It was fun, but did it last? The dynamic interplay between fun motives and contributors' activity in peer-production

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Peer production communities often struggle to retain contributors beyond initial engagement. This may be a result of contributors' level of motivation, as it is deeply intertwined with activity. Existing studies on participation focus on activity dynamics but overlook the accompanied changes in motivation. To fill this gap, this study examines the interplay between contributors' fun motives and activity over time. We combine motivational data from two surveys of Wikipedia newcomers with data of two periods of editing activity. We find that persistence in editing is related to fun, while the amount of editing is not: individuals who persist in editing are characterized by higher fun motives early on (when compared to dropouts), though their motives are not related to the number of edits made. Moreover, we found that newcomers' experience of fun was reinforced by their amount of activity over time: editors who were initially motivated by fun entered a virtuous cycle, whereas those who initially had low fun motives entered a vicious cycle. Our findings shed new light on the importance of early experiences and reveal that the relationship between motivation and participation levels is more complex than previously understood.

CCS Concepts: • **Human-centered computing~Collaborative content creation** • **Human-centered computing~Wikis** • **Human-centered computing~Empirical studies in collaborative and social computing** • *Human-centered computing~Computer supported cooperative work*

Additional Key Words and Phrases: Peer production; online communities; Wikipedia; motivations; fun; sustained participation.

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1 INTRODUCTION

Online peer production platforms such as Wikipedia allow participants a lot of freedom and autonomy in choosing how they participate. Despite this, contributors struggle to maintain participation beyond the initial period of engagement. Research shows that many such platforms suffer from a highly skewed distribution of participation: the majority of participants are minimally active [9,17]. Online production communities, therefore, rely on a small group of persistent contributors to create the majority of content. This presents a challenge for many communities, who strive to sustain participation [4].

Prior research on the mobilization of volunteers [29] suggests this may be an issue related to participants' motivations, as people who are *more* motivated are better able to overcome greater barriers to participation (which, in the context of online peer production systems, may include bad interface design, high learning curve, large time commitment, etc.). Intrinsic motivations in particular have been studied in

relation to participation. Such motives are assumed to arise from within the individual and are inherently autonomous and self-integrated [18,55]. One motivation often found to correlate positively with engagement is "fun" (or enjoyment). Fun was shown to be highly correlated with involvement in online social networks [26], and participation in peer production platforms like Wikipedia [41], open-source projects [33], and online communities [62]; "lack of fun", is one of the primary reasons for discontinuing participation in contexts such as team sports [46].

However, while fun was found to be associated with activity, previous studies of motivation and behavior in peer production largely employed one-time, cross-sectional study designs and aggregate measures of activity over time [26,33,41,62]. As a result, most of these studies are based on correlation analyses with no claims of directionality, and therefore have a limited understanding of the temporal aspects of motivational and behavioral dynamics.

Moreover, prior studies on motivation and participation focus on surveying highly-active and experienced contributors - long after they have been enculturated into a given peer production environment: they already chose to continue contributing and may therefore not be representative of the much larger number of editors who contribute once and never come back [34,41,45]. Such an approach is susceptible to survival bias, and therefore undervalues initial motivations and very early experiences. Early experiences were shown to be formative [60], and individuals' perceptions and motivations are likely to develop and evolve during the first few months of activity [15,16,21,38,47]. Taken together, these findings stress the importance of utilizing a longitudinal research design with activity and motivation measured at multiple points in time.

A recent empirical study [8] found that instrumental motives, including fun motives, decreased significantly over the initial period of engagement in Wikipedia, though the role of activity was not examined. The present research extends [8] and seeks to make both theoretical and methodological contributions by studying the relationship of fun motives and user behavior (both in terms of quantity and persistence) over time. The setting for our empirical analysis is Wikipedia. Wikipedia is not only one of the largest and most successful examples of a peer production platform, it also gives us the ability to focus explicitly on co-production activities (i.e. edits made directly to the articles), rather than other types of activities, as a result of its namespace structure (for example, coordination, administration, and social activities). Editing Wikipedia's main articles has few workflow constraints, and is therefore open for contributors' emergent behavior. Thus, our focus on the co-production space is key to highlighting the interplay between editors' desire to have fun (i.e. fun motives) and emergent behavior.

We use a short-term longitudinal study design in which editors are surveyed twice on their fun motives over the course of roughly six months. These two measures are then compared to two corresponding periods of edit data. This allows us to answer the following questions: How are newcomers' fun motives associated with the amount of their co-production activity in the initial period of engagement? How do newcomers' early level of fun motivation influences the persistence of their editing activity? Among those who continue to participate, how do the amount of activity and fun motives influence each other over time?

Overall, our findings demonstrate an unanticipated interplay between fun motives and activity and an important distinction between how *persistent* versus how *prolific* an editor is. First, we find that persistence is related to fun in the sense that editors who continue to edit over a longer period of time have higher fun motives than those who drop out early. However, the amount of early editing activity that editors engage in does not impact their fun motives, which, in turn, is not related to the amount of activity they subsequently engage in. Further, persistent newcomers' early fun motives were reinforced by their activity over time, emphasizing the importance and long-lasting impact of initial experiences. We believe these are issues of key importance to the designers of peer production websites and communities.

2 BACKGROUND & PRIOR WORK

2.1 Participation Inequality

Our objectives for understanding activity and motivation stem, in part, from the difficulty in sustaining participation in peer production communities over time. Studies of such communities have reported a participation inequality in which only a minority of users contributes in a significant way: the majority of participants remain content consumers [57]. This notion underpins the much-popularized "90-9-1" rule of thumb that states that 90 percent of website visitors will be readers, 9 percent will contribute infrequently, and only 1 percent will be responsible for most contributions to the online community [66].

Kollock and Smith [31] refer to these minimally-engaged individuals as free-riders, i.e., non-contributing, resource-taking members. In their seminal work on "lurking", Nonnecke and Preece [40] adopted the definition of a "silent majority". They showed that the number of lurkers, defined as those who never contribute at all, is much smaller than ninety percent. Yet, when including users who posted only a small number of times (i.e. up to three), the number does come closer to the 90-9-1 explanation.

In a subsequent study, Preece et al. [48] showed that there are many reasons why people lurk in online discussion communities, including: not needing to post, needing to find out more about the group before participating, thinking that they were being helpful by not posting, poor software usability, and not liking the group dynamics or thinking that the community was a poor fit for them. The authors then went on to show that most lurkers can be inspired to change their behavior given the right environment and encouragement. Takahashi et al. [58] argued that lurkers in fact provide added value to an environment: lurkers in one environment may contribute to information to other indirect users outside of the bounds of the shared resource. Indeed, [6] and [5] argue that these types of diversity in experience and centrality lead to better quality outcomes for a Wikipedia article.

These studies demonstrate that the early stages of an individual's participation are not negligible. Lave and Wenger's [35] influential theory of Legitimate Peripheral Participation (LPP) suggests that participants learn from small, less demanding tasks that help them to build the experience that leads them to take on larger tasks. Preece and Schneiderman's [47] "Reader to Leader" framework outlines a similar phenomenon in which newcomers to a social media platform begin as "readers" who consume content without contributing. Over time, some readers will begin to make contributions that increase in complexity and centrality to the project. Antin and Cheshire [2] directly apply the LPP and "Reader to Leader" frameworks to show that different forms of reading in Wikipedia (e.g, 'talk' pages versus general articles) are associated with significantly different knowledge about the system as a whole. More broadly, Oestreicher-Singer and Zalmanson [43] have defined a "ladder of participation" on which users of online content environments climb over time to more effortful and time consuming contribution. Incorporating Bateman et al. [11], they showed that when climbing, the levels of their normative commitment rise - users feel they ought to contribute, with their time, effort and money.

Closer to the context of this research are studies that document the emergence of different activity profiles in peer production systems. Panciera et al. [45] defined two types of editors: "Wikipedians" (high-volume contributors) and "non-Wikipedians" (low-volume editors), a dichotomy similar to that of lurker/core membership in online communities [48,58]. Wikipedians' and non-Wikipedians' behavior diverges almost immediately after they begin to participate. Other research highlights the differences between novice and expert users [3,7,14], and demonstrates that newcomers to peer production communities tend to be motivated differently than core participants in the community [15,16,21,38,47]. Antin et al. [3] built on Panciera et al.'s work [45] in focusing on the activities of new users and the effects of early edit behavior (types, patterns, and diversification of edits) on future activities. The authors found that certain early behaviors are predictive of the complexity and centrality of future contributions, suggesting that different types of work provide editors with more (or less) exposure to, and hands-on experience with, core activities. Finally, [4] show that core participants enact numerous distinct roles in contributing to Wikipedia, and that they tend to move between them as needed.

Further, different activities also provide editors with differing levels of socialization and exposure to community norms . Butler et al. [14] showed that more active participants put in substantial amounts of time on both technical and social tasks. Active participants were more likely to fix issues in the community and play a social, welcoming role for newcomers. In comparison to other users, these individuals also spent more time contributing content and composing messages than reading messages. Taken together, the prior literature demonstrates various ways in which newcomers and experienced participants. One possible explanation for these differences – and why some newcomers will never progress into veteran participants – may relate to how they are motivated.

2.2 Motivations for Participating in Peer-Production Communities

Self-Determination Theory [18,52] draws a distinction between two fundamental types of motivation: when individuals are *extrinsically* motivated, they perform an action with the aim of achieving some outcome. When they are *intrinsically* motivated, they do something because it is inherently interesting or enjoyable. In both cases, motivation is a complex construct of both the individual's expectation and prior experience in a task [37,51]. Research on the motivational determinants of knowledge contribution online is well documented and focused around both conventional and online peer production communities [33,54,64]. A number of relevant extrinsic motivations have been studied (including the improvement of skills [33,44] and enhancement of status [31]) as well as intrinsic motivations: altruism [65], fun [41], reciprocity [30], intellectual stimulation, and a sense of obligation to contribute [13]. In particular, the prior research showed that goals pursued for intrinsic reasons receive sustained efforts offline [55,61] and online [25,41].

In the case of online communities, existing empirical research draws conclusions about the relationship between motivation and behavior based on cross-sectional behavioral data [26,33,41,62]. Findings are therefore underpinned by the methodological assumption that motivations persist over time. But recent research on motivational dynamics tell a different story [1,8,51]. Rotman et al. [51] found that participants in citizen science communities are motivated by various factors which change dynamically with time. Alam and Campbell [1] found that different motivations are relevant at different stages in editors' participation, yet this study relied on a qualitative interpretative method, and neither [1] nor [51] engaged newcomers or incorporated formal measures of activity into their analyses. Balestra et al. [8] used a survey-based short-term longitudinal study to understand how certain motivations change in the early period of engagement, but did not incorporate activity data either. The authors found that non-instrumental motivations (such as collective and intrinsic motives) decreased significantly over time across a representative sample of the editor population. The present study provides an important extension to the broader analyses of [8] by focusing on key research questions regarding the essential role of fun as a core motivation in early peer-to-peer participation. Furthermore, we systematically explore and interpret the direct and indirect relationships between fun motivations and peer editing activities over time.

2.2.1 The Role of Fun Motives. Compared to other intrinsic motivations, fun motives are considered to be a rather straightforward construct which is immediately detectable by observation or by simply asking the observant if they are having fun [26]. "Fun" was found to consistently and positively correlate with engagement. For example, in the context of sports, Petlichkoff [46] surveyed more than 10,000 students and found fun to be the main reason for continued participation while not winning games. On the other hand, lack of fun was presented as the primary reason for attrition. Online, fun was shown to be key for the adoption of online social networks [26]. Research showed that Social Network Services members experience joy from the social interactions they take part in [12,56,59]. Within peer production, fun was found to have a positive effect on participation in Wikipedia [41], an effect stronger than ideological motivation. In open-source projects, Lakhani and Wolf [33] found that enjoyment-based intrinsic motivation is the strongest and most pervasive driver. Similarly, in the context of citizen science, [49] Nov et al. [42] suggest that enjoyment associated with participation was a key component in participants' contribution behavior.

These studies support the conventional wisdom that in general, the more fun an activity is, the more a person is likely to engage in it. However, there is a dearth of evidence on the temporal dynamics of

fun motives and the ways in which changes are shaped by participants' actions and experiences with the community and the work.

3 RESEARCH QUESTIONS

This study is guided by the following research questions: (RQ1) How are newcomers' early levels of fun associated with the amount and persistence of editing activity in the initial period of engagement? (RQ2) How do activity and fun motives influence each other over time?

4 METHODOLOGY

Our study uses a short-term longitudinal design [39], which measures the same group of individuals at multiple points in time over several months. Short-term longitudinal designs of 2-6 months have been used in the study of CSCW and HCI-related topics such as short-term motivation change among crowd-sourced workers [36], online communication and wellbeing [20], and the effects of cyberbullying [10]. More broadly, short-term longitudinal designs are also common in the social, psychological, and biomedical sciences when studying changes in *formative* experiences and motivations (as is the case of Wikipedia newcomers), including problems related to developmental psychology [32] and educational transitions [27].

An important and unique aspect of the present study lies in the recruitment of participants when they first register as Wikipedia editors. Because Wikipedia is characterized by a highly skewed distribution of participation, we employed a stratified sampling technique to capture and compare early users at different levels of engagement early in their "careers" as editors. After examining the activity logs of tens of thousands of new editors, we found that 53.66% of editors make 0 to 1 edits, 28.40% make 2 to 4 edits, 8.85% make 5 to 8 edits, 4.14% make 9 to 14 edits, and 4.95% of editors make 15 or more edits within the first two weeks of editing Wikipedia, representing the 50^{th}, 75^{th}, 90^{th}, 95^{th} and 99^{th} percentiles ("strata") of the number of edits editors make. To avoid sampling only those (many) who created accounts but never made edits, we monitored the first two weeks of editing behavior for all newly created accounts during one of two month-long recruitment intervals to determine the participation-level strata they belonged to. Two recruitment intervals were used to account for any seasonal variation (i.e. periodicity effects).

Participants with active email addresses were identified through the Wikipedia API and emails containing the link to the first survey were sent to several hundred randomly selected editors from each stratum to increase the probability of adequate data from each. 206 individuals responded to the first survey and were told that they would have the opportunity to participate in a future survey, but that they were under no obligation to do so. After approximately 6 months, a second survey was emailed to these individuals, of which 111 participated. Participants received a $10 gift-card as compensation after submitting each survey. After removing participants under the age of eighteen as well as those who made zero edits in the Main Article namespace, 90 viable participants remained who had responded to both surveys.

Table 1 summarizes the final samples' membership in the edit strata. These response rates clearly indicate why a stratified sampling technique was necessary: more active editors were more likely to respond to our survey, even though they made up a much smaller percentage of new editors. To moderate the influence of participants that were overrepresented, and strengthen the influence of those that were underrepresented, the data were adjusted using sample weights (the quotient of the population proportion divided by the sample proportion) in each analysis [24].

Edits made in the "early period" of a participant's career were defined as those made between the individual's date of registration and the day they submitted the first survey; edits made in the "intermediate period" of a participant's career were defined as those made between the submission of the first and second surveys. Importantly, this research design allows us to measure changes in both self-reported attitudes as well as real-world behaviors over time. Figure 1 demonstrates this study design.

Table 1. Stratified sampling edit strata and weights.

Edit strata	Unweighted response rate (% sample)	Weights
0-1 edits	8 (8.89)	6.04
2-4 edits	14 (15.55)	1.83
5-8 edits	14 (15.55)	0.57
9-14 edits	17 (18.89)	0.22
15 + edits	37 (41.11)	0.12

While there are constraints associated with our two-wave design (for example, high attrition between surveys), the associations between key variables are preserved across time periods, thereby increasing the internal validity) of the study. We found roughly equivalent representation from each of our participation-level strata when comparing those participants who only responded to the first survey to those who responded to both surveys. Of those who only responded to the first survey, 6.5% made 0 – 1 edit, 14.8% made 2 – 4 edits, 18% made 5 – 8 edits, 24.6% made 9-14 edits, and 36% made 15 or more edits. Of participants who responded to both the first and second survey, 7.6% made 0 – 1 edit, 16.3% made 2 – 4 edits, 13% 5 - 8 edits, 22.8% made 9-14 edits, and 40.2% made 15 or more edits. Given these similarities in behavior, we believe that the selection bias on observable variables is minimal across time periods for the purpose of our analyses.

We further subsetted our sample according to whether they persisted in editing over time. Contributors who made edits *only* in the early period of activity are referred to as "Dropouts" (N=50, 56%), whereas editors who were active in both the early and intermediate periods are referred to as "Persistent Editors" (N=40, 44%) (this distinction is depicted in Figure 1). This categorization of editors is important because we are interested in the interplay of activity and changes in motivation between early and later stages of engagement, when Dropouts are no longer making edits. Changes in Dropouts' level of fun motives across periods are therefore more likely due to other factors (e.g., motivational decay) than activity. These individuals were therefore removed from the analysis of RQ2.

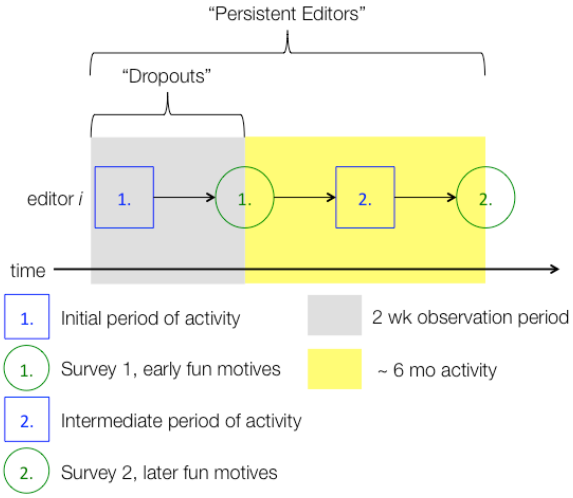

Figure 1: Study design

4.1 Measurement – Editing Activity

The number of edits each participant made to the Main Article namespace was collected using the Wikipedia API. We chose to focus on activity in the Main Article namespace because it allows us to zero-in on "co-production" activities, and to put aside the coordination and administrative duties that occur in

other namespaces. To account for the highly skewed distribution of edits, edit counts in the two periods of activity were log-transformed in our analyses.

4.2 Measurement – Fun Motives

Contributors' different motivations for editing Wikipedia were measured through a series of questions in both of our online surveys. Since the anticipate reward "fun" is a relatively unambiguous concept to self-report [22], we used a single-item construct modeled after [41]. In general, when a construct is very narrow in scope (i.e. uni-dimensional and unambiguous) a single-item question can offer similar predictive validity compared to a multi-item scale [50,53,63]. This is particularly true in smaller sample sizes when items would be highly homogenous and semantically redundant [19].

In our study, participants were asked to respond to the following question: "Consider whether you would agree or disagree with the statement personally...I have fun contributing to Wikipedia" using a 5-point Likert scale (ranging between "strongly disagree" and "strongly agree"), or to indicate that they had no opinion. The fun measure was adapted from Nov [41], which was itself adapted from a study of motivations for participation in open source software development projects [25]. Our one-item measure of the construct of 'fun' is similar in its approach to the prevailing practice of prompting the users onsite with the request to rate a specific opinion or experience which sites incorporate as a "barometer" for their users' sentiment.

4.3 Analysis – RQ1

OLS regression was used to analyze the effect of the number of edits made in the initial period of activity on early fun motivation across all participants. We controlled for the number of days of activity between registration and the submission of the first survey (since participants submitted their surveys on different days). Data were weighted according to the participation-level strata each editor belonged to. Figure 2 demonstrates this approach. Next, to understand how fun motivation was related to editors' persistence in editing, we used weighted, 2-sided student's t-tests to compare Dropouts' and Persistent Editors' early fun motives.

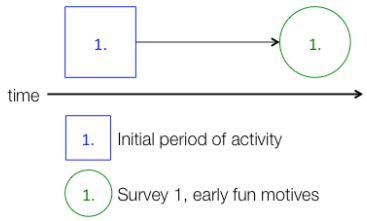

Figure 2: Analytical approach to RQ1

4.4 Analysis – RQ2

Structural equation modeling was used to investigate the interplay between fun motives and editing activity over time. This analysis only used data from Persistent Editors, as they had non-zero activity in the intermediate period of activity. Figure 3 illustrates the composite structural model, including the following observed variables: early level of the fun motive, later level of the fun motive, and the number of edits in the initial and intermediate periods of activity. We first analyzed the model of main effects (represented as purple arrows). Path (a) measures the effect of the number of edits in the initial period of activity on early motives; path (b) measures the effect of early fun motive on the number of edits in the intermediate period of activity; path (c) measures the effect of early fun motive on later fun motive; path (d) measures the effect of edits in the intermediate period of activity on later fun motive. We then analyzed the model containing a moderating effect of early fun motives on the relationship between the number of edits made in the intermediate period and later fun motive (path (e)). Bootstrapping was used to determine the significance of path coefficients.

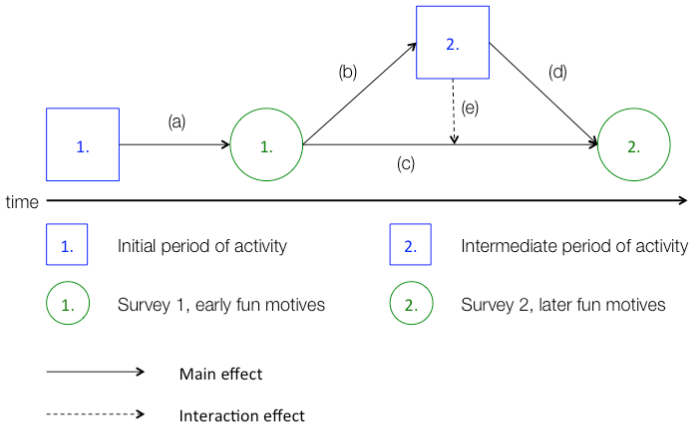

Figure 3: Structural path model of relationship between fun motives and activity over time. (a) Activity in the initial period → early fun motives; (b) early fun motives → activity in the intermediate period of participation; (c) early fun motive → later fun motive; (d) activity in the intermediate period → later fun motives; (e) moderating effect of early fun motive on the relationship between intermediate activity and later fun motives.

5 RESULTS

Our results show that persistence in editing is related to fun, while the amount of editing is not: individuals who persist in editing are characterized by higher fun motives early on (when compared to dropouts), though their motives are not related to the number of edits made. We also found that newcomers' experience of fun was reinforced by their activity over time.

5.1 Effect of Early Fun Motive on Amount of Activity and Persistence in the Initial Period of Engagement (RQ1)

We found no significant main effect of the number of edits made in the initial period of activity on participants' early level of fun motivation (B=0.26, t=1.46, p=0.15). When we compared levels of early fun motive between individuals who continued to participate and those who dropped out in the initial period, we found that Persistent Editors had significantly higher early fun motives than Dropouts (t=3.01, p=0.003). Correspondingly, Persistent Editors also made significantly more edits in the initial period than Dropouts (t=3.2, p=0.002). Table 2 summarizes these data.

Table 2: descriptive data

	Persistent Editors	Dropouts
Motivation – M (SD)		
Initial fun motives	3.94 (0.89)	3.35 (0.97)
Final fun motives	3.76 (0.69)	NA
Edit Activity – M (SD)		
Edits in early period	7.92 (11.83)	2.03 (2.58)
Edits in intermediate period	6.91 (24.03)	NA

5.2 The interplay of fun motive and amount of activity over time (RQ2)

Results from the main effect model and the interaction model are reported in Table 3. In the model of main effects, the overall model fit statistic, R^2, was 0.06; however, when the interaction term between early fun motive and intermediate activity was added, the overall R^2 increased to 0.16.

Table 3: Results from the Main Effect and the Interaction Models of activity and motives. "Path" refers to structural paths in Figure 3.

Structural Model	path	Model 1 (Main Effects)		Model 2 (w. Interaction Effect)	
		Estimate	t-statistic	Estimate	t-statistic
Activity 1 → fun 1	(a)	-0.089	0.437	-0.089	0.474
Fun 1 → Activity 2	(b)	0.084	0.463	0.084	0.50
Fun 1 → Fun 2	(c)	0.061	0.269	0.144	0.696
Activity 2 → Fun 2	(d)	0.248	1.734^{t}	0.074	0.342
Fun 1 * Activity 2 → Fun 2	(e)	NA	NA	0.464	2.45*

'' 0.01; '*' 0.05; 't' 0.1**

First, from the model of main effects, we found no significant effect of early fun motivation on the number of edits made in intermediate period of activity, and a marginal effect of intermediate activity on later fun motives (B=0.248, t=1.734, p=0.083). When we added the interaction term, we found a significant moderating effect of activity on the relationship between fun motives at earlier and later stages (B=0.464, t=0.245, p=0.015). To understand the effect of intermediate activity on final fun, we calculated the marginal effect of activity [23,28] while holding the moderator - initial fun - constant from 1-5 (i.e. values of the Likert scale). The marginal coefficients of intermediate activity were then plotted for each value of initial fun in Figure 4. From this plot, we can see that the effect of intermediate activity on final fun increases for increasing levels of initial fun. The activity of participants with a low level of initial fun motivation had a relatively large, negative effect on later fun motives: that is, participants with low initial fun motives who edited more in the intermediate period had lower final fun motives. On the other hand, the activity of

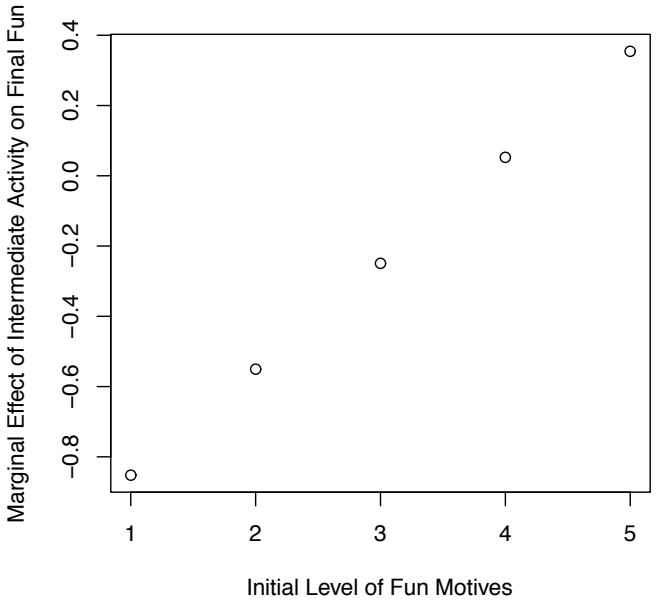

Figure 4: Plot of the marginal effect of activity ($\beta_{activity}$) in the intermediate period of activity on final fun, at varying levels of initial fun ($\beta_{initialFun}$). This indicates that the effect of intermediate activity on final fun increases for increasing levels of initial fun.

participants who initially had a high level of fun motives had a large, positive effect on final fun motives: that is, participants with high initial fun motivation who edited more had a higher measure of fun motives later on. This bifurcation suggests that activity reinforces individuals' initial experience of fun editing Wikipedia. In summary, participants who thought editing Wikipedia was fun in the earlier stages of engagement trended towards a virtuous cycle in the relationship between activity and fun, whereas participants who thought editing Wikipedia was not fun trended towards a "vicious" cycle where the more they edited, the less fun they had.

6 DISCUSSION, LIMITATIONS, & FUTURE RESEARCH

The need to sustain participation in peer production communities calls for longitudinal exploration of participants' motivation, behavior and the relationship between the two. Our study contributes to this goal by delineating the nuanced interplay between peer production activity and fun motivation over time. We found that editors who persist have higher levels of fun motives early on than those who drop out, though this elevated level of motivation was not a function of the amount of early editing activity they engaged in (RQ1). Despite this, persistent editors' early levels of fun motivation were further reinforced by their editing activity over time (RQ2). Thus, early fun experiences were found to have a lasting effect on the relationship between fun and amount of activity. For example, those who claimed little fun to begin with and who edited more over time, also reported less fun going forward. These results stress the criticality of newcomers' earliest peer-production experiences, and they demonstrate that the relationship between activity and intrinsic motives is far more complex than previously understood.

On one hand, the observation that contributors who persist had more fun aligns with prior studies showing that goals pursued for intrinsic reasons receive sustained efforts [28,46]. On the other hand, the lack of a causal relationship between early activity and subsequent levels of fun contradicts the widely held belief that the more fun an activity is, the more people will be willing to engage in it [26,41].

This lack of a direct, causal relationship between activity and fun holds true in later stages of participation for those editors who persist (specifically, in the ~6 months after the first survey). These results suggest that the amount of early editing activity does *not* directly influence fun, and fun does *not* directly influence the amount of activity participants engage in at later stages. This is antithetical to the prior literature [36,46,57], where fun is seen as a major factor in the continued participation of contributors.

It is possible that these findings differ from those of previous studies as a result of our focus on newcomers, in their earliest periods of engagement: the relationship between fun and activity may be more straightforward for more experienced editors. In the early period of contribution, participants may have other experiences on the platform that lead them to develop higher fun motives, but are not necessarily related to core co-production activities. For example, they may engage in meaningful social interactions with other editors [14,60,62]. Alternatively, this may be a function of more deeply rooted differences among editors. Newcomers who are prone to persist may have a higher level of normative commitment to the Wikipedia environment [13,47]. As their contribution is not an "one-off" occurrence, they may be further exposed to the inner workings of the Wikipedia, their peers' contributions, and to other communal aspects of the platform [55] which increase their perceptions of fun or enjoyment, but are not necessarily correlated with the volume of co-production activities they engage in. More research is needed for better understanding of how editors' participation in, and experience of, other (non-editing) activities influence their fun motive in parallel to their core editing tasks.

Our highly controlled study design and methodological approach allows us to draw important and novel insights about newcomers' formative experiences editing Wikipedia; namely, we find that editors' early levels of the fun motivation play a significant role in their experience of participation at later points in time. Our results show that persistent newcomers' early level of fun moderates the effect of their activity on future perceptions of fun. That is, participants who might have seen contributing to Wikipedia as fun in the early stage of engagement trended towards a virtuous cycle in which activity reaffirmed their early perception of fun. Participants who viewed contributing to Wikipedia as *not* fun trended towards a

"vicious" cycle where the more they edited, the less fun they had. Whereas our earlier results suggest that newcomers' fun motives are not necessarily formed through core co-production tasks, the results of this analysis serve to highlight just how significant and tenacious those formative experiences are over the editor's career. This result also has practical implications for practice: platform designers need to be acutely aware of newcomers' earliest motivations because they may foretell future participation and experiences as well. Moreover, websites may consider incorporating even a single question as a prompt, as this study shows that assessing users' self-reported level of fun alongside their actual activity allows us to better understand and predict participatory trajectories over time.

It is widely accepted that one way to motivate individuals to sustain participation in online platforms is to make participation more fun and enjoyable; and many studies have investigated how to do so [2,29,41]. Our approach does not explicate which specific elements of Wikipedia hold the greatest source of fun for the participants. Further, although meta-analytic studies have shown that measures with few items (and even single-item measures) can perform as well as their multi-item counterparts (e.g., [50,53,63]), we are aware of the prevailing concern that single-item constructs are less reliable and may pose a limitation of the present study. Future research may further examine how fun is related to specific activities in Wikipedia.

Despite this, our findings provide important specificity and nuance to the conventional wisdom: (1) *not every* task in peer production needs to be made fun over time. Newcomers should be engaged in fun activities at the earliest period of engagement, though fun activities are less impactful at later stages of participation; (2) the stakes are high for engaging newcomers in fun activities – our results show not only that their early perceptions persist and influence their experiences of participation over time, but, if they do not have fun early on, activity only re-enforces their negative experience of participation.

Overall, we see that users' initial perception in Wikipedia is of critical importance to their experience of participation, albeit not in the ways we necessarily would have expected. This paper strengthens recent findings in the field of HCI [10,18,25,42] that stress the importance of first user encounters with the peer production system on their sustained participation. It also echoes insights from the neighboring field of computer games [17], which showed that the design of the first hour of play is crucial to whether players will be engaged in the game in the long run.

7 CONCLUSION

Challenges in retaining peer production participants may be related to participants' levels of motivation. Prior studies on participation trajectories focus on activity dynamics while overlooking the accompanied changes in levels of fun motivation. Prior studies also tend to describe the relationship between fun motives and activity as unchanging: i.e, you either have it or you do not, and if you have it you are more active. To fill this gap, we combined activity and motivational data in a short-term longitudinal study of new Wikipedia editors. We found that initial perceptions of fun are related to participants' behavior and future perceptions in ways that are substantive but changing and unexpected. We believe this calls into question the conventional belief, held by designers of online platforms and communities, that the more fun a task is the more likely people are to do it. Following from this work, additional research on how to target "fun interventions" at the appropriate stage in the participant's career may lead to a more effective way to engage individuals in the long term.

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