Psychological ownership in open source electronic medical records communities

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Abstract

Purpose – Open source software (OSS) communities devoted to the development of electronic medical records (EMRs) have grown in recent years. The purpose of this paper is to focus on the challenge the leaders of these communities face in terms of building perceptions of psychological ownership among community members.

Design/methodology/approach – Surveys (n = 50) and brief interviews (n = 56) with individual members of an open source EMR community (most of whom are based in African nations) were used.

Findings – Among community members, normative commitment (in comparison to extrinsic motivation and affective commitment) was the strongest predictor of psychological ownership. Interviews revealed that community members tended to feel a greater sense of ownership toward the end user (i.e. hospitals and clinics) than toward the community itself.

Practical implications – To foster engagement and retention – and enhance the worldwide impact of their community on healthcare practices – leaders of open source EMR communities can offer incentives related to certifications and status-based rewards, hold annual meetings to allow members to develop a better understanding of the community and encourage members to "pay it forward" by involving end users (i.e. hospital and clinic employees) within the community, thus furthering public health initiatives.

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Originality/value – OSS communities experience unique challenges compared to traditional organizations. This necessitates a reconsideration of the applicability of commonly accepted principles, tenets and recommendations from the management literature.

Keywords Psychological ownership, Healthcare management, Commitment, Motivation, Affective commitment, Extrinsic motivation, Normative commitment

Paper type Research paper

Introduction

Open source software (OSS) communities provide free source code so that any software developer can modify, view or distribute the product, which, in turn, results in more flexible technologies, greater innovation and lower costs (for an overview, Sharma *et al.*, 2002). In contrast to for-profit technology organizations, these communities are comprised primarily of volunteers and are characterized by fluid membership combined with a lack of formal structure and few rules or regulations. Contributions "are made by developers that are users of that software, either as individual users or user firms, rather than by software manufacturers" (von Hippel and von Krogh, 2003, p. 214).

OSS communities are now quite prevalent in the healthcare space. For example, Wikipedia provides a list of OSS communities categorized according to diagnostic software, medical practice management software and medical information systems, to name a few (see https://en.wikipedia.org/wiki/List_of_open-source_health_software). Electronic medical records (EMRs) is one of the largest categories, with at least 19 different communities. The benefits of EMR – including better patient care and reduced costs associated with paper record keeping – are well documented in the healthcare literature (Rathert *et al.*, 2019). These OSS communities focus not only on the improvement of existing EMRs but also on expanding EMRs into less-developed regions of the world to universally improve healthcare.

However, as membership within these communities continues to grow, the leaders of these communities are faced with difficult challenges (O'Mahony and Ferraro, 2007). They need to manage their limited resources effectively to maximize efficiency and ensure that users of the software contribute back to the community to alleviate the problem of free-riding (von Hippel and von Krogh, 2003). At the same time, they need to avoid too many formal rules and structures to allow their core volunteers to remain autonomous. Viewed from an organizational perspective, the challenge that leaders of these communities face concerns how to build a sense of psychological ownership when factors and incentives, which apply to traditional organizations (e.g. formal employment contracts and salary) are absent from these communities. This paper addresses these challenges by combining deductive and inductive methods, using both survey (n = 50) and anecdotal data (n = 56 interviews) collected on-site at the annual conference of one open source EMR community.

Leveraging theory from the management literature, we make three primary contributions addressing psychological ownership in OSS communities:

(1) First, we identify conceptual nuances between traditional organizations and OSS communities in regard to common antecedents of psychological ownership (e.g. extrinsic rewards). Importantly, these common antecedents promote perceptions of psychological ownership in both settings, yet manifest in context-specific ways;

(2) Second, we differentiate the types of organizational commitment most relevant to the two settings. While continuance commitment (i.e. the need to stay with a current employer) influences psychological ownership in traditional organizations, our work identifies normative commitment (i.e. the belief that remaining

committed is the right thing to do) as a powerful antecedent of psychological ownership in OSS communities; and

(3) Third, our qualitative results reveal that – in contrast to traditional organizations where psychological ownership is felt toward the organization – psychological ownership in OSS communities is often felt toward the end users (i.e. hospitals and clinics) as opposed to the community itself. Taken together, our work not only highlights the importance of studying OSS communities but also offers guidance on how leaders can best manage members to ensure the community's continued success.

Conceptual model and hypotheses

Psychological ownership is defined as a "feeling of possessiveness and of being psychologically tied to an object" (Pierce *et al.*, 2001, p. 299). Within organizations, psychological ownership affords many benefits including improved job performance, greater work engagement and higher satisfaction with work (Pierce *et al.*, 2009). Although we expect that these outcomes are similar in OSS communities, we note that the antecedents of psychological ownership likely differ. For example, although ethical leadership is an antecedent of psychological ownership in traditional organizations, the presence of the leader and his or her behaviors in OSS communities is likely not as strong (Avey *et al.*, 2012). Moreover, the influence of team climates on psychological ownership is likely absent in OSS communities, as work is often conducted remotely and individually (Liu *et al.*, 2012). As a result, it remains unclear as to which are the most influential and relevant antecedents of psychological ownership in OSS communities. This is an important shortcoming to address, as enhanced perceptions of psychological ownership in OSS communities should help members to remain active within the community, in turn, helping the community continue to grow and succeed. Accordingly, we present our conceptual model in Figure 1, which hypothesizes that extrinsic motivation, affective commitment and normative commitment are three critical antecedents of psychological ownership in OSS communities. In the sections below, we synthesize research from the management and OSS literature to explain and justify why we identified these particular antecedents.

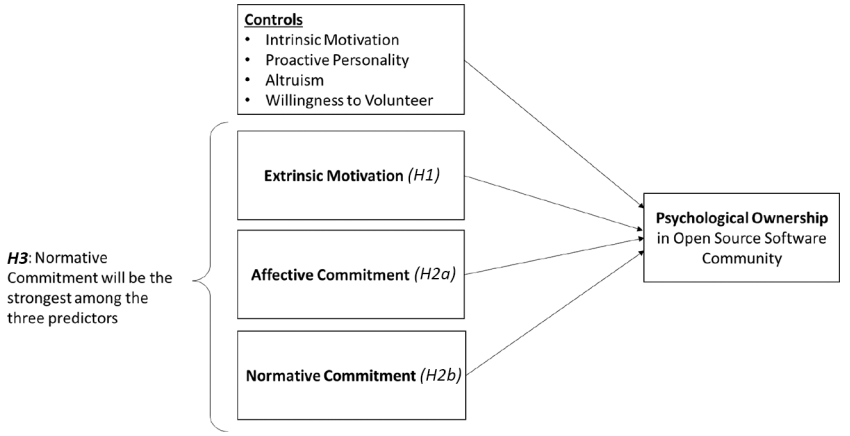

Figure 1.
Conceptual model

Extrinsic motivation

The importance of extrinsic rewards – including financial or pecuniary ownership of employees within firms – is well recognized in the organizational literature (Dunford *et al.*, 2009). For example, Chief Executive Officers are incentivized with stock options to help ensure that their actions are strategically sound and in the best interests of the organization: when the organization performs well, they are rewarded (Sanders and Hambrick, 2007). In terms of reward structures, OSS communities stand in stark contrast to traditional organizations (for a full review, see von Hippel and von Krogh, 2003). As these are often non-for-profit organizations, financial rewards and incentives are not only absent but also discouraged to better promote a sense of community (O'Mahony and Ferraro, 2007; von Hippel and von Krogh, 2003). However, extrinsic rewards still exist albeit in alternate forms. These include situated learning, improving one's skills and knowledge and improving one's professional status (Fang and Neufeld, 2009; Lakhani and Wolf, 2005). All of these lead to enhanced perceptions of psychological ownership, as extrinsic rewards allow members to more fully invest themselves in their work and to develop a better appreciation and understanding of their role within the community (Pierce *et al.*, 2001).

Accordingly, we note a similarity between traditional organizations and OSS communities: both offer forms of extrinsic motivation, which help develop perceptions of psychological ownership. At the same time, we note that the key difference is in the specific forms offered: traditional organizations offer monetary benefits and incentives, whereas OSS communities offer incentives associated with improving skills, knowledge and status. By offering these forms of extrinsic rewards, leaders of OSS communities can create a sense of psychological ownership without gravitating too strongly toward the private investment model (i.e. offering an employment contract and a salary) and creating risks that the community will transform into a more traditional organization. Accordingly, we hypothesize:

H1. Extrinsic motivation will positively predict perceptions of psychological ownership among OSS community members.

Affective and normative commitment

Organizational commitment "characterizes the employee's relationship with the organization and has implications for the decision to continue or discontinue membership in the organization" (Meyer *et al.*, 1993, p. 539). There are three types of organizational commitment as follows:

(1) *Affective commitment*, where employees want to remain with the organization because they enjoy it;

(2) *Normative commitment*, where employees feel as though they ought to remain with the organization (i.e. it is the right thing to do); and

(3) *Continuance commitment*, where employees feel a need to remain with the organization due to costs and disadvantages associated with leaving or quitting (e.g. they need the salary and have no other work alternatives).

Research focusing on employees in the traditional organization suggests that – while affective and continuance commitment are crucial factors associated with psychological ownership (as both create feelings of possession tied to the job and the organization) – normative commitment is more of a dispositional factor, which has less influence (Mayhew *et al.*, 2007). In contrast, we argue that – given the volunteer-based nature of OSS

communities – affective commitment and normative commitment are the most crucial factors influencing psychological ownership. Because membership in OSS communities neither offers financial rewards nor tends to serve as the basis of one's career, continuance commitment is a less relevant consideration, as the costs associated with leaving are more minimal (e.g. salary is not lost).

As virtual organizations, OSS communities are less tangible than traditional organizations. This perspective is understood in terms of artifacts or "the physical characteristics such as dress/attire and décor, mission statements, memos and slogans; and implicit communicators such as rites and rituals" (Sharma *et al.*, 2002, p. 14). Research on psychological ownership shows that the action of merely touching a physical object can increase a perceived sense of ownership (Peck and Shu, 2009). Traditional organizations are able to leverage their physical characteristics as a means to create affective commitment. For example, on-site amenities, the "campuses" of various headquarters, and in-person bonds formed among colleagues all help create feelings of affective commitment (Johnston, 2014). Because of these artifacts, employees may feel a sense of psychological ownership toward a traditional organization more easily than members would toward an OSS community.

However, OSS communities can still find ways to create effective commitment among members. Even though work is primarily conducted remotely and there are few – if any – artifacts toward which one might feel a sense of ownership, annual meetings that bring members together can help create a sense of "place" (Lawrence and Dover, 2015). Moreover, although virtual interactions are a less-rich form of communication compared to in-person interactions (Byron, 2008), virtual relationships are still capable of helping members develop a sense of affective commitment with each other and with the community as a whole (Scott *et al.*, 2006). Accordingly, although OSS communities are handicapped by their lack of a physical workplace, we anticipate that they can still create effective commitment among members, which, in turn, will enhance perceptions of psychological ownership.

At the same time, we argue that normative commitment not only is a unique influence on psychological ownership in OSS communities (as compared to traditional organizations) but also will be a more powerful influence on psychological ownership compared to affective commitment and extrinsic motivation. Management scholars argue that – for traditional organizations – psychological ownership is primarily a function of the organization's characteristics and contexts rather than one's experience or dispositional factors (Mayhew *et al.*, 2007). However, we argue that psychological ownership in OSS communities is heavily influenced by dispositional factors and experience. Indeed, members are often characterized as proactive and altruistic individuals (Fang and Neufeld, 2009; Hertel *et al.*, 2003; Shah, 2006; von Krogh *et al.*, 2003). As a result, members are likely to feel a strong pull and obligation to contribute (and remain committed to) to the OSS community to help achieve or advance its overall objectives. This is a relevant consideration particularly in regard to this paper's source of data collection: OSS communities focused on developing and implementing EMRs in hospitals and clinics located in areas, which lack these resources, whose community members are motivated to make the world a better place by further promoting public health development. In this regard, members are likely to believe that remaining with the community and further investing themselves is "the right thing to do." To the extent that they experience this normative commitment, they are likely to feel an enhanced sense of psychological ownership. Therefore:

H2. (a) Affective and (b) normative commitment will positively predict perceptions of psychological ownership among OSS community members.

As explained above, when weighing the powerful influence of normative commitment against the ways in which extrinsic motivation and affective commitment – although still present – are weaker in OSS communities than in traditional organizations, we suggest:

H3. Among OSS community members, the normative commitment will be a stronger predictor of psychological ownership compared to extrinsic motivation and affective commitment.

Methods

Participants and procedure

Data were collected from participants in attendance at an open source EMR community's annual conference. This open source community has approximately 200 core members located throughout the world and focuses on developing a software platform to enable hospitals and clinics to implement EMRs. To preserve anonymity, this paper refers to the open source community as "[community name]" when discussing the scales and items that were used for measures. At the opening meeting of the conference (when all participants were in attendance), the leadership team introduced the research goals and objectives, including the first author who was on site at the conference. Conference attendees were encouraged at any point during the week to either complete an online version of the survey (via Qualtrics) or to obtain a paper-and-pencil version of the survey and return to the member of the research team. Among approximately 300 participants in attendance, 50 completed questionnaires were received, yielding a response rate of approximately 17%. Although low, this is in line with response rates in previous healthcare research (Perrigino and Dunford, 2016). Because the research objectives and the survey were introduced to the community members at the conference, part of the reason for the low response rate may have been because of:

- unfamiliarity with the research objectives and a reluctance to participate; and
- a heavy conference agenda pertaining to other issues.

However, this likely also served to reduce any social desirability biases given that the research team did not have existing previous relationships with the community members. In total, 16 questionnaires were completed online, while 34 were completed with the paper-and-pencil version. The sample consisted of participants primarily located in African countries (in particular, Uganda, Kenya and Malawi) with a smaller subset ($n = 8$) from the USA. All survey responses were anonymous to further reduce social desirability biases. During the week of the conference, the first author also conducted brief semi-structured interviews with conference participants ($n = 56$). It is likely that there was some – but not complete – overlap between survey participants and semi-structured interview participants.

Measures

Items were rated on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

Extrinsic motivation. The extrinsic motivation was measured using two items as follows: "contributing to [community name] improves my technical skills" and "contributing to

[community name] improves my professional status." Lakhani and Wolf (2005) developed these items specifically for an open source community context.

Normative commitment. The normative commitment was assessed with three items from Meyer *et al.* (1993). The items were: "I would feel guilty if I left [community name] now," "[community name] deserves my loyalty" and "I owe a great deal to [community name]."

Affective commitment. The affective commitment was assessed using three items also from Meyer *et al.* (1993). The items included: "I would be very happy to spend the rest of my career volunteering with [community name]," "I really feel as if [community name]'s problems are my own" and "[community name] has a great deal of personal meaning for me."

Psychological ownership. Psychological ownership was assessed using a shortened two-item scale adapted from Pierce *et al.* (2001). A sample item is: "I feel a very high degree of personal ownership for [community name]."

Control variables. In line with previous literature, we included four control variables so that we could account for the unique explanatory power of extrinsic motivation, affective commitment and normative commitment as antecedents of psychological ownership (above and beyond the variance explained by these other possible antecedents). *Intrinsic motivation* was measured using two items from Lakhani and Wolf (2005): "contributing to [community name] is intellectually stimulating for me" and "I like working with the [community name] team." *Altruism* was measured using an item adapted from Payne and Webber (2006) and *proactive personality* was measured using an item adapted from Parker (1998). The items were, "I squeeze in time for [community name] even when my schedule is full" and "if I see something I don't like, I fix it," respectively. *Willingness to volunteer* ("even for an organization I care about, I am unwilling to work without getting paid"; reverse-coded) was measured using an item from DeVoe and Pfeffer (2007). Single-item and short form measures for these study variables were considered necessary:

- given that survey space was limited; and
- to mitigate any demanding aspects of the survey, particularly for participants whose first language was not English.

Although this is a limitation, these constructs are relatively specific ones, which did not require multiple subscales. Previous research explains the appropriateness of single-item measures in such situations (Wanous *et al.*, 1997).

Analysis strategy

Analyses were conducted using SPSS v23. Hierarchical regression was used to test *H1–H3*. In addition to comparing the regression coefficients to examine *H3*, a relative weights analysis using the guidance provided by LeBreton and Tonidandel (2008) was also used. Finally, given the diverse nature of the sample, a one-way analysis of variance (ANOVA) was used to consider the possibility of subgroup differences (although these appeared to have a minimal impact on our results; please refer to supplemental Appendix).

Results

Table 1 displays the means, standard deviations and correlations of the study variables. Table 2 displays the results of the hierarchical regression analysis. We entered the control variables in Step 1 of the regression equation, followed by the three primary antecedents of investigation in Step 2. Lending only marginal support to *H1*, extrinsic motivation was positively associated with psychological ownership ($\beta = 0.33$) at $p < 0.10$ level. *H2a* was not

supported, as affective commitment did not predict psychological ownership (although the effect was in the expected positive direction: $\beta = 0.23$ and $p > 0.05$). In support of *H2b*, the normative commitment was positively associated with psychological ownership ($\beta = 0.46$ and $p < 0.05$). Lending preliminary support to *H3*, normative commitment was the strongest predictor of psychological ownership among the three variables based on:

- possessing the largest regression coefficient; and
- demonstrating the only statistically significant effect at a $p < 0.05$ level.

Table 3 displays the results of the analysis of the relative weight. Relative weights analysis allows researchers to examine, which predictor is the strongest in comparison to all of the other predictor variables examined (Budescu, 1993). In Table 3, the normative commitment was the strongest predictor of psychological ownership, accounting for 34% of the total explained variance while affective commitment accounted for 24% of the total explained variance and extrinsic motivation accounted for 21% of the total explained variance (adjusted $R^2 = 43\%$ total). This provides further support for *H3*.

Anecdotal data from semi-structured interviews

Although much of the interview content and a full inductive analysis are beyond the scope of this work, an interesting theme to emerge supporting the empirical results was a

Table 1.
Means, standard deviations and correlations

Study variables	M	SD	1	2	3	4	5	6	7	8
Proactive personality	4.02	0.83	–							
Willingness to volunteer	4.13	1.10	−0.21	–						
Altruism	3.86	1.17	−0.07	−0.18	–					
Intrinsic motivation	4.61	0.49	0.08	0.03	0.24	–				
Extrinsic motivation	4.57	0.65	0.19	0.07	−0.08	0.61*	–			
Affective commitment	3.96	0.70	0.19	0.18	0.02	0.50*	0.53*	(0.67)		
Normative commitment	4.15	0.73	0.26	0.05	0.25	0.54*	0.46*	0.58*	(0.74)	
Psychological ownership	3.82	0.93	0.04	0.11	0.16	0.42*	0.55*	0.58*	0.59*	–

Notes: *$p < 0.05$; reliabilities are displayed along the diagonal; M = mean; SD = standard deviation

Table 2.
Hierarchical regression results

Predictor variables	Step 1 β	Step 1 *SE*	Step 1 p	Step 2 β	Step 2 *SE*	Step 2 p
Proactive personality	0.02	0.17		−0.16	0.14	
Willingness to volunteer	0.03	0.14		−0.02	0.11	
Altruism	0.08	0.12		0.10	0.10	
Intrinsic motivation	0.40	0.28	*	−0.16	0.31	
Extrinsic motivation				0.33	0.22	t
Affective commitment				0.23	0.20	
Normative commitment				0.46	0.20	*
Adjusted R^2	0.09			0.43		
ΔR^2				0.21		
		$F(4,35) = 1.96$			$F(2,32) = 7.14$	

Notes: *$p < 0.05$; $^{t}p < 0.10$; outcome variable = psychological ownership

Predictor variables	Psychological ownership
Proactive personality	2.0%
Willingness to volunteer	0.4%
Altruism	9.0%
Intrinsic motivation	9.8%
Extrinsic motivation	21.0%
Affective commitment	23.7%
Normative commitment	34.1%
Adjusted R^2	0.43

Note: The percentages indicate the proportion of total variance in each outcome variable (as indicated by the adjusted R^2) attributable to each predictor variable

Table 3.
Relative weights analysis

commitment to the cause, not the community. In other words, all interviewed participants were extremely passionate about and optimistic toward the goal of implementing open source EMRs in hospitals and clinics throughout the world. In this regard, members exhibited a sense of psychological ownership. However, when asked about the future of this particular OSS community, responses tended to focus not on commitment and a sense of ownership toward the community itself but rather toward the areas where the community made its impact (e.g. hospitals and clinics). For example, one participant answered by explaining how his group had 86 hospitals online (i.e. sites where the OSS was installed and running) and planned to have 300 hospitals running the software within the next few months. Another spoke of the future in terms of the remaining four years on a governmental grant that he and his group were using to help implement the OSS in hospitals and clinics located in smaller European countries. This lack of focus on the community itself underscores the challenges discussed earlier, where leaders of OSS communities must devise ways to create perceptions of ownership without:

- gravitating too much toward structure, rules and an authoritarian style of leadership while avoiding; and
- gravitating too much toward a collective action project where free riding occurs.

The implications of these findings are discussed below.

Discussion

This paper sought to address the challenges facing leaders of OSS communities, as OSS communities possess unique characteristics and attributes in comparison to traditional organizations. Applying theory on psychological ownership, we developed hypotheses to identify the key antecedents of psychological ownership in OSS communities. Our results suggest that normative commitment – particularly in comparison to extrinsic motivation and affective commitment – plays a key role in determining members' perceptions of psychological ownership. However, psychological ownership was felt more toward hospitals and clinics as opposed to the community itself.

Research implications for the study of open source software communities

Our work contributes to the study of OSS communities by comparing their similarities and juxtaposing their differences with traditional organizations. Overall, we identified psychological ownership as a critical factor influencing the performance and satisfaction of

both employees of traditional organizations and members of OSS communities. Despite this importance, the antecedents of psychological ownership differ across the two contexts. Indeed, extrinsic motivation and affective commitment – two of the stronger influences associated with psychological ownership in traditional organizations – were relatively weak predictors in OSS communities. Conceptually, we attribute this to OSS communities' lack of traditional reward structures; and a physical location. Yet, we also explained the unique ways in which OSS communities can offer extrinsic rewards and attempt to build affective commitment. Thus, these factors still possess some influence on predicting psychological ownership. More importantly, our work identifies normative commitment as a strong predictor of psychological ownership among OSS community members. This stands in contrast to studies examining traditional organizations, particularly those which focus on affective and continuance commitment (Mayhew *et al.*, 2007). Normative commitment is likely a key influence because of a combination of:

- individual members' proactive and altruistic intentions; and
- the overall aims and mission of the community.

Finally, our work reveals another contrast: whereas the job or the physical location tends to be the "object" associated with psychological ownership in traditional organizations, it appears that the end users – rather than the OSS community – is the object associated with psychological ownership for OSS community members. We recommend that future research continue to consider and identify these types of nuances associated with OSS communities, weighing the applicability of management theory and the relevance of knowledge derived from studying traditional organizations.

Practice implications for managing open source software communities

Our work offers practical insights regarding how leaders can best manage OSS communities. As all communities grow, they reach an eventual tipping point where they must formally organize or face severe consequences. Interview data in this paper suggested that the OSS community, which served as the focus of this study reached this point. Illustrative quotes include: "they [the leadership team] do a good job of focusing on the community aspects but need to focus more on the incorporated aspects" and "they [the leadership team] need to realize that it's no longer just 50 developers in 50 garages." Yet these suggestions appear contrary to the literature on OSS communities, which suggests that authority is based on meritocracy and that "leaders" serve the function of a sports coach tasked with managing talent rather than someone who holds the formal responsibilities associated with running a sports franchise (Sharma *et al.*, 2002; von Hippel and von Krogh, 2003).

However, to simply state that an organization is required and that a more authoritarian leadership style is warranted is insufficient. While leaders within OSS communities should wield at least a portion of their power, they must do so in ways that do not hinder or restrict the community members: these community members are volunteers who are free to leave at any time (i.e. lack feelings of continuance commitment). Therefore, attempts to build perceptions of psychological ownership by offering salaries or commissions – aside from potential funding-related issues – are likely to be viewed by community members as too formal. Yet, as we explained above, extrinsic rewards extend beyond financial ones. For example, leaders might offer formal certifications or status-based rewards where those who are motivated by these extrinsic factors will seek to obtain them while those who are not motivated by these factors will not feel pressure to do so. Moreover, members may feel further ingrained

within the community and experience a stronger sense of psychological ownership when they reach or achieve these certifications and rewards.

One of the key routes to psychological ownership is developing an intimate knowledge of the target (Pierce *et al.*, 2001). Annual meetings – whether worldwide or regional – can help community members gain a more intimate knowledge of the community itself. Therefore, when financially feasible, leaders should consider ways to meet and further educate members about the community via face-to-face interactions. This is likely to help build feelings of commitment and a sense of ownership, which, in turn, can increase member satisfaction and contributions. Moreover, the location of these meetings can be chosen strategically and – as in the case of open source EMR communities – near implementation sites so that community members can see the direct impact that their work has on improving public health.

It is also important to emphasize that OSS communities and traditional organizations are not complete opposites. In this regard, basic managerial training may be a simple yet effective first step in helping leaders more effectively manage their communities. Those who champion a cause may lack formal training and leadership experience. Yet, when growth in the community occurs, they may feel as though they are thrust into the leadership role. Therefore, education sessions related to basic organizational principles – the importance of managing in an equitable and fair manner, the effectiveness of transformational leadership, etc., – can have a positive impact and create pathways for promoting perceptions of psychological ownership.

Implications for public health

A unique aspect of open source EMR communities is that, beyond software developers, implementers play a vital role. Implementers tend to have a basic knowledge of the software but are responsible for helping implement (as the name suggests) the software within hospitals and clinics. They traditionally serve as a bridge between hospital administration and the core community of developers by reporting issues and requesting additional functionalities. In tying this back to our qualitative results, we observe that – while implementers are likely to feel greater ownership toward the facilities as opposed to the community – they are also uniquely situated to help not only in terms of recruiting new members but also in terms of building commitment to the community. The literature on institutional conversion and persuasion suggests that individuals attempting to create broad-scale change engage in different strategies (Tracey, 2016). These include framing the issues, eliciting sympathy and engaging in performative work (e.g. helping get the software up-and-running). Implementers can help frame their work within the context of the open source EMR community, not only by crediting successful implementations to the community but also by:

- encouraging members of the hospital or clinic to get involved, such as recruiting a developer employed by the hospital to participate in the community; and
- championing the open source EMR software to other hospitals and clinics.

In regard to eliciting sympathy, the promotion of healthcare in underdeveloped areas is likely to be full of both ethos and pathos: many are likely to support this cause and few are likely to resist. Therefore, the leaders of open source EMR communities must recognize the importance of the role of implementer, both in terms of bringing them into the community and recognizing their potential to aid in the recruitment and retention of others. In this sense, they can not only help create feelings of normative commitment but also enhance

perceptions of psychological ownership (both toward the community and the organizations affiliated with the end users).

Limitations and future research

It is possible that the small sample size in this study accounts for why extrinsic motivation and affective commitment did not enhance perceptions of psychological ownership at $p < 0.05$ level, while the cross-sectional survey data creates concerns about common method biases (Podsakoff *et al.*, 2003). Although anecdotal data from interviews supplemented the empirical data, this highlights some of the challenges for future research concerning OSS communities. First, membership is fluid. Members may be active or inactive within the community for stretches at a time, creating sampling-related issues as far as obtaining a sufficient sample size and whether the sample population is indeed represented empirically. This fluid membership also gives rise to concerns about implementing longitudinal research designs, given the potential for a high degree of churn and turnover. Second, many OSS communities have a worldwide presence. Although this study accounted for whether English was spoken as a first language, future research should consider whether surveys must be translated into many different languages and whether psychometric validation is required for scales in different languages. A related limitation and challenges are that this study focused specifically on one open source EMR community. While the experiences of members of other communities are subject to differ, individuals who participate in one open source EMR community might simultaneously participate in others.

Some team-related concepts are applicable to OSS communities, including the degree to which members are cohesive with each other and whether (and where) interdependencies exist within the community. However, the flat, web-like structure of these communities presents challenges for conducting team-based studies in these contexts. Thus, our study is limited in that we focus on individuals as opposed to integrating more team-based perspectives. Future research can consider employing a social network methodology to help unravel these broad webs to better understand how and where relationships are formed and the subsequent impact of these relationships on both psychological ownership and other outcomes.

It is important for future research to consider what OSS community members do outside of the time they volunteer with their community. For example, are these volunteers unemployed, employed part-time with an organization or employed full-time with an organization? If they are employed, what type of support do they receive from work and how does this impact their contributions to the community? If community members are employed by hospitals and clinics, which use the open source EMR software, there can be mutual benefits in terms of the hospital providing effective patient care and the community benefitting based on the volunteers' contributions, aided by the support of his or her hospital administration.

Conclusion

OSS communities are increasingly playing a vital role at the intersection of technology development and healthcare expansion. However, managing the members of these communities present unique challenges to community leaders as compared to the challenges faced by leaders of more traditional organizations. Our study began to identify key antecedents of psychological ownership – a central component that influences members' satisfaction, performance and engagement – among OSS community members. The more that OSS community leaders can further enhance

perceptions of psychological ownership, the more likely it is that the community will have a broader and more positive impact on advancing both technology and healthcare practices throughout the world.

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Appendix. Consideration of subgroups

Given the limited sample size and research questions, this study did not theorize any differences in terms of potential subgroups within the sample. However, prior to conducting analyses, between-group differences according to three categorizations were checked. First, a comparison was made between online respondents and paper-and-pencil respondents. A one-way ANOVA indicated that there were statistically significant differences only in terms of the extrinsic motivation variable (F = 4.852 and $p < 0.05$). Although both groups scored high on this variable, online respondents (M = 4.84 and SD = 0.35) scored higher compared to paper-and-pencil respondents (M = 4.41 and SD = 0.73). Second, geographic differences were compared in terms of the primarily African sample vs the smaller US-based sample. Among the study variables, the one-way ANOVA revealed a statistically significant difference for the altruism measure (F = 4.843 and $p < 0.05$), with US participants scoring higher (M = 4.71 and SD = 0.49 compared to M = 3.69 and SD = 1.21). Moreover, extrinsic motivation again was statistically significant (F = 4.948 and $p < 0.05$). Participants from the US were lower

(M = 4.07 and SD = 1.02) compared to the non-US participants representing the majority of the sample (M = 4.64 and SD = 0.54). Third, in recognition of the diverse background of the participants, one survey item asked whether English was spoken as a first language. In total, 23 participants responded yes, 19 participants responded no and 8 chose not to respond. A one-way ANOVA indicated that altruism was the only variable with statistically significant differences between groups ($F = 6.785$ and $p < 0.05$). Those with English as a first language scored higher (M = 4.26 and SD = 0.96) compared to those who spoke English but not as a first language (M = 3.37 and SD = 1.26). Overall, there were limited differences across these different categorizations for the primary variables of the study and there were no strong reasons to believe that these few between-group differences greatly impacted the final results.

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