Get the Crypto Crowd Going: Evaluating the Signaling Effect of Motivational Cues on Crowd Involvement

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Short Paper

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Abstract

Numerous blockchain projects employ open-source software development to create innovative solutions in collaboration with the crowd. They rely on the voluntary involvement of OSS developers from the crowd who follow several ideological tenets that shape their motivation. Yet, we lack knowledge on how blockchain projects can address the developers' motivation to increase the level of crowd involvement. We draw on a unique panel dataset with 1,893 observations to investigate the association between specific intrinsic and extrinsic motivational cues emitted by blockchain project initiators and crowd involvement. Based on signaling theory, we argue that the level of crowd involvement depends on the signal fit of project-initiated motivational cues with the developers' motivation. We find that higher levels of profit and human interest language relate negatively and higher levels of risk-taking and diversity language relate positively to crowd involvement. Further, our results show that lower quantity of electronic word-of-mouth strengthens these relationships.

Keywords: Blockchain, open-source software development, crowd involvement, signaling theory

Introduction

Open-source software (OSS) development promises superior code quality compared to proprietary software development due to the large crowd of people involved (Stewart and Gosain 2006). In recent years, the emergence of blockchain technology led to a boom of OSS projects since thousands of new blockchain projects utilize OSS to build their platforms and applications (Chen et al. 2021). Such projects rely heavily on the involvement of the crowd to drive their development (Schückes and Gutmann 2021). However, since there is a wide choice of different projects, it is challenging for OSS projects to motivate the crowd to contribute. Yet, the short- and long-term survival of OSS projects crucially depends on developers' contributions to the source code in the form of bug-fixes and new features (Wang 2012).

Prior research of blockchain projects concentrates on determinants of funding performance in the context of initial coin offerings (e.g., Fisch 2019; Lyandres et al. 2022) and so far neglects antecedents of crowd involvement as a type of operational performance (Schaefer et al. 2021). Voluntary crowd involvement in OSS development is essential because it reduces the probability of failure for early-stage blockchain projects

(Momtaz 2021). Thus, projects must stand out from others to convince the crowd to take part in their code development. OSS developers involve in a project based on a variety of intrinsic and extrinsic motives (von Krogh et al. 2012). In the blockchain ecosystem, crowd investors largely base their investment decision on ideological motives such as decentralization of established structures and social motives (Fisch et al. 2021). Besides investors, this ideological stance also applies to blockchain developers, even more than in regular OSS development (Bosu et al. 2019). Thus, the context of blockchain projects is unique compared to regular OSS projects such that blockchain developers are more strongly striving for disruption and societal impact. However, we know little on how blockchain projects can effectively address the motives of external blockchain developers. Drawing on signaling theory (Spence 1973), senders can use motivational cues to signal quality to a receiver (e.g., Cardon et al. 2017). Motivational cues refer to the framing of language to influence motivation (e.g., Allison et al. 2015). We distinguish between extrinsic motivational cues defined as verbal signals using profit and risk-taking language that emphasize a venture's focus on rewards and intrinsic motivational cues defined as verbal signals using human interest and diversity language that target an individual's need for relatedness (Allison et al. 2015). Considering the OSS ideology (Stewart and Gosain 2006), rewards for developers could include learning new skills and achieving self-efficacy, and the need for relatedness could refer to values such as altruism and cooperation. Thus, those motivational cues reflect the ideological values of OSS developers. We neglect other motivational cues because ideology is the key motive of blockchain developers to involve in OSS development (Bosu et al. 2019).

This study deals with two research questions. We examine how specific intrinsic and extrinsic motivational cues emitted by blockchain projects relate to crowd involvement. Referring to motivation and OSS ideology, we investigate qualities of blockchain projects that OSS developers expect. We argue that project initiators can emit specific motivational cues to address the ideological beliefs and values of blockchain developers. Thus, our first research question is: How do ideology-related motivational cues of blockchain projects influence involvement of OSS developers? In addition, we analyze electronic word-of-mouth (eWOM) as a third-party signal to influence this relationship. We propose that a high quantity of eWOM is an amplifying signal of the motivational cues, strengthening the signal's message because it increases the observability and credibility of motivational cues (e.g., Mumi et al. 2019; Risius et al. 2023). Our second research question is: How does eWOM alter the relationship between the motivational cues and crowd involvement? We build on a unique self-compiled dataset with 1,893 quarterly observations to investigate both research questions.

We offer theoretical implications for research on blockchain and OSS projects as well as on signaling theory. First, we show that ideological norms, values, and beliefs of OSS communities shape developers' interpretation of motivational cues sent by blockchain projects. Thereby, we draw the attention to the influence of linguistic cues for OSS projects that lack other strong signals to signal their quality (Setia et al. 2020). Second, we extend signaling theory by revealing how motivational cues interact with the third-party signal of eWOM. We shed light on potential signal conflict in online settings blurring the signal messages (Bafera and Kleinert 2022). Third, we contribute to research on blockchain projects and crowd involvement by elaborating on firm-related antecedents of software co-creation (Cui and Wu 2016). We are among the first to asses longer-term influences on performance of blockchain projects (Schaefer et al. 2021).

Theoretical Framework And Hypothesis Development

Blockchain is a distributed ledger technology allowing two parties to conduct transactions securely without an intermediary (Iansiti and Lakhani 2017). In this vein, blockchain technology promises decentralization, immutability and transparency of transactions (Risius and Spohrer 2017). Blockchain's disruptive potential enabled numerous individuals and teams to develop their own blockchain platforms and applications (Rossi et al. 2019). Many blockchain projects decide to develop cryptocurrencies or blockchain tokens (Weking et al. 2020), which are a unique form of digital assets stored on the blockchain. While cryptocurrencies are mainly intended as payment options, blockchain tokens can inherit a utility function such as access to a product or representation of ownership (e.g., Fisch 2019; Schwiderowski et al. 2023). In general, both types of blockchain assets are tradable on cryptocurrency exchanges (Schückes and Gutmann 2021), which are comparable to stock exchanges. Programming is a key task for the development of blockchain projects (Fisch 2019). Most of these projects utilize OSS platforms such as GitHub to drive the development of their blockchain platform or application. Thereby, they can collaborate with external developers and gain access to the wisdom of the crowd (Schückes and Gutmann 2021). Considering the unique characteristics of blockchain technology, the issuance of tokens and the strong focus on openness, blockchain projects are

highly transparent in their value creation process (Schückes and Gutmann 2021). Thus, they can establish a stronger connection to their crowd than other types of OSS projects.

Research on customer involvement shows that engaging with the crowd is associated with improved performance and innovativeness (Cui and Wu 2016). Therefore, freely sharing source code and engaging with the crowd is of high value for blockchain projects. However, in OSS communities, developers mostly contribute voluntarily and have limited resources. Thus, initiators of blockchain projects face the challenge to convince developers to contribute to their project. We draw on signaling theory by Spence (1973) to explain how project initiators can shape crowd involvement. In the presence of information asymmetries, senders can emit signals to provide their receivers with information about the underlying quality of a project (Connelly et al. 2011). Signals are effective if they are observable by the intended receiver and if they incur costs of sending (Connelly et al. 2011). The effectiveness of a signal also depends on the signal fit that describes how strong a signal correlates to unobservable quality (Connelly et al. 2011). Signals can also influence each other and strengthen or contradict the original signal's message (Bafera and Kleinert 2022).

Signal quality describes "the underlying, unobservable ability of the signaler to fulfill the needs or demands of an outsider observing the signal" (Connelly et al. 2011). The OSS ideology defines common qualities of an OSS project because the motivation of developers is strongly influenced by the norms, beliefs, and values of the OSS ideology (Stewart and Gosain 2006). For example, forking a project or avoiding official channels for communicating code changes violate the OSS norms. OSS beliefs include the belief that the resulting software should be freely available or that more developers will always produce better code. Lastly, OSS values refer to helping others, learning new skills or building a reputation (Stewart and Gosain 2006). Previous research investigates the motivation of OSS developers and mainly distinguishes between intrinsic and extrinsic motives (von Krogh et al. 2012). The latter refer to financial incentives or career development, while intrinsic motives cover fun or altruism (von Krogh et al. 2012).

We argue that language used in social media is an effective signal of blockchain projects to target the motivation of developers. OSS projects find it challenging to send signals of quality as they often have lower popularity than proprietary software projects (Setia et al. 2020). Blockchain projects strongly rely on online communication (e.g., Lyandres et al. 2022). Thus, blockchain developers can evaluate language used in a project's online content to assess the project's quality. Motivational cues can be embedded in the language and function as signals to stimulate motivation of the receivers (Cardon et al. 2017).

The extrinsic motivational cue of profit language indicates a venture's focus on generating profits (Narver and Slater 1990). In OSS development, ideology is an important factor influencing developers' willingness to participate (Stewart and Gosain 2006). Bosu et al. (2019) show that such reliance on ideology is even more pronounced in blockchain contexts. Thus, the effect of ideology on willingness to participate in OSS development should be particularly strong in blockchain contexts. One key belief of this ideology is that software should be free and that a considerable part of the OSS community relies on gift giving (Stewart and Gosain 2006). In this vein, proposing new ideas and changes of the source code are the basis of the OSS culture (Bergquist and Ljungberg 2001). Against this backdrop, high levels of profit language indicate a project that seems to oppose such ideological beliefs. Commercialization runs against the idea that code, and the outcomes of this code, are most useful if they circulate freely (von Krogh et al. 2012; Stewart and Gosain 2006). In view of the discrepancies between the project initiators' linguistics and developers' beliefs, we expect developers to be more reluctant to participate in OSS development if the project initiators signal a higher level of profit language. This is in line with the finding that OSS project initiators can incentivize highly skilled developers if they exhibit no visible commercial orientation (Smirnova et al. 2022). Thus, we assume that profit language helps to reduce information asymmetries but discourages blockchain developers to get involved as it contradicts the ideological value of software freedom. We hypothesize:

H1: A higher level of profit language relates negatively to crowd involvement.

Sending signals of risk-taking indicates the amount of risk a venture is willing to take under uncertainty (Covin and Slevin 1991). Apart from the belief in software freedom, another key feature of OSS ideology is the desire to learn (e.g., Smirnova et al. 2022). In fact, prior research suggests that developers seek to engage in exploration and in expanding their skills (e.g., von Krogh et al. 2012; Stewart and Gosain 2006). Knowledge self-efficacy, which is one's belief to be able to control and influence one's environment, is also an important factor in participation in online communities (Ray et al. 2014). We argue that for achieving high learning outcomes and a high sense of self-efficacy, more complex and uncertain blockchain projects

are more suitable. Specifically, where uncertainty is high, the need for learning is particularly salient (Sommer and Loch 2004). Since uncertainty in blockchain projects is likely to be reflected in risk-taking language, it is reasonable to assume that developers tend to favor projects with higher levels of risk-taking language. Moreover, risk-taking behavior could lead to subsequent high rewards (Covin and Slevin 1991). This indicates that developers can also attain a higher learning outcome when involving in OSS projects that signal risk-taking. Therefore, such projects allow them to better achieve the value of learning (Stewart and Gosain 2006), and to realize higher levels of self-efficacy if the project becomes successful (Ray et al. 2014). Consequently, we argue that risk-taking language shows high signal fit with the value of learning, which motivates developers to involve in the OSS project. We hypothesize:

H2: A higher level of risk-taking language relates positively to crowd involvement.

In the context of intrinsic motivation, linguistic cues can signal human interest by highlighting people and their activities (Allison et al. 2015; Hart 2013). Ideological collaborative values of OSS communities center around sharing information, helping others and cooperation with others (Stewart and Gosain 2006). Altruistic behavior in OSS communities increases satisfaction of developers (Wu et al. 2007). This finding points to the importance of helping others for OSS developers which suggests that human interest language stimulates the motivation of developers to involve in code development. OSS development is a process about co-creating value together with other developers (Stewart and Gosain 2006). Thus, signaling a high focus on people and their activities is in line with a high level of collaboration in the community. Moreover, human interest language stresses the need for relatedness (Allison et al. 2015; Hart 2013), which is of high importance in open source communities (Stewart and Gosain 2006). Thus, we argue that signals of human interest appeal to the collaborative values of OSS developers. We hypothesize:

H3: A higher level of human interest language relates positively to crowd involvement.

Diversity language relates to linguistics focusing on individuals and groups that differ from the norm (Hart 2013). Blockchain developers follow the ideology to disrupting centralized structures and establishing decentralized systems (Bosu et al. 2019). Diversity language might fit to this ideological aim because blockchain challenges established standards by making intermediaries obsolete (e.g., Iansiti and Lakhani 2017). Considering the value of learning for OSS developers (Stewart and Gosain 2006), a high level of diversity language might also signal to the crowd that diversity of knowledge is important for the project. In communities, members can profit from more diverse knowledge distributed among the other members (Constant et al. 1996). Since diversity language is about diverse individuals or groups (Hart 2013), diversity language should better target the entire group of OSS developers and potential access to a greater talent pool. Thus, we propose that diversity language reflects the developers' ideological values. We hypothesize:

H4: A higher level of diversity language relates positively to crowd involvement.

Not only ventures themselves but also third-parties such as the community can send signals to the crowd (Bafera and Kleinert 2022). eWOM is a signal that describes the public online communication by users and customers in relation to a product or venture (Hennig-Thurau et al. 2004). A higher quantity of eWOM indicates that users intensively debate about a project on social media. Signaling theory suggests that signals are often not standalone but interact with other signals from the environment (Bafera and Kleinert 2022). We argue that the community signal eWOM interacts with the project-initiated motivational cues. First, the signal of a higher quantity of eWOM increases the observability of the project's online content (e.g., Aggarwal et al. 2012; Risius et al. 2023). It creates awareness for the motivational cues incorporated in the content because the community spreads word and debates digitally about the content. Second, it legitimizes the projects social media messages (Mumi et al. 2019), indicating that the community is interested in the topics in relation to the projects. Therefore, we propose that eWOM serves as a complementary signal to the motivational cues that adds specific information (Bafera and Kleinert 2022). It leverages the quality of the original message and the strength of the motivational cues presented by the project. Third, eWOM is a signal of high cost because it is not easy to imitate by low-quality projects and involves effort of the community to write the messages (Lin and Kalwani 2018). Therefore, it increases the credibility of the less costly signal of motivational cues. We propose that a higher quantity of eWOM strengthens the project's communication initiatives and leads developers to contribute even less through profit language or even more through the other motivational cues. We hypothesize:

H5: eWOM moderates the relationships between the motivational cues and crowd involvement such that a higher quantity of eWOM strengthens the relationships.

Methodology And Results

Our study draws on self-collected longitudinal data on blockchain projects with a listed token or cryptocurrency. We compile a unique unbalanced panel data set containing 1,893 quarterly observations from 401 projects. The observations range from Q2 2018 to Q1 2022. We rely on the token listing page Coinmarketcap as an established data source to obtain general information on the blockchain projects (e.g., Lyandres et al. 2022), and match them with token data. To ensure high data quality, we exclude projects classified as fraud on multiple websites. In addition, we collect data on blog posts published by the project initiators on the website Medium. The content of these blog posts mostly centers around project news and achievements (Lyandres et al. 2022), which is why they are well-suited for measuring the motivational cues. Moreover, we retrieve information on the OSS projects of the blockchain projects published on GitHub. This open platform enables users to view the source code of OSS projects and to make contributions to the source code. We utilize GitHub to calculate crowd involvement as our dependent variable.

We measure the dependent variable *crowd involvement* as the cumulated amount of pull requests in the entire GitHub OSS project over one quarter (e.g., Fisch 2019). Capturing crowd involvement by pull requests is adequate since they enable external developers to propose changes of the source code in a repository (i.e., a storage location for code). Projects often have multiple repositories containing several branches for distinct versions of the code. The decision whether to accept a pull request and merge it into the main branch is up to a project member with specific rights (Dabbish et al. 2012).

To measure the independent variables, we perform computer-aided text analysis, drawing on the blog posts published on Medium as the basis for dictionary-based word count analysis. We measure the extrinsic motivational cues *profit language* and *risk-taking language* drawn from the established dictionaries about market and entrepreneurial orientation by McKenny et al. (2018). These word lists are an updated version of the original dictionaries suggested by Zachary et al. (2011) and Short et al. (2010). We apply the dictionaries *human interest* and *diversity* of the text analysis software Diction to operationalize the intrinsic motivational cues (Hart 2013). The operationalization holds great potential in the context of organizational research (Short and Palmer 2008). In the blockchain context, the extrinsic and intrinsic motivational cues are particularly suitable because ideology is the most important motive for blockchain developers to contribute (Bosu et al. 2019). The moderating variable eWOM measures the cumulated number of comments over the period of a quarter below the project's Medium posts. This operationalization is similar to other measures of eWOM such as the number of retweets on Twitter (Mumi et al. 2019).

Our study incorporates a set of control variables covering project and market characteristics as well as industry- and time-fixed effects. We include *development activity* using the total amount of commits (i.e., changes to the code) across all repositories to account for the general size of the OSS project (e.g., Chen et al. 2021). We control for the *user interest* by using the total number of stars the users gave to express their interest in the project (Chen et al. 2021). Following IS research, we include dummy variables for the three most popular *programming languages* in our sample to account for the higher accessibility of more popular languages (Stewart et al. 2006). We add dummy variables indicating whether the project has an open, closed or no *OSS license* in place in their largest repository (Sen et al. 2008). Moreover, we control for unique features of blockchain projects such as the availability of a *white paper* (e.g., Fisch et al. 2021) and the *infrastructure layer* indicating whether the project is developing a blockchain platform or application (Chen et al. 2021). We control for linguistic features of the Medium posts in terms of the length of text, measured by the *total words* used over one quarter, and *sentiment* of text, measured by the quarterly average emotional tone using Linguistic Inquiry and Word Count (Boyd et al. 2022). To account for the volatility of the cryptocurrency market, we add the variable *hot market phase*, measuring quarterly returns of the CCI 30 index (Beinke et al. 2021). We winsorize all non-binary variables at the 1% and 99% levels. To reduce the possibility of reverse causality, we lag the time-variant explanatory variables for one quarter.

We apply generalized estimating equations (GEE) which are well suited for the estimation of panel data and allow for several specifications (Ballinger 2004). We assume a negative binomial distribution with a log link function because the dependent variable crowd involvement is a count variable with overdispersion. Moreover, we specify an autocorrelated within-subject correlation structure and include robust standard errors. By standardizing the explanatory variables and following the three-step procedure by Kalnins (2018), we rule out potential concerns about multicollinearity prior to executing the regression analysis.

Table 1 depicts our results. In Model 1, we introduce the control variables, and Model 2 adds the independent variables referring to extrinsic and intrinsic motivational cues. Model 3 is the full model including the moderating effect of eWOM. We find support for H1 (ß = -0.067; $p < 0.05$), H2 (ß = 0.087; $p < 0.01$) and H4 (ß = 0.052; $p < 0.05$). As we are utilizing a log link function, an increase of one standard deviation in profit language means a 6.480% decrease in crowd involvement (= 100 * (exp(-0.067) – 1)). An increase of one standard deviation in risk-taking and diversity language leads to a 9.090% and 5.338% increase in crowd involvement. We do not find support for H3 since we find a significant negative relationship between human interest language and crowd involvement (ß = -0.138; $p < 0.05$). Moreover, H5 is not supported. While the interaction term between eWOM and profit language is not significant, we find significant interaction terms between eWOM and risk-taking, human interest, and diversity language. The analysis of the moderation plots indicates that the moderation effect is only significant for a lower quantity of eWOM. Thus, in comparison to a high quantity of eWOM, we find that the three relationships will be strengthened under the condition of a low quantity of eWOM. To validate the robustness of our results, we carry out further analyses. We consider only merged (i.e., accepted by a project member with commit rights) pull requests as the measure for our dependent variable. All results remain robust. We also separately include additional control variables such as the listing age, readability of text, and signal of venture capital investment. All results remain robust. We tackle endogeneity concerns (e.g., sample selection bias) in the full paper.

	Model 1	Model 2	Model 3
Profit language		-0.076** (0.028)	-0.067* (0.028)
Risk-taking language		0.073* (0.036)	0.087** (0.028)
Human interest language		-0.166*** (0.035)	-0.138*** (0.033)
Diversity language		0.063* (0.025)	0.052* (0.025)
eWOM			-0.026 (0.039)
Profit language x eWOM			-0.033 (0.036)
Risk-taking language x eWOM			-0.115*** (0.034)
Human interest language x eWOM			0.074** (0.028)
Diversity language x eWOM			-0.079* (0.038)
Development activity	0.736*** (0.083)	0.735*** (0.083)	0.747*** (0.084)
User interest	0.877*** (0.087)	0.867*** (0.087)	0.896*** (0.088)
White paper	0.035 (0.357)	0.078 (0.359)	0.124 (0.366)
Infrastructure layer	0.587 (0.306)	0.564 (0.303)	0.556 (0.304)
Total words (Medium)	0.094 (0.049)	0.096 (0.053)	0.092 (0.060)
Sentiment (Medium)	-0.002 (0.033)	0.021 (0.036)	-0.005 (0.032)
Hot market phase	-1.040**(0.357)	-1.057** (0.347)	-1.098** (0.353)
Constant	0.330 (0.608)	0.278 (0.616)	0.182 (0.613)
Observations (projects)	1,893 (401)	1,893 (401)	1,893 (401)
Wald Chi2	955***	1385***	1447***

Note: Robust standard errors in parentheses; Industry- and time-fixed effects, Programming language and OSS license controls included but not separately reported; eWOM: Electronic word-of-mouth; *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 1. GEE for crowd involvement

Discussion

This study sheds light on motivational cues and their relation to crowd involvement of OSS developers in the blockchain ecosystem. In support of our hypotheses, we find that profit language relates negatively and risk-taking as well as diversity language relate positively to the amount of crowd involvement in blockchain projects. Contrary to our expectations, human interest language has a negative relationship with crowd involvement. Moreover, a lower quantity of eWOM strengthens the relations of the motivational cues and crowd involvement. Our study contributes to research on OSS, signaling theory, and blockchain projects.

First, we contribute to research on OSS projects by showing how project initiators can actively target OSS developers' motivation through linguistic cues. Whereas previous research thoroughly studies the motivation to engage in OSS projects (von Krogh et al. 2012), we complement these insights by investigating how signals translate developers' motivation into active crowd involvement. Our findings suggest that ideology plays an important role in the motivation of blockchain developers. We demonstrate that ideology-

related motivational cues have significant relations with the level of crowd involvement. It seems that developers interpret these signals to a significant extent based on their ideological attitude. However, other than expected, we find a significant negative relationship between human interest language and crowd involvement. One might argue that this linguistic cue does not reflect ideological values, but rather leads to the impression that the project`s focus is too narrow. By emphasizing people and their activities through human interest language (Hart 2013), OSS developers could believe that the project only has a low impact for the society and refrain from contributing to it.

Second, we extend signaling theory by analyzing the signaling of ideology-related motivational cues and elaborate on the relation between the signals and the underlying project quality (Connelly et al. 2011). Our findings suggest that motivational cues need to exhibit a high signal fit with the developers' motivation and ideological attitude. Thus, motivational cues that reflect this ideological attitude engage developers to contribute to the OSS development. In addition, we show how signals from different sources (i.e., from the project and community) interact with each other. To our surprise, under a higher quantity of eWOM, we do not find a relationship between motivational cues sent by project initiators and crowd involvement. Even further, however, we find that a low quantity of eWOM significantly strengthens the relationships. The reason for this could be that the linguistic cues blur in the environmental noise caused by third-party signals such as a high quantity of eWOM. It seems that motivational cues get through to the crowd better when signals from the social media community are weak. Although environmental noise usually appears when multiple competing players send signals simultaneously (Plummer et al. 2016), our results suggest that such noise can also occur through simultaneous signaling of the project initiators and the community. Thus, we contribute to the understanding of conflicting internal and third-party signals (Bafera and Kleinert 2022) that dissolve intended messages by the blockchain projects.

Third, we develop theory on important outcomes (i.e., crowd involvement) of blockchain projects. Past research on the performance of blockchain projects concentrates on funding through initial coin offerings but lacks studies exploring their long-term performance (Schaefer et al. 2021). With a unique panel data set, we offer comprehensive insights into signals for crowd involvement throughout several time periods. Our study evaluates crowd involvement of blockchain developers as a performance outcome, which likely affects the project's long-term prospects, and we add to research on the antecedents of software co-creation by taking the perspective of firm-related factors to influence this outcome (Cui and Wu 2016).

We also offer implications for practitioners. On the one hand, we draw attention to the importance of online communication in OSS projects outside the blockchain ecosystem as well. OSS projects should evaluate what motivates their developers to use the right language to address them. On the other hand, our findings show that higher levels of community interaction on social media may conflict with the project's intended messages. Thus, blockchain projects should scan their environment in terms of signals from third parties and actively manage their community to mitigate or embrace potential influences on crowd involvement.

Our study is not without limitations that may also offer future research opportunities. First, we investigate crowd involvement in terms of contributions of OSS developers. Since there are other ways for the crowd to contribute to the innovation process, future studies could investigate other forms of crowd involvement in blockchain projects such as feedback on social media. Second, as we analyze project-initiated texts (i.e., blog posts) that can be subject to impression management (McKenny et al. 2018), scholars should complement our results through survey data. Moreover, since we focused only on specific motivational cues, future research should investigate other motivational cues such as technical or goal-oriented language to further increase our understanding on crowd involvement in the blockchain context. Third, as we do not find an amplifying moderating effect of a higher quantity of eWOM, future studies should evaluate other boundary conditions such as the sentiment of eWOM that may enhance venture-initiated signals regarding crowd involvement. In conclusion, our study identifies prospects for future research by evaluating how blockchain projects can influence crowd involvement. We provide first insights into signaling effects of motivational cues to attract OSS developers for the collaborative development of blockchain projects.

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