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IN THE SPOTLIGHT – EVALUATING HOW CELEBRITIES AFFECT FLOSS DEVELOPERS’ PARTICIPATION MOTIVATION

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Abstract

Motivating one’s workforce is a major challenge for organizations. Demotivated employees not only cause harm to organizations’ productivity and innovation but also show increased turn-over intentions. As in the case of organizations, projects developing Free Libre Open Source Software (FLOSS) depend strongly on the motivation of their contributors. Existing research repeatedly highlights project members’ motivation for FLOSS projects’ success and continuance. However, existing evaluations primarily treat project members’ participation motives as exogenous constructs. As a result no operational advice can be derived for FLOSS projects on how to motivate their contributors. This research takes an alternative view and regards FLOSS developers’ motivation as product of their self-determination and influences of their surrounding environment. Drawing on Self-Determination-Theory (SDT), we consider FLOSS developers’ motivation as multi-dimensional and sensitive to environmental stimuli. As an example for such environmental stimuli we propose that project celebrities (members with a high standing in the FLOSS community) stimulate the participation motives of project members in different ways. An evaluation with 65 participants of Google Summer of Code (GSoC) largely supports our research model and provides evidence for the endogenous character of FLOSS developers’ motivation. Our research results suggest that celebrities stimulate rather self-determined than externally regulated motives.

Keywords: Motivation, FLOSS, Self-Determination-Theory, Celebrities

1 Introduction

Motivated employees are the backbone of every organization and the key for sustainable success in a changing business environment. Organizational studies stress that employees' motivation does not only determine how much effort they spend but also how productive and innovative the entire organization is. All the worse, study results reveal that less than a third of US employees are overall motivated (Coffman et al., 2002). In order to re-ignite employees' motivation, firms often provide extra financial incentives or invest considerable amounts in training programs. This is not possible for projects developing Free Libre Open Source Software (FLOSS), which depend on the voluntary participation of their contributor base. FLOSS initiatives are a substantial part of modern IT. Today, large parts of the internet are based on FLOSS and organizations rely for their mission critical tasks on FLOSS (Gartner Inc., 2008). But, most FLOSS projects fail. According to Madey and Christley (2008), most FLOSS initiatives become inactive soon after registration usually because of leaving or retiring contributors. As in the case of organizations, extant FLOSS literature emphasizes project members' motivation for their project commitment and continuance. Most of these evaluations consider motivation as an exogenous variable, which influences project behaviour. In contrast, very little is known about the ways in which FLOSS developers' motivation can be influenced. This, however, is most relevant for FLOSS projects as it is a key challenge for them to create a high participation motivation among their contributors in order to ensure their continuance.

This research examines new ways in which FLOSS projects can increase the motivation of their developer base. With respect to FLOSS projects' limited resources, we evaluate if collaboration initiatives with celebrities (developers who are known for their competence and standing within the project community) can foster members' contribution motivation. To understand the different stimuli project members can extract from their work with celebrities, we rely on Self-Determination-Theory (SDT) (Deci and Ryan, 2000). This theory provides an appropriate theoretic foundation for our research, as it regards motivation as a product of individual and environmental influences and distinguishes various motivation forms. SDT distinguishes intrinsic and extrinsic motives. Extrinsic motivation classifies behaviour which is accomplished because of external incentives such as financial benefits or status gains. In contrast, intrinsically motivated individuals act in certain ways because they perceive it as fun and enjoyment. By applying SDT to the context of FLOSS development, we propose that project members are driven by extrinsic (such as income and status gains) as well as intrinsic motives which can be stimulated through working together with celebrities. On the one hand, such collaboration opportunities increase developers' extrinsic motives as celebrities help them to achieve higher visibility in the project community and towards potential employers. On the other hand, with their rich contribution expertise, celebrities also assist project members in acquiring and applying new knowledge which, in turn, stimulates intrinsic motives. Hence we evaluate the research question: *Can collaboration initiatives with celebrities raise project members' intrinsic and extrinsic motivation?*

With examining the motivational effects of collaboration initiatives with celebrities, we contribute to FLOSS and organizational research. First, our evaluation enriches existing FLOSS literature as it commonly treats members' participation motivation as an exogenous variable and provides ground for future studies on FLOSS developers' motivation. Moreover, our research provides a first step for deriving practicable guidance for FLOSS initiatives on how to raise the participation motivation of their contributor base. At the same time, our research has implications for the organizational domain. Researchers increasingly recommend organizations to consider knowledge workers as volunteers (Drucker, 2002). With respect to this new perspective, this study provides ground for new motivation studies in the organizational domain. Considering the large amount of unmotivated employees in organizations, the derived advice for FLOSS projects may also inspire managers to design new measures to kindle the motivation of their workforce.

In order to evaluate how collaboration initiatives with celebrities affect project members' motivation, this research paper is structured as follows. The following section summarizes relevant FLOSS

literature. Based on this, we detail our theoretic fundament and develop our research model. Next, we present our research methodology and the results of our evaluation. Finally, we discuss our research findings in light of existing FLOSS literature and derive possible directions for future studies.

2 FLOSS Research

Existing FLOSS literature commonly examines project members' contribution behaviour either from an individual centric or from a project centric perspective. Research with an individual centric view suggests a variety of relevant contribution motives for FLOSS developers. With their empirical research, Roberts et al. (2006) provide evidence that financial benefits are an effective stimulus for FLOSS developers' project participation. In addition, the authors suggest that status gains within the project community are another stimulus for FLOSS developers' commitment. Ke and Zhang (2010) support the importance of status motivations among FLOSS developers. In particular, their research findings indicate that project members who are driven by status gains put more effort into their project work. Another reason for FLOSS developers' project participation is their ideological conviction. Stewart and Gosain (2006) conclude that strong ideological views on open source software development facilitate project members' commitment and continuance. In line with their conclusion, other evaluations indicate that FLOSS developers who socialize into the project community put more effort into their project work. According to Bagozzi and Dholakia (2006), a common reason for developers to contribute to a FLOSS project is their identification with the community. Fang and Neufeld (2009) support this. Based on their longitudinal examination of FLOSS developers' project behaviour, the researchers reveal that members' identification with the project community stimulates them to continue their coding efforts. Finally, existing evaluations support the importance of enjoyment for members' project engagement. Shah (2006) points out that members have to perceive their project work as enjoying and satisfying in order to intensify their commitment.

Beside individuals' motivations, previous FLOSS studies highlight the role of relational aspects for project members' participation. Various studies examining FLOSS projects' topological properties underline the relevance of preferential attachment. This topological characteristic is also known as "the rich get richer". It describes the phenomenon that project members tend to collaborate with those who are experienced and known within the project community. In contrast, project members who have only little collaboration experience are less likely to attract and sustain the commitment of others. Another topological characteristic which affects members' participation is team cohesiveness. Singh et al. (2011a) provide evidence that project members commit themselves stronger in the project when they know members in the team closely. Research findings by Grewal et al. (2006) support this. In addition to this structural evaluation approach, various studies examine members' interactions from a more relational perspective. Hu et al. (2012) highlight the key role of members' reputation in order to understand the preferential attachment phenomenon in FLOSS projects. As the researchers point out, the ability of FLOSS developers to attract and retain project members depends on their reputation within the FLOSS community. The underlying reasons why members with high reputation are able to increase the project commitment of other developers, however, are unknown. An understanding of these relational processes is vital for FLOSS projects as it provides them with relevant advice on how to best stimulate their members' commitment and hence ensure their continuance.

This research combines motivational research with relational aspects in order to understand how project members with high reputation can stimulate the participation behaviour of other project members. This understanding is highly relevant for FLOSS managers as it provides them with the necessary know-how for stimulating the development efforts of their contributor base. In order to understand FLOSS developers' various contribution motives and how members with high reputation are able to affect those, we draw on Self-Determination-Theory (Ryan and Deci, 2000). According to this theory, individuals' motivation is a product of their selves and the surrounding environment. The following section provides the theoretic background of our research and develops our research model.

3 Research Model Development

Motivation describes individuals' will to behave in a certain way. While some theories see motivation as a uni-dimensional construct which varies only in strength among individuals, Ryan and Deci (2000) designed with SDT a theory which differentiates between various motivational forms. The basic tenet of SDT is that people have three innate psychological needs which they seek to satisfy. These three needs are: the need for competence, relatedness and autonomy. Behaviour, which arises naturally through the satisfaction of these needs, is termed intrinsic motivation. In contrast, extrinsic motivation describes the behaviour which is caused through external regulation. In addition to this basic classification, Ryan and Deci (2000) distinguish four sub-types of extrinsic motivation. These sub-types differ on the degree to which individuals perceive their behaviour as self-determined. External motivation describes the type of extrinsic motivation with the least amount of self-determination. Individuals driven by this motivation accomplish certain behaviour only in order to gain an external reward or to avoid external punishment. The next motivation along this spectrum is introjected motivation. Driven by this motivation type, individuals behave to achieve self-esteem and maintain self-worth. Thereby, individuals still perceive an external point of causality for their actions but are also to some degree self-determined. Identified motivation categorizes behaviour which is regarded necessary in order to achieve a valued goal. While individuals with this motivation still perceive their behaviour externally regulated they also perceive it equally self-determined. Integrated motivation describes the fourth form of extrinsic motives with the highest amount of self-determination. This motivation form is highly similar to intrinsic motivation, except that the causes for one's behaviour originated not from oneself but from the external environment.

In line with SDT, we consider FLOSS developers' motivations multi-dimensional and subject to external regulation. With respect to previous research which highlights the key role of preferential attachment for members' interaction, we hypothesize that those members in the project with high levels of expertise and contribution experience can motivate FLOSS developers. Because FLOSS projects follow a meritocracy (Roberts et al., 2006), we suppose that members with high levels of expertise and collaboration experience are well known among members and have a strong standing in the community so that we refer to them as 'celebrities'. In the following, we propose that developers with extrinsic motives may be stimulated from collaborating with celebrities by the increased visibility within the community and towards corporate sponsors. In contrast, intrinsic motivated members may be stimulated by celebrities' assistance in acquiring and applying new knowledge.

Developers with external motives contribute to a FLOSS project in order to gain external rewards or to avoid punishment for their doing. According to SDT, individuals' external motivation rises with the prospect of higher external stimuli (Stone et al., 2009). In the context of FLOSS, this can be achieved through working together with celebrities. With their expertise, celebrities are of great value for project members. Especially project members, who are paid for their work in a FLOSS project, will most likely appreciate the help of celebrities as it increases their chances to succeed with their job. In addition, celebrities can boost project members' market value and therefore create the prospect of higher financial compensation. As Dahlander and Wallin (2006) point out companies often seek to use FLOSS projects as complementary asset for their products or services. Therefore, they strive to control the development of the FLOSS project. Consequently, such firms look to employ project members with the highest influence within the project. With respect to this practice, FLOSS developers may use celebrities to increase their influence in the project and with that their visibility to potential employers. Hence, we expect that celebrities' expertise and standing in the project community makes FLOSS developers to perceive higher external rewards for their doing and hypothesize that:

Hypothesis 1: Working together with celebrities increases FLOSS developers' extrinsic motivation.

According to Raymond (1999), introjected motivation is a common driver for FLOSS developers. This is supported by Roberts et al. (2006) who similarly conclude that project members engage in FLOSS development to enhance their sought-after status in the community. With respect to SDT, FLOSS

developers' introjected motivation rises with the prestige and respect for their doing from the project community. Celebrities can help project members to achieve this. On the one hand, members' coding activities get higher attention among other members through the involvement of a celebrity. On the other hand, celebrities' coding expertise may cause introjected motivation to rise. Because of their rich project experience, celebrities can assist project members to produce outstanding code which they can use to showcase their programming abilities to other FLOSS developers. We expect therefore that celebrities' standing in the community and their coding expertise increases the awareness and appreciation FLOSS developers experience for their doing among other members, which in turn increases their introjected motives. Therefore we hypothesize that:

Hypothesis 2: Working together with celebrities increases FLOSS developers' introjected motivation.

Identified motivation causes project members to participate in a FLOSS project's development because they value its goals and mission (Fang and Neufeld, 2009). It is not an easy task to facilitate this type of motivation as it depends on the existence of both external regulation and members' self-determination. According to Koestner and Losier (2002) project managers can promote this motivation only when they provide project members with increased autonomy and a personal rationale for their doing. We suppose that celebrities are capable of providing FLOSS developers with both of these aspects. While less known project members may struggle to get the necessary freedom to implement fundamental changes, celebrities may use their standing in the community to pledge for higher autonomy for a FLOSS developer's coding initiative. We assume that these higher levels of freedom stimulate FLOSS developers' feelings of self-determination for their project work. Further, we expect that such collaboration initiatives are capable of providing FLOSS developers with a personal rationale for their doing. Celebrities exemplify the possibility that project members can not only achieve higher coding capabilities but also advance their career with their project participation. Consequently, we hypothesize that celebrities help project members to experience higher levels of autonomy and a rationale for their doing, which in turn stimulates their identified motivation.

Hypothesis 3: Working together with celebrities increases FLOSS developers' identified motivation.

With integrated motivation, individuals fully internalized external regulations. For FLOSS development, this is the case when FLOSS developers deeply believe in the norms and values of open source software development (Ke and Zhang, 2010). In order to foster this form of motivation, members' need for autonomy, relatedness and competence has to be satisfied through their project work. This can be achieved through working together with celebrities. As outlined previously, celebrities can use their community standing to offer project members higher levels of autonomy for their doing. In addition, celebrities who assist regular project members in their doing may foster feelings of belongingness towards the top contributors of the project, which would have never developed otherwise. Finally, celebrities can satisfy members' needs for competence. This is because FLOSS developers may regard their collaboration with a celebrity as privilege for their previous contributions to the project. Moreover, with their profound coding knowledge, celebrities are able to provide their collaboration partners with competent feedback for their coding and inspire them to build new knowledge. Hence, we hypothesize that:

Hypothesis 4: Working together with celebrities increases FLOSS developers' integrated motivation.

FLOSS developers with intrinsic motivation derive satisfaction from their project work. Very much like in the case of integrated motivation, one has to satisfy project members' feelings for autonomy, relatedness and competence in order to facilitate this form of motivation. An important difference, however, is that intrinsically motivated FLOSS developers naturally perceive their project work as enjoyable. We suppose that celebrities foster members' intrinsic motivation in various ways. First, celebrities have the necessary standing in the project community to provide FLOSS developers with high levels of autonomy for their doing. In addition, long term contributors, like celebrities, are often intrinsically motivated, so that they can foster relatedness feelings among intrinsically motivated

project members. Finally, celebrities can increase project members' intrinsic motivation by providing them with appropriate feedback for their doing. Considering that intrinsically motivated FLOSS developers strive to acquire and apply new knowledge (Singh et al., 2011b), this assistance is a significant stimulus for them. With respect to these positive effects celebrities can have on project members' needs for autonomy, relatedness, and competence we hypothesize that:

Hypothesis 5: Working together with celebrities increases FLOSS developers' intrinsic motivation

4 Research Methodology and Results

In this section, we detail our research methodology and present the results of our evaluation. The following subsection first details our collection method. Thereafter, we describe the used measures and present the evaluation results of our validity and hypotheses testing.

4.1 Data Collection

In order to evaluate our research model, we surveyed FLOSS developers on their motivation and the celebrity status of the developers they have worked with. Google Summer of Code (GSoC) provides an optimal research setting for our evaluation. GSoC is an annual event sponsored by Google, which intends to assist developers to contribute to FLOSS initiatives. Therefore, the participants of the event are teamed together with long-term contributors of a FLOSS project, who guide and assist them in their doing. Beside the assistance of experienced contributors, Google provides GSoC participants with a scholarship. By offering financial compensation, prestige, and learning opportunities, GSoC attracts the whole spectrum of purely intrinsic to purely extrinsic motivated developers. In order to apply for GSoC, candidates are required to work out a project proposal which is then reviewed and prioritized by the corresponding organizations.

To ensure that the FLOSS developers GSoC participants are teamed with could have achieved celebrity status, we restricted our evaluation sample to GSoC projects with a large developer base and a rich contribution history. KDE and GNOME, the two popular desktop environments for UNIX systems and two of the largest organizations in GSoC, satisfy these requirements. Not only has their development started over 10 years ago but they could also maintain a strong development activity throughout the years. Another advantage of these two organizations is that they strongly recommend GSoC applicants to find a mentor for their coding project before submitting their application. As a consequence, the surveyed GSoC participants generally selected their mentors themselves.

In order to restrict our survey sample to GSoC students of these two large FLOSS projects, we created a private survey using LimeSurvey. Next, we generated unique access tokens for this private survey and emailed them to the targeted GSoC participants. Thus, only invited students could participate in the survey. With this surveying method we also had the possibility to send out reminders to invited participants who did not complete the survey two days before the announced deadline. In total, we invited 97 GSoC students to our study of whom 65 participated in our survey. This results in a response rate of 67.01%.

4.2 Measurement

All constructs are measured using five point Likert scales. To ensure validity and reliability of the used question items, we adopted whenever possible questions that have already been used in previous evaluations. In line with previous evaluations by Ke and Zhang (2010) and Sen et al. (2008), we measure project members' motivation types as reflective constructs, which are assessed with three questions each. All used measurement items can be found in the Appendix section of this research paper. Examples for the used question items are: "It is important to me that I can promote my career prospects through participating in this project" (External Motivation), "I am strongly motivated by the

	Celebrity	Extrinsic	Identified	Integrated	Intrinsic	Introjected
Celebrity 1	0.9071	0.1547	0.4844	0.5222	0.5229	0.42
Celebrity 2	0.7667	0.1597	0.3474	0.3324	0.2785	0.1276
Celebrity 3	0.8758	-0.0492	0.5412	0.4708	0.4327	0.2355
Extrinsic 2	0.0913	0.9973	0.2245	0.1538	0.0954	0.4633
Extrinsic 3	-0.008	0.544	0.1987	0.2666	0.2311	0.5874
Identified 1	0.408	0.172	0.8693	0.7753	0.7948	0.4948
Identified 2	0.4992	0.16	0.9114	0.7578	0.7902	0.4782
Identified 3	0.5294	0.2406	0.8735	0.6847	0.6638	0.4298
Integrated 1	0.4387	0.2208	0.7385	0.8891	0.742	0.5401
Integrated 2	0.4776	0.0436	0.7026	0.9096	0.8261	0.4876
Integrated 3	0.48	0.105	0.7452	0.8327	0.737	0.3128
Intrinsic 1	0.5274	0.0707	0.848	0.8636	0.9774	0.5387
Intrinsic 2	0.4497	0.0612	0.7818	0.8756	0.968	0.5625
Intrinsic 3	0.4708	0.0976	0.8049	0.8048	0.9543	0.4781
Introjected 1	0.0788	0.4081	0.3559	0.3419	0.2985	0.7822
Introjected 2	0.267	0.393	0.3911	0.3975	0.4617	0.9002
Introjected 3	0,3737	0,3964	0,5702	0,5355	0,5655	0,9523

Table 1: Loadings and Cross Loadings

recognition I can earn through participating in this project” (Introjected Motivation), “When I talk about the project, I usually say ‘we’ rather than ‘they’” (Identified Motivation), “The project shares my views on open source software”, “It is fun participating in this project” (Intrinsic Motivation).

To the best of our knowledge this is the first study which subjectively evaluates the celebrity status of project members. As a result, we designed new measurement items for this construct with respect to existing FLOSS literature. According to Roberts et al. (2006), FLOSS projects follow a meritocracy so that members’ influence within the FLOSS project is determined by their code contributions. Hence, we measured project members’ celebrity status by evaluating how others project members assess their competence and respect within the community. Examples for the used measurement items for this construct are: “Other developers know my mentor for his/her competence” and “The standing of my mentor in the community is very strong”.

4.3 Measurement Model

We start our data analysis by evaluating the reliability and validity of the used measurement model. To ensure convergent validity, we evaluated (i) each items’ reliability, (ii) the composite reliability of all latent constructs and (iii) the average variance extracted (AVE). The reliability of the used measurement items was assessed by calculating their loadings on the particular construct and checking it against the recommended benchmark of 0.5. One measurement item for external motivation (ExtM 1) did not pass this benchmark and was therefore excluded from further evaluation.

Table 1 visualizes, the loadings of all remaining items achieved considerable higher amounts than 0.5, which supports measurement validity. Next, we calculated each construct’s composite reliability (CR), which measures the degree to which a latent variable is explained through its items. As shown in Table 2 the composite variability of all evaluated constructs, are above the recommended threshold of 0.7. Finally, we calculated the AVE, which is the degree to which a construct’s variance is explained by its

	Cronbachs Alpha	Composite Reliability	AVE	Construct Correlations (AVE square roots on the diagonals)					
				1	2	3	4	5	6
Celebrity	0.814	0.888	0.726	0.852					
Extrinsic	0.754	0.770	0.645	0.097	0.803				
Identified	0.862	0.916	0.783	0.547	0.218	0.885			
Integrated	0.850	0.910	0.770	0.532	0.137	0.831	0.878		
Intrinsic	0.965	0.977	0.934	0.501	0.079	0.841	0.877	0.967	
Introjected	0.872	0.912	0.776	0.330	0.434	0.525	0.507	0.544	0.881

Table 2: Construct Consistency Values

items in relation to its measurement error. In our case, the AVE of all latent variables is well above 0.5 and, therefore, in line with the recommendations by Rodgers and Pavlou (2003).

Next, we evaluate discriminant validity between the constructs. To do so, we employed two different tests. First, we checked that all measurement items load strongest with their corresponding construct than with any other. Table 1 lists the loadings and cross-loadings of all used measurement items in our evaluation and confirms that all measurement items load strongest with their associated construct. In line with the recommendations of Fornell and Larcker (1981), we performed another test for discriminant validity. The two researchers recommend that the square root of a construct’s AVE should be higher than the correlation between itself and any other construct. Beside the evaluation results for construct validity, table 2 lists the details of this reliability test. It displays the correlation between the various constructs and, in the diagonal cells, the square roots of the AVE values. As the square root of all constructs’ AVE is higher than their correlation with any other construct, our measurement model fulfils Fornell and Larcker (1981)’s criteria for discriminant validity.

4.4 Hypotheses Testing

To evaluate our research model, we chose to examine the strength and significance of the defined paths in our structural model using the Partial Least Squares (PLS) algorithm. PLS is a structural equation modelling technique which already produces robust results for relatively small sample sizes (Wetzels et al., 2009). Other relevant advantages of the PLS algorithm for our research context are that it does not make assumptions about the distribution of the collected data and that it is well suited to predict dependent endogenous variables (Henseler et al., 2009).

The results of the PLS analysis reveal an overall positive effect of celebrities on FLOSS developers’ motivation. In particular, the results show that celebrities have only minimal explanatory power for project members’ external motivation ($R^2 = 0.01$). In addition, we find no significant influence of a partners’ celebrity status on FLOSS developers’ external motivation ($\beta = 0.097$, $p = 0.580$). Hence, our study sample does not support hypothesis 1. A collaboration partners’ celebrity status explains some variance of FLOSS developers’ introjected motivation ($R^2 = 0.109$). Moreover, we find a moderate, positive influence of the celebrity status on members’ introjected motive ($\beta = 0.33$, $p < 0.001$). This is in line with our hypothesis 2. In contrast to these two motives, a collaboration partner’s celebrity status explains considerable amounts of the variance in FLOSS developers’ identified ($R^2 = 0.299$), integrated ($R^2 = 0.283$) and intrinsic motives ($R^2 = 0.252$). Consistent with our hypotheses 3, our evaluation results show that the celebrity status of the project member a FLOSS developer works with has a significant and strong positive influence on her identified participation motive ($\beta = 0.547$, $p < 0.001$). In a similar vein, our study sample shows that a collaboration partner’s celebrity status has a strong positive influence on project members’ integrated participation motives ($\beta = 0.532$, $p < 0.001$) which in turn supports hypotheses 4. Finally, our evaluation provides evidence that celebrities have an effect on FLOSS developers’ intrinsic motives. In detail, our study sample shows that the celebrity

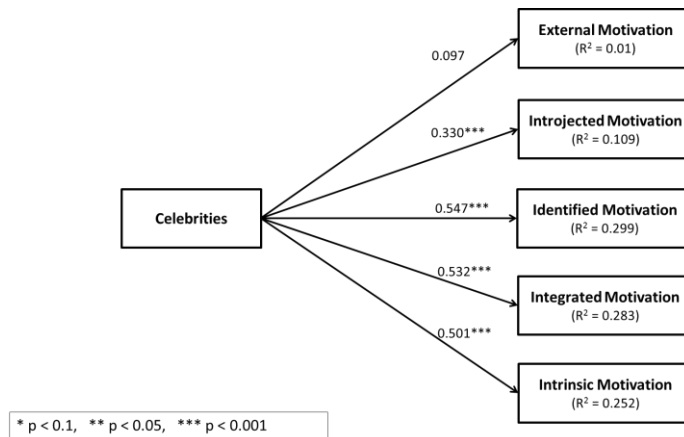


Figure 1: Evaluation Results

status of a collaboration partner has a significant, strong positive influence on FLOSS developers' intrinsic participation motive ($\beta = 0.501$, $p < 0.001$).

5 Discussion and Implications

In this section, we discuss the findings of our study and derive possible avenues for future research. In the following we outline the implications for theory and practice. Thereafter, we point out the limitations of our study and provide a conclusion of our research.

5.1 Discussion

While other studies largely ignore individuals' motivation and study only the concrete behavioural outcomes of environmental influences (Dalle et al., 2004), this study helps to understand why some individuals react differently to environmental stimuli than others. To do so, this research draws on Self-Determination-Theory and considers FLOSS developers' motivation as a multidimensional construct that is sensitive to contextual factors. Moreover, this research complements existing literature which studied the distinct effects of FLOSS developers' motives on their behavioural actions to build a comprehensive understanding for the influence of contextual factors on project members' participation behaviour. This understanding is fundamental to design effective means to increase project members' participation motivation and to decide when and how to use those.

As an example for an environmental influence, we analysed how project celebrities affect FLOSS developers' participation motives. The results of our evaluation indicate that the celebrity status of a collaboration partner explains relatively little of the variance in FLOSS developers' external and introjected participation motives. Taking a closer look, these results might not come as of a surprise. Externally and introjected motivated project members align their behaviour in the first place to gains in income respectively status. It seems plausible that externally motivated developers are much more affected by the presence of corporate sponsors in the FLOSS project. The low explanatory power of celebrities for the formation of introjected contribution motives could suggest that the project community is only a part of FLOSS developers' relevant peer group. This, however, raises the question of whom project members' peer groups consists of and whether it is subject to change. In contrast to these rather external regulated motives, a collaboration partner's celebrity status within the project explains to considerable degrees the variance of FLOSS developers' identified, integrated, and intrinsic participation motives. In the case of FLOSS developers' identified participation motives, a collaboration partner's celebrity status even explains nearly a third of its entire variance. Nevertheless, future research is required to identify other environmental factors which influence FLOSS developers' self-determined motives. According to Bagozzi and Dholakia (2006), FLOSS developers' social

identity could play an important role for their project identification. Other relational characteristics could also be relevant for integrated participation motives as Stewart and Gosain (2006) link trust relationships to the formation of shared ideological values among FLOSS developers. Finally, it will be interesting to see, if project members' intrinsic motives are influenced by their level of expertise.

In contrast to hypotheses 1, our study results show no significant relationship between celebrities and project members' external motivation. This could be because working together with celebrities does not increase FLOSS developers' value to potential employers. Another reason for this insignificant relationship could be the extremely low exploratory power of celebrities for project members' external motivation. As we hypothesized, our study sample provides evidence that collaborating initiatives with celebrities increase project members' introjected participation motives. This supports our assumption that working together with celebrities strengthens FLOSS developers' need to feel respected for one's project work. Future research is necessary to fully understand how celebrities are able to kindle this need for status among their collaboration partners. In line with hypotheses 3, our evaluation results suggest that celebrities increase FLOSS developers' identified participation motives. This finding complements existing research by Fang and Neufeld (2009) which highlights the role of FLOSS developers' previous participation behaviour and the help of other members for their project identification. In addition to these two aspects, our study indicates that the celebrity status of the project members a FLOSS developer works with plays a pivotal role for her project identification. It will be interesting to see in future research whether this is because celebrities are better than others in transferring the FLOSS project's goals and mission or because members develop sooner feelings of responsibility through such collaboration initiatives. In line with hypotheses 4, our evaluation supports the positive effect of collaboration initiatives with project celebrities on FLOSS developers' integrated motivation. Celebrities achieved their status in the project due to their on-going contributions. Hence, it seems plausible that they are better than others in transferring the values and beliefs of open-source development to their collaboration partners. An important question for future research is, how celebrities actually convey these convictions to their collaboration partners. Finally, our study sample provides evidence for the positive effect of celebrities on project members' intrinsic motivation. This relationship suggests that project members perceive their work more playful when working together with celebrities. However, further research is required to understand whether this playfulness stems from celebrities' understanding of members' needs or rather through their contribution guidance.

Overall the results of our evaluation are very encouraging for managers of FLOSS projects. We provide evidence that FLOSS developers' participation motivation can be strengthened by factors of the project environment. This means that managers of such initiatives do not have to accept members' motives, but can actively intervene to increase the motivation of their contributor base. More positive news for FLOSS project managers is that there are incentives other than pecuniary rewards to stimulate developers' motivation. In particular, we show that working initiatives with celebrities are a very effective means to stimulate FLOSS developers' self-determined participation motives.

5.2 Limitations

There are three important limitations in our evaluation which we would like to outline in the following. The first limitation relates to the cross-sectional study design of our research. With this study design, we can examine how FLOSS developers' motivation changes with the celebrity status of their collaboration partner but not the lasting effects of such working initiatives on individuals' participation motives. Future studies with a longitudinal research design may address this issue and provide relevant insights on the lasting effects of collaboration initiatives with celebrities on FLOSS developers' motivation. The second limitation of this research is its focus on GSoC. GSoC is a very special event. While the coding during GSoC is similar to regular project contributions, participants of this event are exposed to various special extrinsic (such as financial rewards) and intrinsic influences (e.g.: coding challenges) which may bias our evaluation. Therefore, future research with a more diversified project sample including GSoC and non-GSoC projects is necessary to analyse the

generalizability of our evaluation results. The third limitation of this study is its sample size. With 65 GSoC students at KDE and GNOME, our study sample satisfies statistical requirements, but it is too limited to derive a comprehensive picture of celebrities influence on FLOSS developers' motivation. Therefore, future research is required to test our evaluation results with a larger study sample.

5.3 Conclusion

This study examined whether celebrities stimulate the contribution motivation of FLOSS developers. In line with Self-Determination-Theory, we do not view motivation as a unitary construct but differentiate between various forms of motivational drivers which lead individuals to contribute to FLOSS projects. Because of their strong standing in the project community and their rich coding expertise, we hypothesized that celebrities boost both FLOSS developers' extrinsic and intrinsic contribution motivation. An evaluation with 65 FLOSS developers largely supports our research hypotheses and indicates that celebrities promote self-determined contribution motives.

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Appendix

External Motivation (adapted from Ke and Zhang, 2010)

- 1: Monetary rewards for my participation in this project are not important to me. (R)
- 2: It is important to me that I can promote my career prospects through my participation in this project.
- 3: I am keenly aware of the income goals I have for myself if I participate in this project.

Introjected Motivation (adapted from Ke and Zhang, 2010)

- 1: I am strongly motivated by the recognition I can earn through participating in this project.
- 2: I want other people to find out how good I really can be in software development.
- 3: I am motivated to participate in this project because it gives me the possibility to earn respect for my work.

Identified Motivation (adapted from Ke and Zhang, 2009 and Xu and Jones, 2010)

- 1: When I talk about the project, I usually say 'we' rather than 'they'.
- 2: I feel a sense of belonging toward this project group.
- 3: This project group has a great deal of personal meaning to me.

Integrated Motivation (adapted from Ke and Zhang, 2010)

- 1: It is important to me that this project shares my views on open source software.
- 2: The project shares my views and beliefs on open source software.
- 3: My personal values and those of the project are similar.

Intrinsic Motivation (adapted from Li et al., 2012)

1. I enjoy working in this project.
2. Participating in this project gives me a satisfying feeling.
3. It is fun participating in this project.

Celebrity

1. My mentor is highly respected by other developers in the community.
2. Other developers know my mentor for his/her competence.
3. The standing of my mentor in the community is very strong.