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A pilot study exploring the interactive effects of intrinsic and extrinsic motivations in Open Source problem-solving

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This study examines the interaction between intrinsic and extrinsic motivations in open-source problem-solving. Using a pilot moderation model, we analyze the combined and interactive effects of these motivations on collaborative crowdsourcing within open-source projects. Our quantitative approach, involving respondents from the Mturk platform, employs structural equation modeling to explore the relationships between motivational types and problem-solving success. The findings show that intrinsic motivation significantly enhances open-source problem-solving. Conversely, extrinsic motivation has a moderating effect, reducing the positive impact of intrinsic motivation when perceived as controlling. This research contributes to the theoretical understanding of motivation in crowdsourcing, highlighting the complex role of extrinsic rewards in collaborative settings.

keywords: open innovation, open source, crowrdsourcing

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Introduction

In the rapidly evolving landscape of business and innovation, open innovation has garnered significant attention, marking a pivotal shift in academic research and practical applications across various industries worldwide. This concept illuminates the strategic advantage firms gain by integrating external sources of knowledge into their innovation processes, a paradigm shift underscored by the works of Randhawa, Wilden and Hohberger (2016), Vanhaverbeke and Cloodt (2014), and West and Bogers (2017). Among the diverse mechanisms underpinning open innovation, crowdsourcing has emerged as a transformative approach, propelling the democratization of innovation. Introduced by Howe in 2006, crowdsourcing disrupts traditional models by distributing tasks across an expansive, albeit undefined, network of participants rather than relying on specific employees or contractors. This approach enables firms to extend their problem-solving capabilities beyond their immediate organizational confines, inviting contributions from a global community of potential solvers. Such openness in problem disclosure and solution

solicitation, as elaborated by Afuah and Tucci (2013) and Jeppesen and Lakhani (2010), paves the way for leveraging collective intelligence and expertise to address complex challenges, signifying a paradigm shift towards more inclusive, collaborative innovation practices.

Solving complex problems through crowdsourcing, particularly in open-source projects, underlines a multifaceted interplay of motivational factors that drive participant engagement and sustained contribution. While intrinsic motivations, such as the pursuit of personal satisfaction, intellectual curiosity, and a sense of belonging, are frequently cited as primary drivers in open-source participation, the role of extrinsic motivations, such as financial incentives, reputation gains, and professional development opportunities, also presents a significant influence on contributors' behavior.

Integrating these motivational spectrums poses a complex scenario for understanding how diverse incentives are combined to foster innovation, ensure the quality of contributions, and maintain a robust and active crowdsourcing community. Despite the acknowledged importance of intrinsic rewards in fueling creativity and self-directed engagement, the evolving landscape of open-source projects and crowdsourcing platforms indicates a growing emphasis on extrinsic rewards to attract and retain talent, navigate project complexities, and achieve sustainable development outcomes (Roberts et al. 2006).

The literature has only separately assessed the influences of extrinsic and intrinsic motives for crowdsourcing through open-source projects. This dichotomy raises critical questions regarding the optimal balance between these motivations to maximize participation, innovation, and project success in collaborative problem-solving endeavors. There remains a knowledge gap regarding the collaborative or interactive effect of intrinsic and extrinsic motivation on problem-solving in crowdsourcing.

Thus, this research aims to investigate the interaction between extrinsic and intrinsic motivations in solving complex problems through collaborative crowdsourcing in open-source projects. It seeks to unravel how these motivations influence individual and collective engagement, the quality of contributions, and the long-term viability of open-source initiatives. Through empirical investigation and theoretical analysis, this study endeavors to provide actionable insights for designing crowdsourcing platforms and managing open-source projects in a way that harmoniously integrates diverse motivational drivers to foster innovation, participation, and sustainable development. The following section provides a literature review of the relevant concepts of this paper based on prior publications that lead to the two hypotheses. The study was underpinned by self-determination theory and cognitive evaluation theory. The literature review is followed by a discussion of the methods used to conduct the study and a presentation of the findings. In the penultimate section of this paper, the discussion and managerial implications are presented. Our conclusion section ends the paper with closing remarks.

Literature Review

Open innovation involves expanding knowledge beyond internal market mediums and avoiding limiting internal pathways for bringing a firm’s knowledge to market (Mdaka & Longweni 2023, 2024, Mohalajeng & Kroon 2016). Open innovation combines resources and assets within a company with outside sources to gain the greatest value. As an open innovation mechanism, crowdsourcing encompasses several key components essential for successful problem-solving, including open-source problem-solving approaches. Firstly, the composition of the crowd lacks a definitive characterization within the literature, yet contributions are typically based on either qualifications or demographics, with crowd sizes varying from a few hundred to several hundred thousand participants (Bassi et al. 2020). The crowd's purpose bifurcates into completing tasks or solving problems, with some scholars advocating for the divisibility of problems into smaller tasks to facilitate crowdsourcing (Brabham et al. 2014, Karachiwalla & Pinkow 2021). Open-source problem-solving, in particular, leverages the crowd's collective intelligence and diverse expertise to address complex, non-trivial issues, often resulting in innovative solutions that may not emerge from traditional problem-solving methods.

The rewards for crowd participation can be monetary, non-monetary, or voluntary, with motivations encompassing skill development, community contribution, enjoyment, knowledge sharing, and recognition, collectively referred to as the 'four f's of crowdsourcing:' fun, fulfillment, fame, and fortune (Acar 2019, Liang et al. 2018). Open-source initiatives often attract participants driven by intrinsic motivations, such as the desire to contribute to the greater good or the intellectual challenge of solving a complex problem.

Institutions or organizations, whether private or governmental, typically initiate crowdsourcing activities by issuing an open call to the crowd, specifying participation criteria and conditions. Theoretical and application conditions further delineate the appropriate contexts for employing crowdsourcing (Wazny 2017). The utilization of crowd responses involves either the aggregation or selection of contributions. Platforms such as InnoCentive and Threadless exemplify the selection of optimal solutions, whereas Amazon M-Turk aggregates diverse solutions from the crowd (Mourelatos et al. 2022). Open-source problem-solving often benefits from a hybrid approach, where initial ideas are aggregated and refined collaboratively, followed by the selection of the most viable solutions.

Lastly, the accessibility to peer contributions varies significantly across platforms, ranging from no access to full modification capabilities. For instance, Innocentive and Amazon Mturk restrict access to contributions, while platforms like Threadless allow the crowd to view, judge, and modify each other's submissions, facilitating a more collaborative approach (Brabham et al. 2014, Chesbrough et al. 2024). Open-source problem-solving platforms, such as GitHub or Wikipedia, exemplify high levels of accessibility and collaboration, enabling participants to build upon each other's work, thereby accelerating innovation and improving the quality of solutions. This open-access model enhances transparency and fosters a sense of community and shared purpose among contributors, ultimately leading to more robust and widely accepted solutions.

Theory and Hypothesis Development

The motivations driving individuals to participate in crowdsourcing, such as open-source projects, are multifaceted and comprise intrinsic and extrinsic elements. Central to understanding the interplay between intrinsic and extrinsic motivations is the Cognitive Evaluation Theory, which suggests that extrinsic rewards can sometimes undermine intrinsic motivation, especially when the rewards are perceived as controlling rather than supportive of one's autonomy. This theoretical perspective provides a foundation for examining how different types of motivations influence the engagement and performance of contributors in open-source projects.

Cognitive Evaluation Theory: A Focus on the Effects on Intrinsic Motivation

Deci and Ryan (1980) established Cognitive Evaluation Theory (CET), the first sub-theory of SDT, from their prior experiments, in which they observed a dynamic interaction between extrinsic factors (e.g. rewards and choice) and people's intrinsic motivation (e.g. task interest or enjoyment). CET stipulates that external factors in social contexts either undermine or support intrinsic motivation (Deci & Ryan 1980). The support or thwarting of intrinsic motivation is the hallmark of Cognitive Evaluation theory.

Intrinsic motivation is defined by interest and enjoyment. Engaging in an activity for its inherent interest or enjoyment is the hallmark of being intrinsically motivated (Deci & Ryan 2012). With CET, enjoyment is the by-product of total immersion in an activity rather than the active pursuit of enjoyment before engaging in an activity. From the CET perspective, the enjoyment resulting from intrinsic motivation is personally relevant and long lasting, conducive to personal growth and Eudaimonia (Ryan et al. 2008). This contradicts the hedonic approach to well-being proposed by seminal authors Kahneman, Diener and Schwarz (1999). This enjoyment from the pursuit of immediate gratification results in superficial, short-lived feelings of excitement and positivity. Also central to intrinsic motivation is interest.

The denotation of interest, in CET, is the attraction an individual feels toward an activity. In the hedonic approach, activities serve one's self-interest or personal benefit as such interest is outward and thus forms part of extrinsic motivation.

Prevalent research on open-source software (OSS) attests to participants' involvement and task effort to seek fulfillment experienced through the crowdsourcing problem (Hertel et al. 2003, Jeppesen & Lakhani 2010). Emotions of interest and enjoyment remain core concepts of intrinsic motivation. Seminal studies highlight the predominance of intrinsic motivation among open-source contributors, emphasizing that participants in collaboration-based crowdsourcing, i.e. OSS communities, are not driven by monetary incentives (Crump 2011, Michel et al. 2015). In a more recent study, Smirnova, Reitzig and Alexy (2022) found that highly skilled individuals who contribute to a specific open-source software project do so to enjoy contributing and interest in the project. Literature also demonstrates crowdsourcing as an effective mechanism for problem-solving aimed at innovation (Afuah & Tucci 2013, Jeppesen & Lakhani 2010). However, in recent years, little can be attributed to whether intrinsic motivators contribute to effective and successful problem-solving in open-source projects. Hence, we propose our first hypothesis.

H1. *Intrinsic motivation is positively associated with collaborative problem-solving through open-source projects.*

From the cognitive evaluation perspective, humans have inherent intrinsic motivational propensities that will be expressed under particular conditions. In other words, the maintenance and improvement of these innate propensities necessitate supportive conditions, while unsupportive conditions equally disrupt those, does not concern what causes intrinsic motivation since it is viewed as an innate propensity; instead, it examines the conditions that facilitate or undermine this innate propensity (Ryan et al. 2008, Vansteenkiste et al. 2010, p 106). Various contexts initiate the thwarting or support of intrinsic motivation. Pivotal studies in CET emphasize how interpersonal settings influence intrinsic motivation. Controlling settings, where rewards are administered in a pressuring manner (e.g. performance-based bonuses and imposed goals), undermine intrinsic motivation by making individuals feel pressured to think, feel, or behave in specific ways (Deci & Ryan 2012). Such settings shift the perceived locus of causality from internal to external, diminishing feelings of autonomy and, thus, intrinsic motivation (Decharms 1968). Research has shown that performance-based rewards, verbal rewards perceived as controlling, and a lack of freedom of choice significantly undermine intrinsic motivation (Deci 1971, Moller et al. 2006). Social and environmental contexts like threats, deadlines, directives, and competitiveness also diminish intrinsic motivation (Amabile et al. 1994, Reeve et al. 2004).

Conversely, non-controlling interpersonal settings can enhance intrinsic motivation by being perceived as informational rather than controlling. These settings support autonomy and competence, essential for intrinsic motivation. Positive informational settings, such as providing choices and using rewards as feedback rather than control, have been found to enhance intrinsic motivation by satisfying the needs for competence and autonomy. Unexpected rewards, given after task completion, also support intrinsic motivation by not thwarting autonomy. Additionally, receiving positive feedback in an informative manner enhances intrinsic motivation by fulfilling the need for competence and freedom of choice.

Zheng et al. (2011) found that intrinsic motivation was more critical than extrinsic motivation in driving participation in a Chinese crowdsourcing community, suggesting that the quality of contributions was closely tied to intrinsic factors. On the contrary, Rogstadius et al. (2011) observed that an imbalance favoring extrinsic motivation over intrinsic motivation led to lower levels of accuracy and quality in crowdsourced tasks, supporting the CET's predictions. The interaction between intrinsic and extrinsic motivations in open-source projects remains complex. However, we propose next hypothesis:

H2: Extrinsic motivation negatively moderates the relationship between intrinsic motivation and collaborative problem-solving through open-source projects, such that the relationship is weakened as extrinsic motivation increases.

Figure 1 provides a matrix summarising the effect of extrinsic factors on intrinsic motivation by associating the extent to which a reward is perceived as controlling the thwart or support of intrinsic motivation.

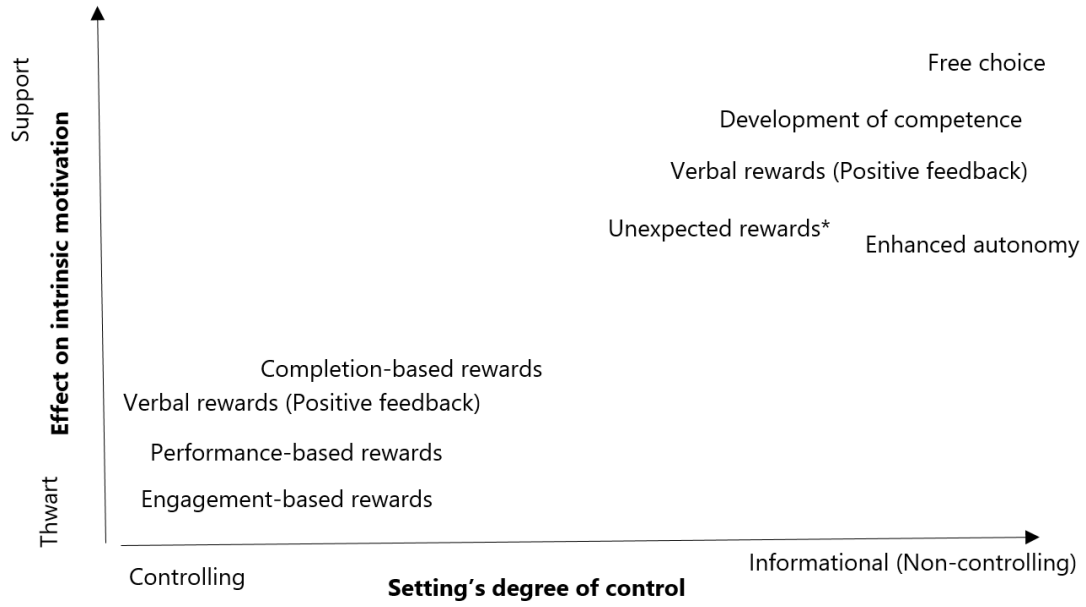

Figure 1. Extrinsic incentives and intrinsic motivation
Source: the authors' illustration based on literature

Figure 2 illustrates the conceptual model.

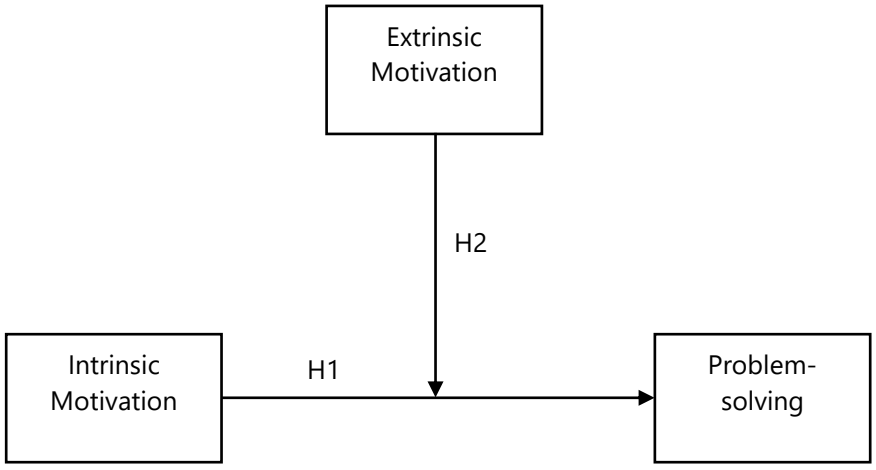

Figure 2. Conceptual Model
Source: the authors

Methodology

Quantitative research methods were employed through a purposive sampling procedure. Purposive sampling allowed for a substantial number of respondents to be surveyed quickly while ensuring that the appropriate participants were chosen to provide the data needed to test the hypotheses. The population from which the empirical sample was drawn includes all Amazon Mechanical Turk (Mturk) platform participants with experience in crowdsourcing. Mturk is a popular crowdsourcing platform that allows firms to hire workers to perform tasks for meager incentives. The Mturk participants are anonymous, complete various crowdsourcing tasks in various locations internationally, and are financially incentivized (Hauser & Schwarz 2016).

Sampling Mturk participants is a precedent of previous studies that have used Amazon's Mturk to collect survey data. About 300 Mturk crowdsourcing participants were targeted to gather data on participants' motivation in open-source projects. A total of 311 responses were gathered, and 288 usable responses were used for analysis. Notably, the sampling on Mturk adapted previous work by Liang et al. (2018) and Pee, Koh and Goh (2018). Pee et al. (2018) aimed to sample individuals participating on different crowdsourcing websites through Mturk. The use of Mturk in seminal academic research has expanded into other areas of social science, including psychology, health, and economics research (Bohannon 2016). Harrison-Walker (2015) sampled 600 Mturk participants to test the differences in psychology between lab participants and Mturk participants. Additionally, Stothart, Boot and Simons (2015) sampled 515 Mturk participants to investigate cognitive aging, while Heen Lieberman, and Miethe (2014) sampled 304 Mturk participants to contrast online survey hosting websites.

Operationalization of the Scales

The research instrument was a self-administered online questionnaire developed on SurveyMonkey and posted as a task on the Mturk platform. The Work Preference Inventory (WPI) was first introduced by Amabile et al. (1994) as a 30-item scale measuring two domains of motivation—extrinsic and intrinsic motivation. The items from the WPI scale were adapted to fit the study's context. The measure of successful problem solving in collaboration-based crowdsourcing was adopted from the perspectives of ISO/IEC 9126 on evaluating new software (Bhatti 2005, Colombo & Guerra 2002). ISO/IEC categories used to measure successful problem-solving in collaboration-based crowdsourcing, particularly open-source software, included functionality, reliability, usability, efficiency, maintainability, and portability. All the constructs were measured with five-point Likert scales, ranging from 1=strongly disagree to 5=strongly agree.

Data Analysis

The data was analyzed utilizing the SPSS and AMOS statistical programs to calculate the descriptive statistics and Cronbach's alpha coefficients and applying Structural Equation Modeling (SEM) to compare the relationships between respondents' intrinsic and extrinsic motivations, problem-solving, and interactive effects of these relationships. The measurement model was analyzed using covariance-based modeling through maximum likelihood estimation and modification indices. The Chi-square statistic, RMSEA (Root Mean Square Error of Approximation), SRMR (Standardised Root Mean Square Residual), CFI (Comparative Fit Index), IFI (Incremental Fit Index), and TLI (Tucker-Lewis Index) were used to assess how well the model fits the data. The $CFI > .90$, $TLI > .90$, $SRMR < .08$, and $RMSEA < .06$ thresholds must be attained to conclude that the measurement model relatively fits the observed data. To create interactive effects for extrinsic and intrinsic motivation, we followed the two critical steps. First, the extrinsic and intrinsic variables were standardized as a caution to eliminate the possibility of multicollinearity. Second, the product indicator approach was utilized to measure interactive effects. This approach multiplies the

indicators of the latent variables (independent variables) to create moderator variable indicators that measure the interaction term in the path model (Kenny & Judd 1984).

Results

Descriptive Analysis

This section details the descriptive statistics for demographic variables such as age, gender, years of experience in crowdsourcing, nationality, highest qualification, employment status, expertise, and hours spent crowdsourcing per week. The demographic analysis reveals predominately male participation (approximately 62% male), with a wide age range from 21 to 74 years, centring around a mean age of approximately 34. This diversity in age highlights the broad appeal and accessibility of crowdsourcing across different life stages. Educational backgrounds vary widely among participants, with the data suggesting a tilt toward higher education. Employment status distribution indicates a significant portion of the participants are likely employed (mean code of 3.42), suggesting crowdsourcing activities are supplemental to their primary employment. The dataset encompasses respondents from three distinct nationalities, with a mean code slightly over 1.5, indicating a majority from the first coded nationality, pointing towards a geographically concentrated pool of respondents, though still incorporating a modest international representation.

Years of experience in crowdsourcing span from newcomers to highly experienced individuals, with an average experience of approximately 3.4 years. This spread indicates a mix of seasoned and newer participants within the crowdsourcing ecosystem, reflecting its dynamic nature and ongoing attraction to a wide range of individuals. The notable maximum of 35 years of experience in crowdsourcing highlights the longevity and evolution of participation over time. However, such outliers may also suggest a need for further data verification or represent pioneering participants in early forms of crowdsourcing.

Reliability and Validity—Measurement Model

The fit statistics of the measurement model revealed that a relatively good model fit was achieved. The fit index values of *CFI* (.94), *IFI* (.94), and *TLI* (.93) were well above the cut-off point of .90, and RMSEA (.05) and SRMR (.04) were less than the conservative cut-off of .06, with 90 percent confidence lower limit of .03 and upper limit of .06. Further, the CMIN/df value was found within the recommended range of 2–5 (1,712), demonstrating that the measurement model fits the data well. Figure 2 shows a graphical representation of the measurement model.

Once the model fit was established, reliability and validity tests were conducted to determine the accuracy of the measurement model. First, Cronbach's alpha coefficients were calculated to determine the internal consistency of all scales measuring extrinsic motivation, intrinsic motivation, and problem-solving. The reliability of all the measurement scales used reported in Table 1 indicates that Cronbach's alpha coefficients for each factor are larger than .7, indicating high reliability and consistency between items measuring each construct under study. This shows that all the items are internally consistent and reliable for measuring the construct variables.

Secondly, two measures of validity were calculated to measure how accurately the instrument measured what it was intended to. Discriminant validity was measured to determine the relationship between constructs. In doing so, the average variance explained should be greater than the squared correlation. The discriminant validity reported in Table 1 indicates that the instrument had discriminant validity.

Lastly, the average factor loading was calculated to determine convergent validity. An average factor loading of .7 indicated convergent validity. The convergent validity is reported in Table 1, which indicates that the average factor loading was below the .7 threshold.

Table 1. Reliability and Validity

Variables	Discriminant validity (AVE>Correlation^2)	Reliability Cronbach alpha	Convergent Validity (Av. factor loading)
Extrinsic Motivation	.41>.04	.88	.56
Intrinsic Motivation	.27>.06	.90	.49
Open-source problem solving	.46>.39	.71	.67

Hypothesis Testing—Structure Model

Structural paths were incorporated into the measurement model following the assessment of correlations, average variance extracted (*AVE*), and reliability. This model is detailed in Table 2 lists the hypotheses (*H*), path coefficients (β) with statistical significance at the .05 level (p-values), and the outcomes of each path. Specifically, intrinsic motivation statistically significantly influenced open-source problem solving (β=.17, p<.00; supporting H1).

Table 2. Structural Model of the Variables and Interaction Effects

Hypothesis	Relationship	β weights	Std. β weights	P-value
H1	Intrinsic motivation → Problem-solving	.17	.18	.00
H2	Intrinsic motivation x Extrinsic motivation → Problem-solving	-.07	-.15	.01

Further, the interaction between intrinsic and extrinsic motivation was statistically significant (estimate=-.07, p<.01). The result identifies extrinsic motivation as a negative moderator of the relationship between intrinsic motivation and open-source problem-solving. Thus, the relationship between intrinsic motivation and open-source problem-solving becomes negative in the presence of extrinsic incentives.

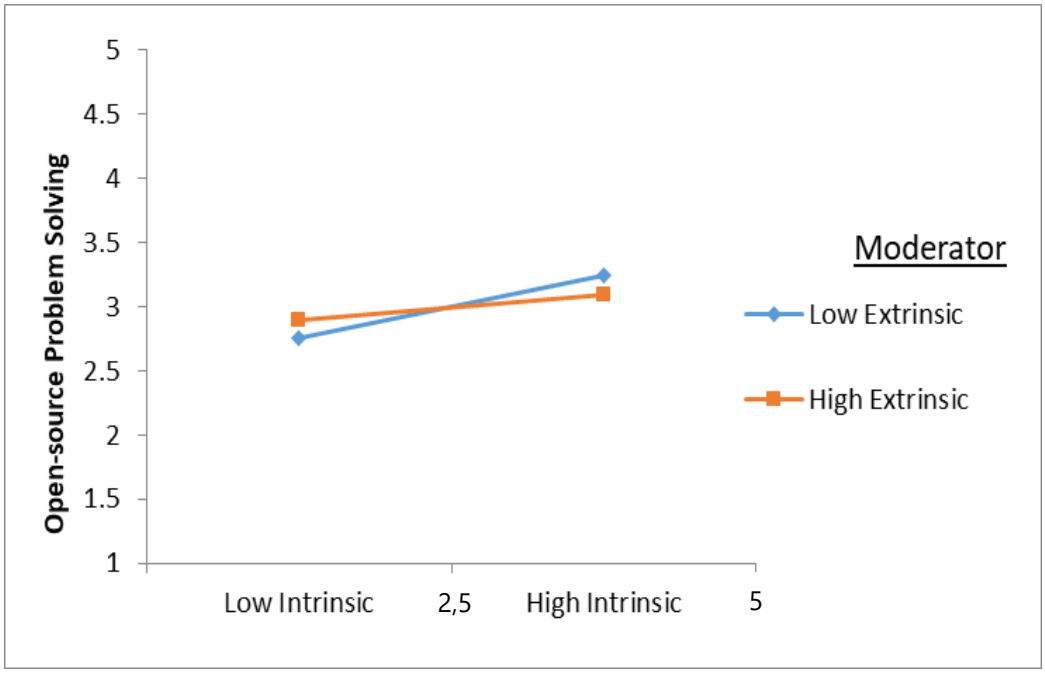

Figure 2. Two-Way Plot of Interaction Effects of Intrinsic and Extrinsic Motivation

Hypothesis 2, stating extrinsic motivation negatively moderates the relationship between intrinsic motivation and open-source problem-solving, such that the relationship is weakened as extrinsic motivation increases, is supported. The two-way interaction plot illustrated in Figure 2 supports this finding. Extrinsic motivation weakens the relationship between intrinsic motivation and open-source problem-solving.

Discussion and Conclusion

The purpose of this research was to investigate the interaction between extrinsic and intrinsic motivations in solving complex problems through collaborative crowdsourcing in open-source projects through a pilot study. This interplay is critical for understanding how motivations impact the effectiveness of cooperative efforts in complex, voluntary environments such as open-source communities. First, it was found that open-source problem-solving is significantly associated with intrinsic motivation. Second, the moderating effect of extrinsic motivation on the relationship between intrinsic motivation and successful problem-solving was investigated. It was found that extrinsic motivation significantly moderates the relationship between intrinsic motivation and successful problem-solving. More specifically, extrinsic motivation negatively moderates the relationship between intrinsic motivation and successful problem-solving, such that the relationship is weakened as extrinsic motivation increases. The literature strongly supports this finding (De Jesus et al. 2013, Fischer et al. 2019). We can draw parallels between the Ubuntu philosophy and intrinsic motivation in open-source communities. Ubuntu, an African philosophy emphasizing interconnectedness, compassion, and collective success, aligns with the principles of intrinsic motivation by fostering a sense of community and shared purpose. Just as intrinsic motivation drives open-source contributors through personal satisfaction and community impact, Ubuntu encourages business practices prioritizing collective well-being and ethical behavior (Longweni & Mdaka 2023). Additionally, more recent work on habits of mind during creative problem-solving highlights the importance of diverse thinking skills in managing complex problems and emphasizing persistence, continuous learning, and listening with understanding and empathy as crucial for effective problem-solving in dynamic environments (Longweni & Mdaka, 2024). These habits resonate with the intrinsic motivations found in open-source projects, where contributors often persist through challenges, continuously learn, and value collaborative input.

The cognitive evaluation theory of motivation stipulates that external factors in social contexts either undermine or support intrinsic motivation. The support or thwarting of intrinsic motivation is the hallmark of cognitive evaluation theory. When the interpersonal style of administering external events and rewards is relatively pressuring (e.g. performance-based rewards and imposed goals), the rewards are experienced as more controlling, thus leading to more deterioration of intrinsic motivation. The findings contribute to cognitive evaluation theory by illustrating how external motivators can interfere with or diminish intrinsic motivation, particularly in crowdsourcing contexts. This aligns with Deci and Ryan's (1980) theoretical framework, which posits that intrinsic motivation is undermined when extrinsic rewards are perceived as controlling or coercive. Additionally, the findings of this research paper assist in understanding how motivation works in non-traditional work environments. This is particularly relevant as collaborative and open-sourced projects become more prevalent across various sectors.

Implications for Managers

The findings suggest that project leaders and managers of open-source projects should carefully consider the types of rewards or incentives they offer. Performance-based rewards and imposed goals, experienced as pressuring, could harm the intrinsic motivation that drives many open-source contributors. Managers should consider implementing more autonomy-supportive reward systems that enhance intrinsic motivation and use extrinsic rewards more judiciously to avoid diminishing the inherent motivation often

critical for creative and innovative outcomes. Managers should design reward systems that support autonomy rather than control. Performance-based rewards and imposed goals can feel pressuring and diminish intrinsic motivation, which is critical for open-source projects' voluntary and innovative nature. Instead, rewards should recognize contributions in a way that enhances feelings of autonomy and mastery.

Extrinsic rewards should be used sparingly and thoughtfully. While they can be effective in some contexts, overreliance on extrinsic incentives can weaken the intrinsic motivation that drives many contributors. Managers should balance recognition and rewards to maintain high intrinsic motivation. Ubuntu emphasizes interconnectedness and collective success, which aligns well with the collaborative spirit of open-source projects. Managers should cultivate a community where contributors feel their work is part of a larger, meaningful effort. This can be achieved through team-building activities, open communication, and shared goals.

Limitations and Future Research Directions

While the study outlines the negative impact of extrinsic motivation when it acts as a controlling mechanism, it does not fully explore scenarios where extrinsic rewards might synergize with intrinsic motivation. Different types and delivery methods of extrinsic rewards could have varying impacts, an area that remains underexplored. The data was collected solely from Mturk users, which may not represent the broader demographic of global open-source contributors. Future research should include a more diverse participant pool from various crowdsourcing platforms and geographic regions to enhance generalizability. Also, this study has limitations. Some measures, particularly for convergent validity, did not meet the desired thresholds, suggesting a need for further validation of the measurement instruments. Learning for this pilot study will be adapted for the main research study.

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