problems for users and invite them to fix the problems. Suggest problems in a context-sensitive manner. For example, Cyclopath could highlight potentially missing intersections [27] along a route a user requested. Wikipedia might indicate specific parts of an article that may have problems, e.g., that are written at an inappropriate level.
- **Benefit Self.** Emphasize that (and how) information entered by a user directly benefits the user. For example, in Cyclopath, entering ratings generally leads to better routes, and in MovieLens, entering ratings leads to better movie recommendations. While a “benefit to self” appeal would seem likely to work on both intuitive and theoretical grounds, prior research has not demonstrated this [16, 29]. Our results suggest that more experimentation is justified.
- **Benefit Cyclopath.** Remind users how they benefit from knowledge entered by other community members and invite them to reciprocate. Appeals to reciprocity, both direct and generalized, are generally powerful motivators to action [3, 4]. For example, Wikipedia articles might be augmented with statements such as “This article brought to you by the efforts of over 50 volunteer editors. Please click here to find out how you can share your knowledge to help others”.
- **Benefit Others.** Remind users that their contributions can directly benefit other users who are “like

them” or even (if appropriate) their friends. Prior work has demonstrated the effectiveness of such appeals [29]. Cyclopath might tell users that other cyclists in their neighborhood or who ride the same trails as these users would benefit from their contributions. Wikipedia might tell readers of an article that other users who are interested in the topic would benefit if they improved the article.

- **Ideology.** Appeal to the presumed shared values of the community. For a system like Cyclopath, these appeals could refer to the real-world community of bicyclists or to the online community of Cyclopath editors, both of which share fairly powerful values: for example, health, fitness, sustainability for bicyclists and a commitment to open content systems for Cyclopath editors.

### Enhanced Participation by Information Consumers.

As we noted, a fair number of our information consumer subjects said that they benefited the community by “spreading the word” about Cyclopath. This finding reminds designers to make it easy for users to spread the word. This can be as simple as including an “invite a friend” feature. More complex techniques include enabling users to publicize results they received from the system or their activity on the system. For example, Cyclopath users could share – via email, Twitter, or Facebook, say – a route that they received and liked. This would have multiple benefits for the Cyclopath community: informing the recipients about Cyclopath, letting them know that the person who shared is positive about Cyclopath, and providing a pointer into Cyclopath (Cyclopath routes can be shared as hyperlinks). Similar techniques would work in other systems: for example, StackOverflow could make it easy for a user who asked a question to share the question and some answers that the user really liked.

**New Forms of Participation.** Many of the ways users told us that they benefited personally from using Cyclopath seem like the kernel of interesting stories, for example:

*“I’ve quickly learned how to find “child-friendly” bike routes to different locations.”*

*“I commute more often by bicycle and share routes with friends.”*

*“I’ve found a few new places to ride, and had fun editing too.”*

Bicyclists (and other people who share a passion) enjoy sharing stories about their experiences, joys, and problems. Such stories both bind a community together and serve as important carriers of knowledge, albeit in a subjective and situated form. Yet many production-oriented online communities like Cyclopath don’t provide support for users to share such stories. This is a missed opportunity, as they would enhance the community and form a new and “technically easy” way for users to contribute to the community. In Cyclopath it would be natural for users to be able to tell stories about routes they have received. In Wikipedia, it would be natural to collect stories such as “My first edit”, “The first time I was reverted”, “The first time I got in an edit war”.



## 9. SUMMARY

We surveyed Cyclopath users to identify their motives for participation, benefits they perceived themselves to receive from their participation, and benefits they perceived their participation to yield for the broader cycling community. In our analysis, we examined whether contributors (editors) and consumers (readers) differed in their responses.

Consumers and contributors gave different reasons for joining Cyclopath. The most common reason contributors gave for joining was to edit content, while the most common reason cited by consumers was to get bicycling information. Further, as users contributed more, their motivations diverged more sharply from those of consumers.

When it came to assessing perceived personal benefits gained from participating in Cyclopath, consumers and contributors gave similar responses, mostly relating to getting better bicycling information. However, when assessing the benefits others received from their contribution, contributors and consumers gave rather different answers. Contributors said that the cycling community benefited directly from their edits to Cyclopath through access to better routes and knowledge of trail and road conditions. On the other hand, consumers mentioned that the bicycling community benefited because they “spread the word”, sharing useful knowledge they learned by using Cyclopath.

Contributors gave different reasons for beginning and for continuing to edit Cyclopath. They often were inspired to start editing to fix specific problems they noticed, while they continued editing to benefit other cyclists and because of general commitment to bicycling.

We used our findings to articulate a number of new and general techniques to encourage more participation in open collaboration communities.

We plan future work to further investigate issues raised by our study. First, we will investigate user motivations and perceptions contextually, with micro-surveys that are triggered by key events (e.g., registration, first route request, first edit, etc.). Second, we are planning an experiment to investigate the effect of appeals to reciprocity to motivate contribution.

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