

Motivation of Newcomers to FLOSS Projects

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ABSTRACT

While the motivations of Free/Libre and Open Source Software (FLOSS) developers have been the subject of extensive research, the motivations for their initial contribution to a FLOSS project has received only little attention. This survey of 94 newcomers to the FLOSS projects Mozilla and GNOME identifies the motivations for the modification of the FLOSS components and for the submission of these modifications back to the FLOSS project. With the responses, we test a hypothesis based on the previous qualitative research on newcomer motivations: Most newcomers modify a component because they need the modification for themselves. Surprisingly, this is not the case for our respondents, who have a variety of primary modification motivations. Newcomer occupation is discussed as a reason for this difference to previous results.

CCS Concepts

•Software and its engineering → Open source model;

Keywords

FLOSS; Open Source; Motivation; Newcomers; Survey

1. INTRODUCTION

Some developers of Free/Libre and Open Source Software (FLOSS) are altruists, others want to learn something, and yet others are simply paid for their work. The motivation of FLOSS developers has been the subject of extensive research.

Most motivation surveys looked at developers that currently worked in their FLOSS projects, but not on the initial motivations to join a FLOSS project. Their results are therefore likely biased towards the views of a small, but very visible minority of expert contributors, while newcomers are less visible and thus harder to reach. We know of only two exceptions. First, Shah [22] explicitly distinguished between the motivation for initial and long-term participation. Second is an exploratory survey [9] that we used as the starting

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point for the larger survey presented in this paper.

Especially when looking at newcomers, contributor motivation splits into two different types. First, FLOSS developers have a motivation to modify the FLOSS component, which we call *modification motivation*. Second, they had a motivation to submit their modification back to the FLOSS project. This is the *submission motivation*. As a consequence, some newcomers modify a FLOSS component, but never submit their modification to the FLOSS project, because their submission motivation does not suffice. To our knowledge, Shah's survey [22] and our exploratory survey [9] are again the only surveys so far that looked at these two different types of motivation.

Raymond proposed that “every good work of software starts by scratching a developer's personal itch” [20]. Indeed, the most important modification motivation for the respondents of the exploratory survey was their Own Need: They needed the modification for their own use of the application. This is also in agreement with Shah's qualitative results [22]. This may be a general rule for modification motivations, which we formulate as the following research hypothesis:

Hypothesis: Most first-time contributors modify the FLOSS project's source code primarily because they need the modification for themselves.

This paper presents a survey of 94 newcomers to FLOSS projects to explore their contributor motivations. In particular, the survey statistically tests the mentioned hypothesis, which was formerly based only on qualitative research.

2. RELATED WORK

FLOSS contributor motivation has been a domain of extensive research over the course of the last about 15 years. Von Krogh et al. summarized the state of research as of 2011 on FLOSS contributor motivation with more details in a literature review [26]. This section describes the main concepts and studies, especially in regard to new contributors.

Early work on developer motivation includes Lerner and Tirole's theoretical application of economic theories to the FLOSS phenomenon [15]. They explored reasons to explain the FLOSS phenomenon without stressing altruistic motivations and found egoistic reasons to work in FLOSS projects. They argued that there is a signaling incentive for FLOSS developers, as they increase their market value if they demonstrate their programming skills in a FLOSS project.

Ye and Kishida [30] agreed that altruism is not the main motivation for FLOSS developers, but they argued that learning and social recognition are the most important intrinsic and extrinsic motivations for FLOSS developers.

A number of surveys asked software developers about their motivations to contribute to FLOSS projects. According to Hertel et al. [11] and Hars and Ou [10], the enjoyment of programming is a major motivator for most developers. Besides this, pragmatic reasons such as needing the modification for their own project were most often mentioned not just in Hertel et al.’s, but also Lakhani and Wolf’s survey [13]. Improvement of one’s own programming skills was also frequently cited in these studies, and seems to be an important factor in starting FLOSS project involvement according to Gosh [8]. David et al. found particularly high numbers of developers driven by the belief that source code should be open, and they should return something to the community for using it [4].

As Krishnamurthy pointed out [12], these surveys do not differentiate between different types of tasks within FLOSS projects. Types of tasks include but are not limited to *usage* of the component, *modification* of the source code, and *submission* of resulting patches. Exceptions include a survey of the motivation of active users instead of the developers within a FLOSS project [14], an analysis of the social structure in FLOSS projects [3], and Benbya and Belbaly [1] also addressed this in a more recent survey of Sourceforge [23] developers. Mair et al. [16] differentiated two types of tasks, source code contributions and mailing list participation in the community of the statistical FLOSS project R. However, they considered only three types of motivation: intrinsic, extrinsic, and hybrid. They showed that hybrid motivations have stronger effects on participation, and particularly extrinsic motivation is even negatively associated with mailing list participation.

In a qualitative empirical study using mailing lists and 88 interviews as data sources, Shah [22] found that the primary usage and modification motivations are the developers’ own need, as they need the modification for themselves. Another identified reason is enjoyment of the coding task. However, the modification motivation of *newcomers* was “need” in 42 out of 45 cases in her data set, i.e. they modified the application because they wanted to use the modification for themselves. Submission motivations were different and comparable to existing studies. Shah acknowledged that there are developers who modify the application but do not submit their modifications back to the FLOSS project, which is a consequence of the separation between modification and submission motivations.

3. PARTICIPANT SELECTION

The survey design was based on the Tailored Design Method (TDM) [5]. Some adaptations were necessary to account for invitations via email.

The survey targeted first-time contributors of the FLOSS projects Mozilla and GNOME. With data from Mozilla’s and GNOME’s issue trackers, we identified those developers who had their first patch accepted recently. These newcomers were invited to a web-based survey. In the survey, we referred to the first accepted patch and asked about their motivation to create and submit it. We repeated this identification and invitation to the survey multiple times, so we could invite participants that had their first patch accepted recently and their experiences were still fresh. We invited all newcomers to Mozilla from between May 2013 to October 2013 and the newcomers to GNOME from November 2013 to January 2014.

Figure 1 shows the identification and invitation process exemplary for GNOME. In the first step, we used scripts presented by Zhou and Mockus [31] to download the data from Mozilla’s and GNOME’s issue trackers. An additional script and a Java application created a list of developers sorted by their first acceptance of a patch (FA). Those with a recent FA were participant candidates, but had to be filtered manually because the automated scripts had incorrectly identified some candidates as newcomers. For example if they had changed their email address recently, the account with the new email address might be seen as a newcomer. Employees of Mozilla had also been filtered out, as their motivation was not in the scope of this study.

The invitations included a manually written summary of their first accepted patch. This added personalization to the invitation and showed that it was not just an unsolicited mass email. According to the TDM, each first invitation also contained a \$ 2 gift code for amazon.com.

In total, we send out 132 invitations to Mozilla newcomers and 48 to GNOME newcomers. We received 97 answers from Mozilla contributors and 32 from GNOME contributors, out of which 91 and 26 contained a large proportion of useful answers, respectively. This is a total response rate of 65 %, which is considerably higher than all other surveys of FLOSS developers that we know of, which achieved a response rate of 38.1 % at most [1, 10, 13, 16, 27–29]. However, beside the part of the survey presented in this paper, the survey also contained questions regarding contribution barriers. Between 71 and 94 participants responded to the questions considered in this paper, so the response rate relevant for this paper is only between 39.4 % and 52.2 %, which is still very high for a survey of FLOSS developers.

This paper cites respondents to the questionnaire directly and indirectly. In these citations, a symbol “[Mn]” for Mozilla or “[Gn]” for GNOME identifies the quoted respondent, where n is a number assigned arbitrarily to each respondent within the groups of Mozilla and GNOME.

4. QUESTIONNAIRE

The questionnaire asks for modification and submission motivation. Additionally, it asks for *usage motivation*, i.e. why the participants approached the FLOSS project in the first place. For each domain, there is an open question and a closed question. Each open question is asked before its corresponding closed question to ensure unbiased answers in the open question.

The questionnaire first asked in open questions about their usage, modification, and submission motivation. Usage can be seen as a precondition to contribution [2]. Therefore, usage motivation influences the motivation to contribute, and the questionnaire includes usage motivation. Afterwards, the participants were presented closed questions for the three types of motivation. For modification and submission motivation, the participants could pick motivations that applied for them from a list, and put them into an order that represented the importance of the selected motivations. For usage motivation, the questionnaire presented only a multiple-choice checklist. This gave less insight about usage motivation than the method used for modification and submission motivation, but it was also not as much in focus of our study and cost the participants less time.

Using an open coding methodology taken from Grounded Theory [24], the answers to the *open* questions received

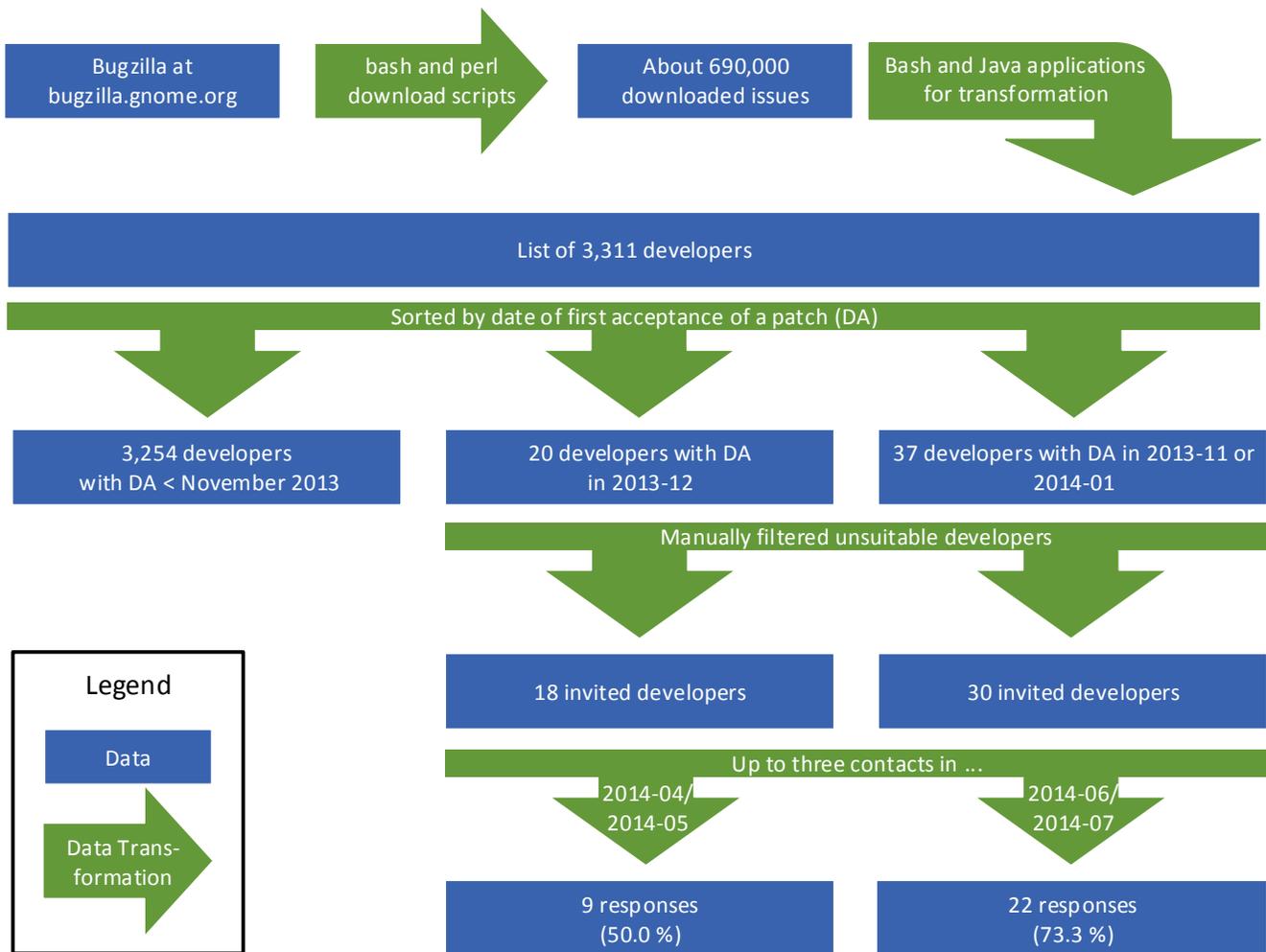


Figure 1: Data flow for the selection and invitation of survey participants from GNOME

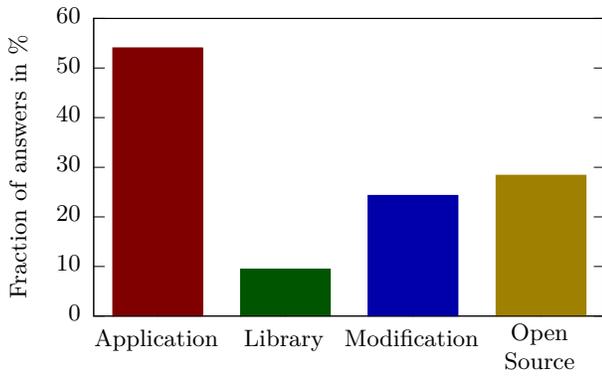


Figure 2: Codes of open answers for usage motivation

tags identifying the contributor motivation that the participants mentioned. The tags have a hierarchy, so for example, wanting to help the community is a form of altruism, and altruism itself, together with the motivation to foster FLOSS in general, belong to the more general category “Ideal”. 71 participants explained their modification motivation as an open answer, and 60 participants explained their submission motivation. 82 and 91 tags describe the answers, so each participant gave 1.15 and 1.52 modification and submission motivations, respectively.

The pre-defined items for the closed questions match the motivations identified in the existing research [12, 13]. As previous research did not distinguish between modification and submission motivations, each motivation item appears either in the closed question for modification motivations or the closed question for submission motivations. Additionally, as a result of the pretests and the experiences gained in the exploratory survey [9] this survey built upon, the phrasing of some items are different to those of the existing research.

4.1 Usage Motivation

74 participants responded to the open question of why they use project Mozilla or GNOME. Their answers were assigned 91 codes, so each answer was assigned about 1.23 codes. Figure 2 shows which codes have been frequently assigned to the answers. 54.1 % of the respondents gave answers coded with *Application* and thereby expressed that they used an application that the project develops, like Mozilla Firefox. 9.5 % of the respondents use a *Library* that the project develops. 24.3 % of the participants engaged with the project with a source code *Modification* and possibly had the submission of their modification in mind. For example, they wanted “to get involved in open source” [M28]. 33.8 % of the respondents explicitly mentioned that the project was “*Open Source*” [M3, M7, M8, ...], “FOSS” [M2], “FLOSS” [M38], or the like. 9 of these “Open Source” respondents did not specify further why specifically they came in touch with the project, admittedly because the question was not clear enough that this was asked for.

The pre-defined answers to the corresponding closed question are the x-axis labels in Figure 3. Participants could select any number of use cases. If they did not select any, this analysis excluded their answer as nonresponse. Figure 3 shows which fraction of the remaining 94 respondents selected each item. The answers show more clearly than the

open answers that most respondents, 87.2 % specifically, use an *Application* for themselves. Another use case for 21.3 % of the respondents is using a project *Library* in their own applications. This seems to be more important for GNOME contributors than Mozilla contributors, with 45.0 % and 14.9 % of the respective respondents selecting the usage motivation *Library*. About 20.2 % of the respondents got in touch with the FLOSS project in order to contribute a modification to increase *Interoperability* with another software. Hence, these respondents possibly favor a competitor over the FLOSS project for usage. 5.3 % of the respondents, and especially 10.0 % of those who contributed to GNOME, provide *Consulting* for other organizations that use Mozilla or GNOME. 7.4 % of the respondents, all of them Mozilla contributors, had *Other* reasons to get in touch with Mozilla. For example, M11 participated in a college student program to contribute to Mozilla, and M60 as well as M65 merely wanted to write code without using the application.

4.2 Modification Motivation

Figure 4 shows the four tag categories assigned to more than 7 % of the respondents’ answers to the open question for their modification motivation. There were 71 respondents to this question, so at least 6 respondents must have given answers that belong to a category to pass the threshold.

38.0 % of the respondents answered that they modified the FLOSS application due to their *Own Need*: Either they themselves or their employer had experienced a bug that they fixed with their modification, or they wanted a specific feature that they had implemented with their modification. That this is the most frequent answer supports the hypothesis of this paper.

As a close second, 35.2 % of the respondents wrote that they wanted to *Contribute* to the FLOSS project to support it. In these cases, the modification is a means to an end, as only the submission of the modification to the FLOSS project eventually improves the FLOSS project.

About 22.5 % of all respondents mentioned that their motivation to modify the FLOSS project was *Learning*. M90 wanted “to learn versioning practices”, M39 wanted to gain “experience working with code written by others” and M7 simply wanted to improve “programming skills”. Respondents in this group all contributed to Mozilla and not GNOME. Learning might be especially important for Mozilla contributors, as some of them contribute to Mozilla as part of a student program like Google Summer of Code [19].

6 respondents, 8.5 % of all respondents, claimed that they started the modification for the *Joy* of programming.

4.2.1 Closed Question on Modification Motivation

Participants had to select modification motivations from a list and rank them in order of importance. Figure 5 shows how many participants selected each motivation and ranked them as one of the first three priorities. Different ranks have different colors. The motivations were presented in random order for each participant to rule out any bias because of the order. Figure 5 presents them ordered by the number of selections with first rank. A total of 93 participants responded to this question.

Contrary to the open question, “the *Joy* of programming and/or the intellectual challenge” was the most important modification motivation. For 37.6 % of the respondents, it was the primary modification motivation, and for 86.0 % of

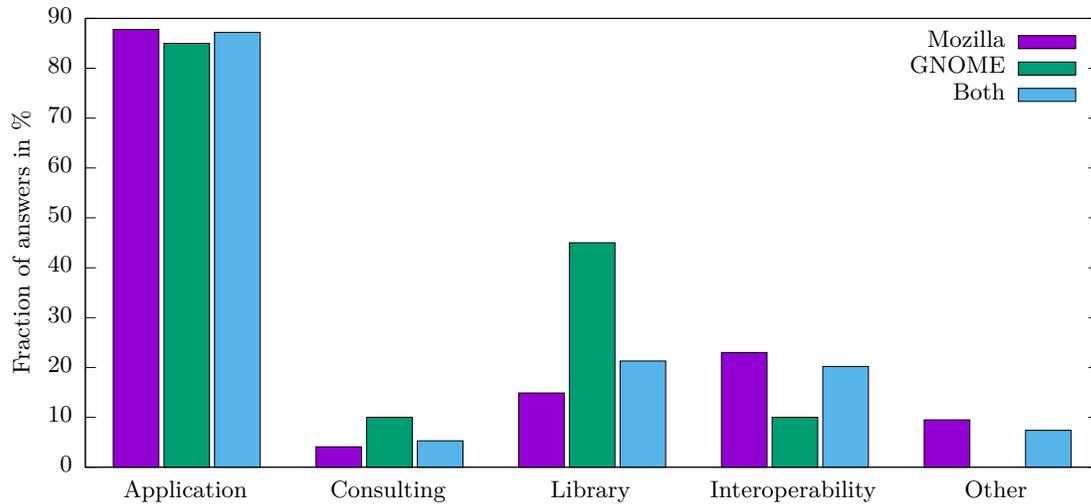


Figure 3: Distribution of answers for the closed question of usage motivation

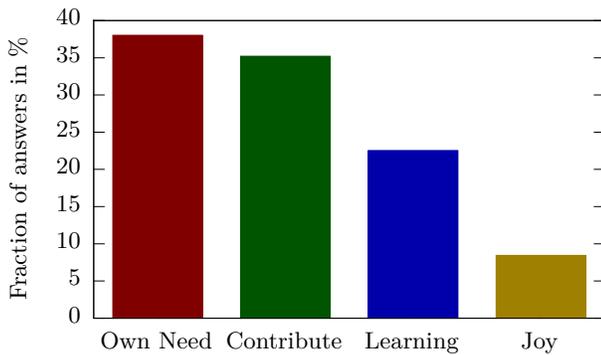


Figure 4: Answers to the open question for modification motivation

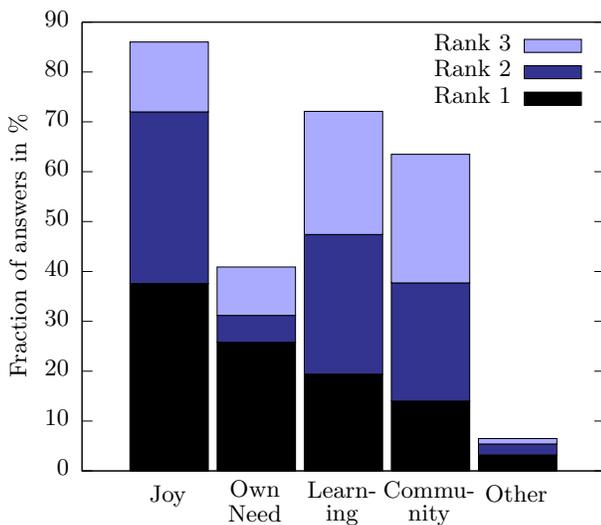


Figure 5: Ranked modification motivations

the respondents, it was one of the top three modification motivations. Even when considering only those with Joy as primary motivation, this is more than four times as much as the 8.5 % respondents who mentioned the joy of programming in their answer to the open question. There are two explanations for this discrepancy: Firstly, the participants may not be aware that the joy of programming is a possible modification motivation and it was only brought to their attention through the closed question. They possibly saw the joy of programming as a self-evident property of their modification that needed no mentioning. Secondly, they may have seen joy of programming on another level of abstraction than other motivations. They may have become software developers because they experienced joy when programming generally, but they had more specific motivations for their specific modification asked for in the questionnaire.

About 25.8 % of the respondents modified the FLOSS application primarily in order to satisfy their *Own Need*, phrased in the questionnaire as “A malfunction or missing functionality bothered me/my organization as a user of the project”. The hypothesis predicted Own Need to be an important modification motivation. However, in deviation to the other modification motivations, only a few respondents ranked this reason second- or third-most important, resulting in only 40.9 % of the respondents ranking this reason as one of the top three modification motivations. Then again, this is put into perspective by another 25.8 % of the respondents ranking this modification motivation fourth.

Learning is the primary or one of the top three modification motivations for 19.4 % or 72.0 %, respectively, of the respondents. More specifically, this modification motivation was labeled “acquiring experience in technologies used by project [Mozilla or GNOME]” for the participants. This is in line with the answers to the open question.

Getting in touch with the *Community* was the most important modification motivation for 14.0 % of the respondents, and one of the three most important modification motivations for 63.4 % of the respondents. The questionnaire phrased this modification motivation as “I like the developers of project [Mozilla or GNOME] and like to work with them”.

Participants could describe *Other* modification motivations in free-text form. About 3.2 % of the respondents ranked a free-text motivation as most important modification motivation, and about 6.5 % ranked it among the three most important modification motivations. Among these, four respondents repeated the frequent answer in the open question that they modified the FLOSS application just to have something to submit. Three respondents explained that they modified the FLOSS application as part of a student project like their thesis, although only one ranked this among the three most important modification motivations.

4.3 Submission Motivation

Figure 6 shows which answers the respondents gave to the open question about their submission motivation. Analogously to the open question on modification motivation, each submission motivation mentioned in the free text of an answer was assigned a code. These codes had a hierarchy to group classes of codes. The analysis includes only codes assigned to at least 7 % of the respondents' answers. Among these, Figure 6 shows two hierarchy levels, with Ideal, Personal, and Economic on the higher level of abstraction and the remaining motivations as more specific submission motivations. The trees below the graph indicate which motivation codes belong to which more abstract category.

Unlike other open questions in this questionnaire, a considerable number of statements could not be assigned codes that unambiguously represent submission motivations, and were not included in the analysis. 13 respondents explained their submission motivation similar to M28: "This is how my patch gets in the official source tree of Mozilla". These answers suggest that the submission is an end in itself and the respondents do not seem to consider that it would be an option to keep the modification for themselves. While this indicates altruism as a matter of course, these answers do not clearly and unambiguously imply the true motivation for submission.

Exactly half of the respondents justified their submission to the FLOSS project as an act of *Altruism*. M38's reason "to make it available to everyone" is an example of a direct answer, M50 explained a bit more indirectly "to help out". However, 20.0 % of the respondents who were in the altruist category just circumscribed that they wanted to "make it [Mozilla] better" [M8], possibly inspired by the slogan "Made to make the Web a better place" of Firefox 4 [18] and "make the Internet an ever better place for everyone" in The Mozilla Manifesto [17]. Instead of accounting this as altruism, this explanation might mean that the contributor merely wants to create something beautiful like good software, without the explicit intent to make a positive impact on the software's users. However, no respondent enunciated this non-altruistic meaning of making Mozilla better, and, to the contrary, some of these respondents seem to take it for granted that helping other users is a strong motive by itself.

15.0 % of the respondents wanted to *Foster FLOSS* in general or Mozilla in particular. About 11.7 % of the respondents felt a commitment to *Return Something* to the FLOSS project for the benefits gained through the usage of the FLOSS application. Together, the three preceding *Ideal* submission motivations accounted for about 69.5 % of the respondent's answers.

16.7 % of the respondents submitted their modification to the FLOSS project in hope of *Learning* something about the

contribution process, for example as part of a student project or in order to improve skills needed in their future careers. 10 % of the respondent submitted the modification for *Fun*. This includes cases like M49's, who found it "very satisfying" that the "product now has my [M49's] contribution". Learning and Fun constitute the main components of the major category of *Personal* submission motivations. About 26.7 % of all answers belong to this major category. Answers in this category describe intrinsic submission motivations with personal benefits the contributor expects.

The last major category describes extrinsic submission motivations for *Economic* benefits to the contributor, which 20 % of the respondents mentioned. As the only relevant submission motivation in this major category, about 13.3 % of the respondents wanted to avoid paying the so-called *Stupid Tax* [7, 25] of FLOSS: Reintegrating a self-written modification into every new official release of the FLOSS application. When the modification is submitted back to the main project, their maintainers take care of the modification and the modification's developer can use the off-the-shelf version of the FLOSS application.

4.3.1 Closed Question on Submission Motivation

Figure 7 shows which items the respondents selected as submission motivations in the closed question. As in the closed question for the modification motivation, the participants had a randomly ordered, but pre-defined list of submission motivations that they could select and had to bring into an order of importance. Figure 7 regards only the three submission motivations ranked as most important. It is ordered by the fraction of respondents selecting each motivation as their primary submission motivation. In total, 90 participants responded to this question.

For 34.4 % of the respondents, the primary submission motivation was to "gain experience in the procedures of (OSS) projects", i.e. *Learning* something. For 65.6 % of the respondents, Learning was among the three most important submission motivations, so both metrics indicate that Learning is the most important submission motivation. Interestingly, Learning appears to be more important when looking at the closed question as compared to the answers to the open question. Possibly, the respondents became aware of their motivation only through the suggested answers in the questionnaire.

In a question not detailed in this paper, about 36.5 % of the respondents answered that they were students. This comparatively high fraction of student participants at least partially explains why Learning is so important for the respondents, as students can be expected to see Learning as an important motivation: Learning about FLOSS could be part of the students' curriculum or a desire to learn made them both students and FLOSS contributors. And indeed, 51.4 % of the student respondents ranked Learning as the most important submission motivation.

Altruism was the most important submission motivation or one of the three most important submission motivations for 22.2 % or 57.8 % of the respondents, respectively. Similarly, 20.0 % respectively 45.6 % *Foster FLOSS*, or, more specifically, "publish the source code, because [they] believe source code should be open". Together with those 6.7 % respectively 31.1 % who wanted to *Return Something*, and the 1.1 % respectively 7.8 % who wanted to *Fight Closed Source*, these four motivations constitute Ideal submission

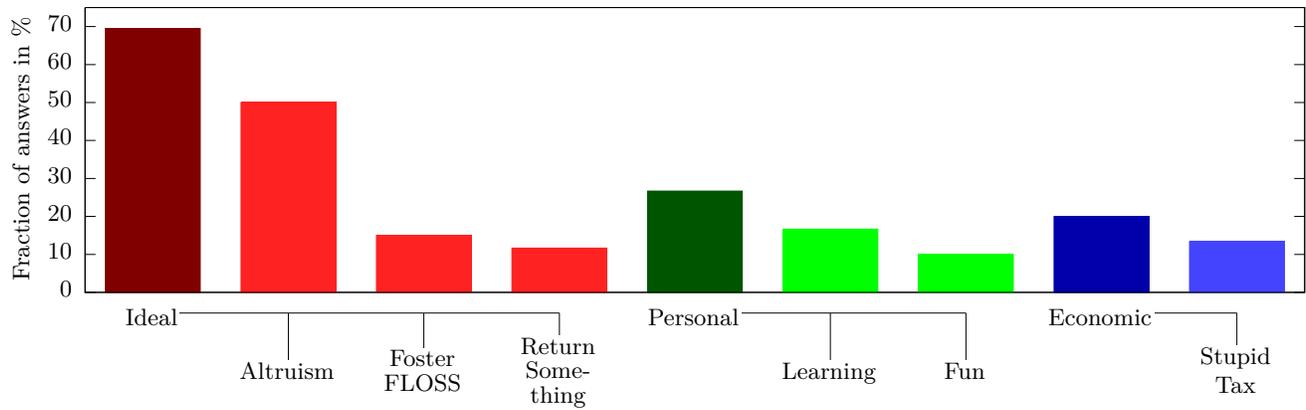


Figure 6: Answer frequency to open questions for submission motivation

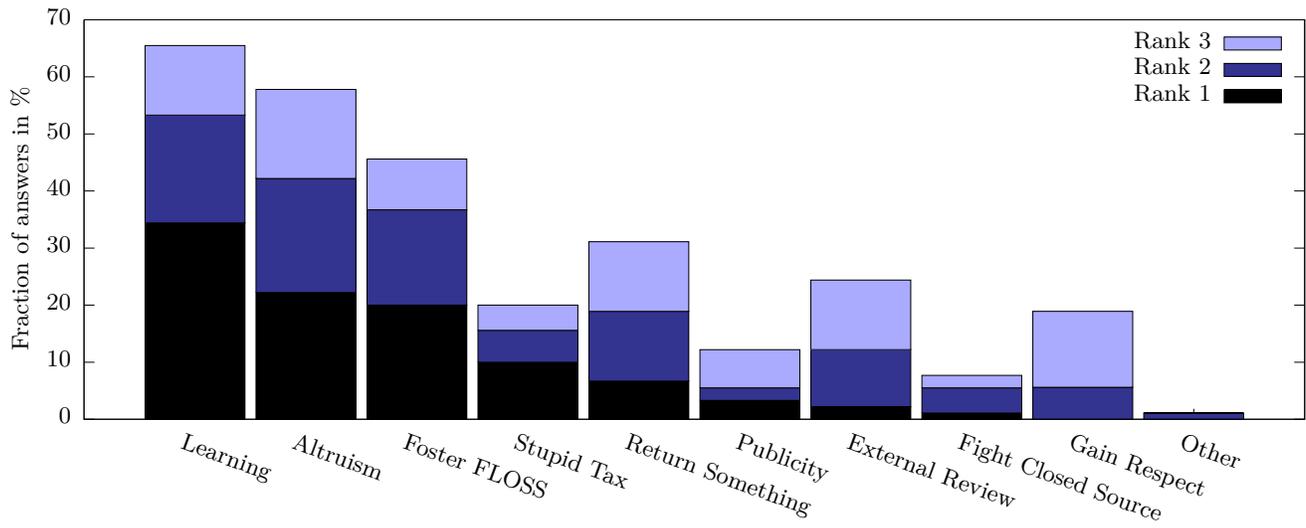


Figure 7: Ranked submission motivations

motivations which appear to be the most important group of submission motivations. This is in line with the answers to the open question.

10.0 % of the respondents submitted their modification to the FLOSS project, primarily in order to “avoid the work of reintegrating [their] changes into new releases of the OSS project”. 20.0 % of the respondents had this *Stupid Tax* among the three most important submission motivations, so this submission motivation seems to be polarizing. Contrarily, getting an *External Review* of the modified code from experts was the primary, or one of the most important three submission motivation, for 2.2 % or 24.2 % of the respondents. This is surprising as these motivations are similar in that they are the two motivations with technical benefits to the submitter.

3.3 % respectively 12.2 % of the respondents wanted to gain *Publicity* “(for example, you might have wanted to get job offers)”. 0.0 % respectively 18.9 % wanted to gain *Respect*. Gaining respect seems to be a common additional submission motivation besides others, while publicity is a strong enough submission motivation to work as the primary submission motivation – but may have an egoistic and therefore negative sound that comes with it, and therefore participants do not pick this submission motivation unless it was very important for them.

Participants who felt that the pre-defined items did not represent their submission motivation could pick *Other* and describe this submission motivation in a text box. Only participant M84 used this to explain that M84’s employer was paid to develop the submitted feature.

5. DISCUSSION

This section compares the motivations of newcomers as found in this survey to motivations of FLOSS contributors in general as identified in previous research. A quantitative or even statistically sound comparison is not possible, though, as the methodology and results vary between studies. Additionally, the demographic structure of this survey’s participants is different to the demographic structure of previous surveys’ participants. The reasons for these differences are not entirely clear. These differences, like the fraction of students in the set of survey participants, influence the motivations to contribute to FLOSS projects [13].

In Hars and Ou’s survey, Learning was the primary and self-determination the secondary motivation [10]. The motivation self-determination includes hedonism and therefore the Joy of Programming. Lakhani and Wolf [13] found learning as the third-most important reason for contribution. The two more important were the Joy of Programming and what is dubbed Own Need in this paper. This is also in accordance with this survey’s results. David et al.’s questionnaire items are too different to be compared with this survey’s results [4]. Hertel et al. found that hedonistic motivation had the strongest agreement from contributors, and found “pragmatic motives” and “social/political motives”, to which Learning belongs, as next-most important [11]. Their results are difficult to compare, though, as their factor analysis categorized motivations differently than our survey.

Previous research identified hedonism and Learning as primary motivations for participation in FLOSS projects, although the scope of these categories varies from study to study. In terms of this survey’s categories, Joy belongs to hedonism and is usually a modification motivation. Learn-

ing can be either a modification or submission motivation and previous research did not distinguish between these two different activities. This survey’s results indicate that Learning is more important as a submission motivation and less important as a modification motivation. This confirms Ducheneaut’s analysis that newcomers already have good programming skills and want to learn how to contribute to large projects [6, p. 352].

For the participants of this survey, Altruism and similar Ideal motivations are more important than in preceding research. One reason may be that developers have Joy or Own Need as modification motivations, and Altruism is only an important motivation for the submission – submission motivations may go unnoticed in preceding research because they have only one category of motivations. As another explanation, Rullani argued that monetary and signaling-related motivations increase in importance over the time after a developer has joined a FLOSS project [21]. It is therefore unsurprising to see that these types of motivations are not important in a survey of newcomers.

6. MODIFICATIONS OUT OF OWN NEED

The hypothesis proposed in Section 1 says that most first-time contributors modify the FLOSS project’s source code primarily because they need the modification for themselves. This means that more than half of the respondents should have ranked Own Need as their most important modification motivation. As only 25.8 % of the respondents ranked Own Need first as a modification motivation, the hypothesis must be rejected – a binomial test as post-hoc analysis using the hypothesis as null hypothesis instead of alternative hypothesis gives a p-value < 0.0001 .

Without the hypothesis, there must be another explanation for the high number of respondents ranking Own Need as their primary modification motivation in the exploratory survey [9] and in Shah’s survey [22]. As the phrasing and user interface in the main and exploratory surveys were identical, the questionnaire implementation cannot cause bias. The differences between the participants of the exploratory survey and those of the main survey may be this explanation. All participants in the exploratory survey were professional software developers. Thus, the high importance of the modification motivation Own Need may be due to the participants’ occupation. This first possibility will be discussed next.

6.1 Modification Motivation and Occupation

Previous research did indeed identify associations between occupation and contributor motivation for FLOSS developers. The results are ambiguous whether Own Need depends on occupation. The next two paragraphs discuss the state of research and the paragraphs afterwards presents statistical clues from this survey.

In their survey, Hars and Ou [10] differentiate between contributors paid for their contribution, employed developers whose primary assignment is not their contribution, and contributors who are non-professional programmers. Although the three groups vary in some contributor motivations, they do not vary measurably in others. Interestingly, Own Need has of all included contributor motivations the least variance between the three groups: 38.5 % of the contributors who were paid for their contribution, again 38.5 % of the employed developers, and 36.4 % of the non-professional programmers rate Own Need “high”. This indicates that while occupation

does influence the contributor motivation, it does not influence Own Need in particular. Thus, the difference between the exploratory survey and the main survey supposedly has another reason.

Lakhani and Wolf [13] also collected contributor motivation and occupation data. They found statistically significant differences in contributor motivations between contributors who were paid for their contribution and those who were not paid. However, this survey explicitly excluded employees of the Mozilla Foundation, the main employer of developers working on Mozilla, and did not distinguish explicitly between paid and unpaid contributions for the remaining participants. Furthermore, Lakhani and Wolf partition Own Need in “Work need only” and “Non-work need” and so the overall number for Own Need cannot be derived from the published data for paid and unpaid contributors, as the data do not contain the overlap between those two types of needs. They tested both subtypes “Work need only” and “Non-work need” of Own Need successfully for statistically significant differences between paid and non-paid contributors, but they did not test Own Need as an aggregated motivation. The individual differences might cancel each other out and therefore still be in concordance with Hars’ and Ou’s results. Therefore, a direct comparison with Lakhani’s and Wolf’s results is not possible, but casts doubt on the independence between contributor motivation and Own Need.

As a follow-up analysis, we restricted the initial hypothesis to employees and tested it again. With this restriction, the respondent group better resembles the respondents of the exploratory survey. Of the 29 employed respondents who answered the closed question of modification motivation, 14 ranked Own Need first, so this is still slightly less than 50 %. Contrary to the original unrestricted form of the hypothesis, the restricted hypothesis may still be true and the too low number of employed respondents in our survey may have introduced a random error: Neither the restricted hypothesis nor its opposite can be rejected with statistical significance.

In continuation of the literature discussion above, the next research question is: Do employees rank Own Need as a more important modification motivation than non-employed contributors? As the motivations scales are rankings and not continuous numerical data, a t-test is not possible. Instead, a Mann-Whitney U test fits this research question, especially as it allows to consider those respondents who did not consider Own Need as a modification motivation at all – these respondents implicitly ranked Own Need less important than any explicit rank. In contrast to a t-test, the Mann-Whitney U test does not need a concrete numeric value for these implicit rankings, as it suffices to know that they are ranked with least importance. Low ranks designate a high importance, so the null hypothesis is: The rank of Own Need for employed respondents tends to be at least as high as the rank for non-employed respondents. The Mann-Whitney U test yields a p-value of 0.0781, so the difference is not significant at a significance level of $\alpha = 0.05$, but it is significant at $\alpha = 0.1$. Occupation may have an influence on Own Need, but the results are not conclusive.

6.2 Grouping Newcomers through Own Need

As noted in Section 4.2.1 and visible in Figure 5, Own Need is more polarizing than the other modification motivations: A comparatively low number of respondents ranked Own Need second or third, although Own Need is the second-most

popular option for the first rank. Specifically, 25.8 % of the respondents ranked Own Need as their primary modification motivation. 41.9 % of the respondents saw Own Need as a modification motivation but not as their primary motivation: most of them, 25.8 % of all respondents, ranked Own Need fourth. 32.3 % did not see Own Need as modification motivation at all.

Thus, using this motivation, three main groups of contributors can be distinguished: First, those who missed a feature or suffered from a defect in the FLOSS application, and modified the FLOSS application to solve their problem. They ranked Own Need first. Second, those who also missed a feature or suffered from a defect, but there was a workaround or the problem did not impact them very much – fun of programming, the project community, and learning about technology are more important motivations for them to modify the FLOSS application, but at least Own Need is a modification motivation for them. Third, those who actively searched for a task in the FLOSS project and who did not find a problem through their own usage of the FLOSS application. For them, Own Need was no modification motivation at all.

7. CONCLUSION

The survey presented in this paper targeted newcomers to FLOSS project, out of which 94 responded to the questions presented in this paper. The survey extends the previous qualitative research on newcomers [9, 22] with quantitative data, as it has more respondents. It also stands out with a high response rate of 52.2 %.

The results are in line with previous research on FLOSS contributor motivation. However, we differentiated modification and submission modification and found that hedonistic motivations and needing a modification for oneself are usually only modification motivations. Altruism, formerly identified as only a less important contributor motivation, turns out to be a very important submission modification.

Previous research on newcomer motivations [9, 22] indicated that needing a modification for oneself (Own Need) is by far the most important modification motivation. This hypothesis was put to test with the quantitative data of this survey. Surprisingly, Own Need was the primary modification motivation for only one fourth of the respondents, so we could reject the hypothesis with statistical significance. We identified two other groups of newcomers by how they ranked Own Need: 41.9 % of the respondents found other modification motivations to be more important than Own Need, and 32.3 % did not see it as a modification motivation at all.

We explored the reasons for the strong differences of this survey’s results to those of the previous research on modification motivations of newcomers. Possibly, Own Need is the primary modification motivation for employed newcomers only. However, the results of this analysis were not conclusive. Therefore, future research should identify the factors influencing to which of the three groups identified in this survey a newcomer belongs.

8. REFERENCES

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