Voluntary Engagement in an Open Web-based Encyclopedia: Wikipedians, and Why They Do It

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Abstract

The online encyclopedia Wikipedia can be considered as a highly successful *Open Content* project, written and maintained completely by volunteers. Little is known, however, about the motives and interests of these volunteers. Results from an online survey among 106 contributors to the German Wikipedia project are presented. As potential predictors of contributors' engagement and satisfaction, both motives derived from social sciences (e.g., costs-benefits, valence of the Wikipedia goals, identification with Wikipedia, etc.) as well as perceived task characteristics (e.g., task significance, autonomy, skill variety, etc.) were measured. The results reveal that satisfaction ratings of contributors are determined by perceived benefits, identification with the Wikipedia community, and task characteristics. Contributors' engagement (e.g., hours per week) was particularly determined by their tolerance for opportunity costs and the experienced characteristics of their tasks, the latter effect being partially mediated by intrinsic motivation. Most relevant task characteristics both for contributors' engagement and satisfaction were autonomy, task significance, and skill variety. Additional motives reported by Wikipedia contributors suggest the importance of generativity.

Voluntary Engagement in an Open Web-based Encyclopedia: Wikipedians, and Why They Do It

Wikipedia is a free online encyclopedia, completely written and maintained by volunteers who collaborate over the Internet.[1] Founded in January 2001, Wikipedia has quickly become one of the 10 most popular websites worldwide.[2] Today, the English Wikipedia contains more than two million articles, followed by the German, French, Polish, Japanese, Dutch, Italian, Portuguese, Swedish, and Spanish Wikipedias with at least 260.000 articles each, and more than 200 smaller projects organized by language or dialect. Despite the huge success of Wikipedia, however, little is known about the motivation of its contributors, usually called *Wikipedians* (Bryant, Forte & Bruckman, 2005). As volunteers, many contributors invest a considerable amount of time and endeavor into researching and writing articles, maintaining the technical infrastructure, or participating in community discussions without receiving any financial compensation for their efforts. Moreover, in contrast to other Internet-based voluntary collaboration projects such as Free and Open Source software development (e.g., Hertel, Niedner, & Herrmann, 2003; Moon & Sproull, 2002), Wikipedia has no established public recognition system that might be used as reference in job applications ("credit files"; cf, Voss, 2005; Arazy, Ji & Patterson, 2006). Thus, the question is how to explain the high motivation of contributors to Wikipedia. Lessons learned from this successful web-based collaboration project might not only be relevant for other Internet projects based on voluntarism, but also for knowledge sharing systems in commercial business organizations (cf. Majchrzak,Wagner & Yates, 2006).

In the next sections of this paper, we first summarize the main principles of Wikipedia and its relation to similar Internet-based projects; i.e., Free and Open Source Software

development. Second, we outline two theoretical models rooting in different research traditions which together provide a theoretical framework for the explanation of contributors' engagement for Wikipedia. The first model builds on research on social movement participation and civic engagement (Klandermans, 1997, 2003; Simon et al., 1998; Stürmer & Simon, 2004) and was already applied in research on Free and Open Source Software development (Hertel et al., 2003). In fact, the Wikipedia project can be understood as a social movement with common goals ("free access to information for everyone"). The second model builds on research explaining task characteristic as antecedents of intrinsic motivation and work satisfaction (Hackman & Oldham, 1975, 1980). Task characteristics and intrinsic motivation might be important factors to explain voluntary engagement in this project because Wikipedia contributors receive neither financial compensation nor explicit public recognition as authors. Both models are not mutually exclusive but complement each other in order to understand the motivational processes in the Wikipedia project.

Wikipedia, Open Content and Open Source Software

The term Wikipedia implies two central properties of the project. First, Wikipedia is technically based on *wiki* software (Leuf & Cunningham, 2001) that enables visitors of a website not only to view web-pages, but also to edit the web-pages easily and instantly, and to add new web-pages. This property is reflected in the term "wiki" which is derived from the Hawaiian word for "quick." Second, the central goal of Wikipedia is the creation of an encyclopedia that is free to use and modify for everyone. As its founder Jimmy Wales has stated in an interview,[3] the vision of Wikipedia is "a world in which every single person on the planet is given free access to the sum of all human knowledge. That's what we're doing." Consequently, Wikipedia is licensed under the GNU Free Documentation License (GFDL; Free Software Foundation, 2002) that

requires authors to consent that their contributions to Wikipedia may be used, redistributed, or modified by others as long as the derived content remains free and the original authors are credited.

Each article in Wikipedia can be easily edited by using hyperlinks next to the text, and the changes made are visible immediately. A version history is available for each article along with the real name, user name, or Internet address of the respective author, so that changes can be tracked and reverted easily. Although registered authors might refer to this version history to receive credit for their personal contributions, such references are not as common as in Free and Open Source projects. One reason for this might be that being mentioned in the version history of an article does not indicate the quality of the individual contribution (Voss, 2005). Moreover, many substantial contributions are made by anonymous authors (Anthony, Smith & Williamson, 2007).

Registered authors can keep a *watchlist* to monitor changes to certain articles, usually those to which they made a contribution themselves. Similarly, a special page lists all *recent changes* to any Wikipedia article. These software features are designed to foster a system of continuous peer-review among contributors and even occasional readers of Wikipedia articles. Research suggests that this system of continuous peer-review may in fact help to improve the quality of articles and prevent obvious vandalism (Giles, 2005; Viégas, Wattenberg & Kushal, 2004; Anthony et al., 2007; Brändle, 2005). More generally, supervision by peers or administrators increases the quality and quantity of contributions to online communities (Cosley, Frankowski, Kiesler, Terveen & Riedl, 2005).

The quality of articles, however, remains a central concern among contributors to Wikipedia. Quality concerns typically include problems from less obvious errors such as

omissions of important facts, biased points of views proposed by certain contributors, or disputes between lay authors and experts such as scientists. In case of disagreements, a fine-grained system of dispute resolutions exists, including a specific discussion page per article, informal or formal mediation, internal opinion surveys, temporarily "freezing" of articles, or blocking users by Wikipedia administrators (i.e., experienced contributors with additional rights).

Wikipedia is often called an *Open Content* project to stress similarities to *Free* or *Open Source Software* (F/OSS) projects such as the Linux operating system, the Mozilla Firefox web browser, or the OpenOffice.org office suit. The source code of these software products is licensed under legal terms (Free Software Foundation, 1991; Open Source Initiative, 2006) that guarantee its availability for possible enhancements in the future. This transparency facilitates a similar process of peer review among F/OSS developers and might lead to more reliable software because "given enough eyeballs, all bugs are shallow" (Raymond, 1999). In order to be effective, however, such a peer review process requires the coordinated efforts of a larger number of volunteers.

Voluntary Participation in Social Movements

Research on social movements such as the civil rights movement has a long tradition in the social sciences (e.g., Della Porta & Diani, 2006; Snyder & Omoto, 2001; Stürmer & Simon, 2004). Social movements can be defined as "collective challenges by people with common purposes and solidarities, in sustained interaction with [others outside the movement]" (Tarrow, 1994, p. 4). Although Wikipedia differs from many traditional social movements because it does not focus on political protest, there are various similarities that might allow the adoption of theoretical models that explain participants' motivation to contribute. In particular, the vision of free knowledge collected by collective effort and made available to everyone is a common

purpose among regular contributors to Wikipedia. Moreover, the voluntary nature of contributions to Wikipedia is another important feature similar to social movements. Due to these structural similarities, we argue that theories of social movement participation may also explain the motivation of contributors to Wikipedia. A similar case has been made for the explanation of successful F/OSS projects (Hertel et al., 2003).

A recent model that integrates central findings from social movement research was developed by Klandermans (1997, 2003). According to this model, the motivation to participate in a social movement depends on subjective expectancy and importance of several motives, which can be categorized into three classes, as well as identification processes: Elements of the first class, *social motives,* refer to expected reactions of relevant others, such as friends, family, or colleagues. More favorable reactions of relevant others should lead to a higher motivation to participate. The term "social motives", however, can be misleading because other motives such as the interest in social contacts and meeting other people are not included in this construct but are considered as individual benefits (Klandermans, 2003). For reasons of clarity, in this paper we will refer to motives related to expected reactions of relevant others as *norm-oriented motives*.

Like Klandermans (1997), we will consider social contacts and meeting other people as individual benefits, which are part of the second class of motives. This second class of motives, individual *costs and benefits* (sometimes called selective incentives), include expected gains and losses associated with the voluntary engagement. Losses in the context of voluntary engagement can be direct costs (e.g., donations of money) and opportunity costs (e.g., lack of time for other activities, lack of income because the work is not compensated as in a commercial context). Potential benefits include learning, socializing with others, and meeting other people. The more

favorable the expected overall relation of costs and benefits, the higher the motivation to engage in a social movement should be.

Third, *collective motives* (sometimes called collective incentives) refer to the experienced importance of the common goals of a social movement. The higher the importance of the goals, the higher the motivation to participate should be. The impact of these three classes of motives on the motivation of contributors is often conceptualized as weighted by the subjective expectation that the respective goals will be achieved. Such expectancy models are well established in social sciences (e.g., Finkel & Muller, 1998).

Fourth, *social identification* processes should complement the three classes of motives and constitute an independent pathway to social movement participation (Klandermans, 2003; Simon et al., 1998; Stürmer & Simon, 2004). When persons feel and categorize themselves as members of a social movement, they are more likely to accept the norms and standards of the movement, resulting in higher motivation to contribute to common goals. Moreover, this pathway should be stronger the longer individuals participate in a social movement. The different components are assumed to contribute additively to the motivation of participants in a social movement.

It should be noted that most other motivational taxonomies discussed in the literature on F/OSS projects are compatible with the Klandermans Model (Clary et al., 1998; Ghosh, 2005; Kollock, 1999; Lerner & Tirole, 2002, 2005). For instance, the economic perspective developed by Lerner and Tirole (2002, 2005) focusing on opportunity costs, career concerns, and ego gratification, might be integrated into the individual costs and benefits component of the Klandermans Model. Similarly, the three dominant types of developers' motivations proposed by Ghosh (2005), social motivations, career or monetary concerns, and political motivations, can be integrated into the costs and benefits component and the collective motives component of the

Klandermans Model. In sum, the research on voluntary engagement in social movements and F/OSS suggests that contributors are usually not motivated by altruism, but pursue specific individual interests.

Task Characteristics as Antecedents of Intrinsic Motivation

In addition to extrinsic factors described in the Klandermans Model, a second group of important predictors of voluntary engagement for the Wikipedia project might be based on intrinsic motivation from the activities itself. *Intrinsic motivation* is defined as "the doing of an activity for its inherent satisfaction rather than for some separable consequence. When intrinsically motivated, a person is moved to act for the fun or the challenge entailed rather than because of external [reasons]" (Deci & Ryan, 2000, p. 260). Thus, *interest* and *"having fun"* during an activity are important elements of intrinsic motivation. Moreover, the experience of *competence* when performing a task can be understood as a key component of intrinsic motivation (e.g., Deci & Ryan, 2000). The main determinants of experienced competence are feedback, and the experience of autonomy in conducting the activity. Finally, the *experience of "flow"* describes a state of absorption when performing a task that is characterized by a distortion of time experience, clear goals, immediate feedback from the activity, focused attention on the activity instead of on the person, a feeling of control, and no concerns about failing at the activity (Csikszentmihalyi, Abuhamdeh & Nakamura, 2005; Waterman, Schwartz, Goldbacher, Green, Miller & Philipp, 2000). Flow usually requires an optimal fit between task and challenges (Csikszentmihalyi et al., 2005). Since higher task-related autonomy allows persons to better adjust tasks to their respective skill levels, we expect a higher chance of flow experiences in self-selected activities.

Intrinsic motivation is increasingly defined as a multidimensional construct both in psychology (Thomas & Velthouse, 1990) and related fields, such as information systems research. In some cases, however, different labels are used to refer to these constructs. For instance, Agarwal and Karahanna (2000) use the term *cognitive absorption* to refer to a multidimensional construct that covers various aspects of intrinsic motivation (curiosity; control; temporal dissociation; focused immersion; and heightened enjoyment). Similarly, Schaufeli, Salanova, González-Romá and Bakker (2002) point out the substantial conceptual overlap between intrinsic motivation and their multidimensional construct of *work engagement*. In this study we will use the term intrinsic motivation to refer to an integrative construct that covers the three aspects of task enjoyment, experienced competence and flow experiences outlined above. Thus, *intrinsic motivation* denotes motivational processes that are directly and immediately triggered by performing or succeeding in an activity (Deci & Ryan, 2000).

Interestingly, these three indicators of intrinsic motivation have been already documented in Internet-based Open Source software development projects. "Having fun while programming" is one of the reasons most often mentioned by developers in F/OSS projects both in free format surveys and in open discussion lists (e.g., Torvalds & Diamond, 2001). Moreover, experience of self-efficacy was reported as a significant predictor in collaborative work in F/OSS projects (Hertel et al., 2003). Finally, flow experience and the distortion of time experience is sometimes reported among F/OSS developers (Lakhani & Wolf, 2005). We expect similar effects of intrinsic motivation in the Open Content project Wikipedia.

The *Job Characteristics Model* (JCM; Hackman & Oldham, 1980) was developed to explain why and how the characteristics of a job or task might influence intrinsic motivation,

satisfaction, and performance. Five core characteristics of tasks are considered as relevant in the original model: *Skill variety* is defined as the extent by which the task requires diverse activities, *task identity* measures whether a task is completed as a whole from beginning to end and leads to a noticeable result, *task significance* exists when a task and its outcomes have substantial impact for others, *autonomy* indicates a worker's possibility to determine how and when to do the task, and finally, *job feedback* is provided either from the job itself or from other persons, such as colleagues (cf. Hackman & Lawler, 1971). These job characteristics are conceptualized as evoking psychological states in the worker (i.e., experiences of meaningfulness and responsibility, and knowledge of results), that in turn are expected to determine intrinsic motivation, job satisfaction, and work performance. In order to assess their model empirically, Hackman and Oldham (1975) developed the Job Diagnostic Survey (JDS) as a self-report questionnaire instrument that measures individual perceptions of task characteristics, psychological states, and outcomes. The JDS also includes additional scales that refer to contextual factors, such as dealing with others and satisfaction with co-workers, which are not part of the JCM itself but potentially helpful in practice.

Subsequent research has scrutinized the JCM, the JDS, and the interpretation of results collected with the JDS. First, research on the JCM (e.g., Wall, Clegg & Jackson, 1978) found strong associations between the different task characteristics and work outcomes, but only inconclusive evidence for the proposed psychological states. Second, a major problem of the psychometric properties of the JDS is the negative wording in some of the original JDS items, leading to a measurement artifact (Idaszak & Drasgow, 1987). Another problem are the commonly reported substantial zero-order intercorrelations between core task characteristics (Hackman & Oldham, 1980, p. 313; Stone & Gueutal, 1985) that complicate the evaluation of

specific consequences of each task characteristic. Third, alternative interpretations of associations between task characteristics and outcomes cannot be rejected based on cross-sectional data (Taber & Taylor, 1990). For example, the social information processing model (cf. Judge, Bono & Locke, 2000) considers individual differences between workers (expectations, standards, etc.) as influences on the perception of task characteristics in addition to objective task characteristics. In spite of these difficulties, the JDS is still the most widely used assessment instrument of job characteristics and the meaning of work (Morgeson & Humphrey, 2006). It provides useful information about the subjective perceptions of task characteristics (Taber & Taylor, 1990) that are important supplements of more objective or observable task characteristics. In fact, for many psychological processes the subjective experience of work conditions are better predictors than objective measures. Moreover, several strategies are available to compensate for the potential caveats mentioned. For instance, an analytical strategy to handle the substantial zero-order intercorrelations between core task characteristics is to combine ratings of perceived task characteristic into a single score, reflecting the overall motivational potential of the task (e.g., Hackman & Oldham, 1980, p. 313).

Outcomes and Hypotheses

Two measures of Wikipedia participation are investigated as criteria in this study. Both the extent of volunteer engagement[4] (time spent for Wikipedia, articles on their watchlists) and satisfaction with the engagement as precondition to continue the engagement are expected to be determined by the four components of the Klandermans Model and perceived task characteristics. Volunteers are generally more satisfied if their engagement meets important needs (Clary et al., 1998; Houle, Sagarin & Kaplan, 2005), and Wikipedia contributors in particular should be more satisfied with their engagement if it meets important classes of

motives, such as those specified in the Klandermans Model. The relative importance of each component of the model, however, depend on the nature and context of social movements (Klandermans, 2003; Stürmer & Simon, 2004). We will first specify the expected effects of each component of the Klandermans Model, and then discuss effects of task characteristics on engagement and satisfaction.

Hypotheses based on the Klandermans Model of social movement participation

Research on voluntary engagement in social movements and F/OSS suggests that contributors are usually not altruists, but pursue specific individual interests. We expect similar processes in the Wikipedia project, assuming that the perceived relation of costs vs. benefits is positively related to both engagement and satisfaction:

Hypothesis 1: A positive net value of individual costs and benefits is positively associated with the extent of contributors' engagement for Wikipedia.

Hypothesis 2: A positive net value of individual costs and benefits is positively associated with contributors' satisfaction with their engagement for Wikipedia.

Second, identification is an important motivational factor for volunteers in general (Stürmer & Simon, 2004) and for F/OSS developers in particular (Hertel et al., 2003; Lakhani & Wolf, 2005). Contributors to Wikipedia call themselves *Wikipedians*[5] and often express their affiliation with the Wikipedia community on mailing lists or user pages, suggesting social identification processes. Interviews with highly active Wikipedia contributors also suggest the importance of social identification processes (Bryant et al., 2005). Thus, identification with the Wikipedia community is expected to be positively associated with engagement and satisfaction:

Hypothesis 3: Identification with the Wikipedia community is positively associated with the extent of contributors' engagement.

Hypothesis 4: Identification with the Wikipedia community is positively associated contributors' satisfaction with their engagement.

The two remaining components of the Klandermans Model, norm-oriented motives and collective motives, are important factors in social or political movements (e.g., Simon et al., 2003) but are considered as less relevant in research on F/OSS projects. For instance, Ghosh (2005) identified only 13% of developers as primarily motivated by political motives, and only one third of developers surveyed by Lakhani and Wolf (2005) considered collective motives important at all. This lower importance of collective and normative motives might be due to the fact that F/OSS developers, unlike participants in other social movements, do not belong to a disadvantaged minority in society or have to face serious risks (e.g., violent acts of political opponents, loss of social support by relevant others) when participating in F/OSS development. In a similar way, we expect that norm-oriented and collective motives show weaker effects on the engagement and satisfaction of Wikipedia contributors than expected costs and benefits and identification:

Hypothesis 5: Norm-oriented motives and collective motives are less strongly associated with Wikipedia contributors' engagement compared to perceived costs and benefits and identification.

Hypothesis 6: Norm-oriented motives and collective motives are less strongly associated with Wikipedia contributors' satisfaction with their engagement compared to perceived costs and benefits and identification.

Hypotheses based on the Job Characteristics Model

Task characteristics have been studied in a wide range of industries, including commercial software development (Couger & Zawacki, 1980; Thatcher, Stepina & Boyle, 2002). However, task features have not been explored in research on voluntary engagement in web-based collaboration so far. We expect that the perceived task characteristics predict satisfaction, intrinsic motivation, and engagement of Wikipedia contributors in a similar way as in other work environments. Based on more recent adaptations of the JCM (Parker, Wall & Cordery, 2001), we expect that a positive perception of task characteristics leads to higher intrinsic motivation, which in turn leads to higher engagement:

Hypothesis 7: Perceived task characteristics positively affect the extent of engagement for Wikipedia, and this effect is mediated by intrinsic motivation.

Hypothesis 8: Perceived task characteristics positively affect Wikipedia contributors' satisfaction with their engagment.

Considering the relative impact of the specific task characteristics, we expect autonomy, task significance, and skill variety as most important determinants of the variable representing participants' task experience. Autonomy enables both experiences of flow (Csikszentmihalyi, Abuhamdeh & Nakamura, 2005) and competence (Deci & Ryan, 2000). Task significance should affect the overall task experience of Wikipedia contributors due to the public-utility goals of Wikipedia (e.g., Wikipedia can be used by millions of readers for free). Feedback from others should be an important factor because writing articles for Wikipedia heavily relies on peer review processes. In one initial study on civic engagement (Wehner & Güntert, 2005), feedback has been documented as important for the task experience during voluntary work, such as youth work, sports clubs, cultural committees, and welfare work. In addition, skill variety might be

important because Wikipedia contributors can select and tailor their activities to their diverse interests and skills. Together, we expect:

Hypothesis 9: Perceived autonomy, task significance, and feedback most strongly determine the overall task experience of contributors to Wikipedia.

Methods

A web-based questionnaire survey was conducted among contributors to the German version of Wikipedia measuring the components of the Klandermans Model and perceived task characteristics as predictors, intrinsic motivation as mediator, and engagement as well as satisfaction with the engagement as criteria variables. Moreover, open questions for additional motives were included apart from demographic variables for exploratory reasons.

Data Collection and Participants

Participants were invited over the mailing list of the German Wikipedia project. We also asked subscribers to the mailing list to forward our invitation to other contributors who would not read the mailing list, and link to the survey from suitable web sites. A total of $N = 106$ contributors participated in our survey. Eighty-eighty percent of these participants were male, 10 percent were female, and 2 percent did not specify their sex. The mean age was 33 years (SD = 12 years, range from 16 to 70 years). The majority of participants worked full-time (43%) or part-time (10%), whereas 5% were unemployed. Another large group were university students (26%) or high-school students (6%). The remaining participants reported a different employment status, such as retirement. At the time of the survey, participants had been engaged in the Wikipedia project for 16 months on average ($SD = 10$, range from 1 to 48 months), and had used the Internet for 92 months on average ($SD = 33$, range from 12 to 180 months). Most of the

participants categorized themselves as authors (86%), and more than a third (37%) also had at least administrator rights. Only 4% were engaged in the development or translation of software for Wikipedia, but more than a quarter (27%) of the participants reported to be engaged in one or more F/OSS projects, such as Linux (11%), Mozilla (9%), or OpenOffice.org (7%).

The high number of administrators[6] in the sample suggests that participants in this study were recruited from a sample of highly active contributors. These core contributors, however, are vital to the success of the Wikipedia project. For instance, 67% of edits to the Dutch Wikipedia are conducted by 20% of the contributors, although this relation varies between articles (Spek, Postma & van den Herik, 2006). This effect becomes even more pronounced when the popularity of articles is taken into account, as more than 80% of the content actually retrieved is written by only 10% of the editors (Priedhorsky, Chen, Lam, Panciera, Terveen & Riedl, 2007). Thus, the results reported in this study might be indicative of motivational processes in this core group of Wikipedia contributors.

Measures and Questionnaire Design

Predictors based on the Klandermans Model of social movement participation

Items measuring the components of the Klandermans Model were mainly adopted from Hertel et al. (2003) and translated into German. The *norm-oriented motive* component was measured by only one item asking participants about attitudes of relevant others (family, friends, or colleagues) towards their engagement for Wikipedia. The measure of the *individual costs and benefits component* contained five items. Participants rated the importance of two potential benefits (learning and job/school qualification,) as well as two aspects of opportunity costs, (time loss and as lack of payment) due to the engagement in Wikipedia. Contributors also indicated

how they judged the relation of effort to the benefits from their engagement for Wikipedia. Such a "selfishness" measure (Ghosh, 2005, p. 33) allows for are wider range of individual costs and benefits which might not be covered by the specific items above, and has proven informative in research on the motivation of F/OSS developers. The *collective motive* component was measured by participants' ratings how important central goals of the Wikipedia community project were to them: improving the quality of Wikipedia as a whole, and the belief that information should be free. Finally, the *identification* component was measured using three items referring to identification with the Wikipedia project, feeling proud to be a Wikipedian, and self-description as a typical Wikipedian (Doosje, Elemers & Spears, 1995). All items were measured on seven-point Likert scales.

Perceived task characteristics

Perceived characteristics for skill variety, task identity, task significance, autonomy, feedback from others were measured using items from the German version of the Job Diagnostic Survey (Schmidt & Kleinbeck, 1999). Only single item-measures with positive wording were selected from the JDS to reduce method-specific variance for task identity, task significance, autonomy and feedback from others. Two items were used to measure skill variety. Feedback from others was included instead of feedback from the job itself because the continuous peer-review process in Wikipedia largely depends on interactions with others. Finally, dealing with others was included as a context factor to supplement core task characteristics, and measured by two items. All task characteristics were measured using seven-point Likert scales.

Intrinsic motivation

Experienced competence was measured using three items adapted and translated from an intrinsic motivation scale by Warr, Cook, and Wall (1979) to reflect cognitive, affective, and behavioral aspects of this construct. *Task enjoyment* was measured using three items mainly adapted and extended from Hertel et al. (2003), and referred to fun from writing articles, fun from reviewing articles, as well as the relation of fun versus strain ("fun outweighs the effort"). Finally, a single item-measure was used to measure the experienced distortion of time as a key component of flow experience (Lakhani & Wolf, 2005). Because this item only reflects a part of the flow construct, we will refer to this item as *experienced time distortion* throughout this paper. Again, all items were measured using seven-point Likert scales.

Engagement

Current engagement was measured by three items. Participants were asked to indicate the time spent per day for Wikipedia-related activities both during leisure time and at work in two open questions to improve data quality (cf. Tourangeau, Lips, & Rasinski, 2000). They were also asked to specify the number of articles on their watchlists (if any) as a proxy for the number of articles they contributed to or were involved in.

Satisfaction with Wikipedia engagement

Items from three subscales of the JDS were used to assess facets of satisfaction with the engagement in Wikipedia. *General satisfaction with Wikipedia engagement* was measured using two items, whereas *growth satisfaction* was measured using four items because it might be an especially relevant subscale in volunteer work. Similarly, *satisfaction with co-workers* as a potentially relevant context variable was assessed using four items. Wording was adapted to fit

the context of Wikipedia engagement, and all items were measured using seven-point Likert scales.

Demographic data and further motives

Finally, demographic data about participants was collected, including sex, age and nationality. Participants were also asked to report further motives for their engagement that were not covered in the survey using an open question at the end of the questionnaire.

Statistical Approach

Partial Least Squares path modeling

Data analyses were conducted using the *Partial Least Squares* (PLS; e.g., Jöreskog & Wold, 1982; Anderson & Gerbing, 1988; Fornell & Cha, 1994) path modeling algorithm. The PLS algorithm estimates path models using variables, usually called latent variables, from a number of indicator items, sometimes called manifest variables. In this respect, the variance-based PLS path modeling is similar to covariance based structural equation modeling (SEM, e.g. using LISREL, Jöreskog & Sörbom, 2003) because both algorithms estimate complex relations between several latent variables simultaneously. Nevertheless, a number of conceptual and formal differences (cf. Chin & Newsted, 1999) make PLS path modeling especially suited for this study. Compared to covariance-based SEM, the PLS path modeling algorithm can be used with smaller samples, requires fewer assumptions about data distributions, is robust in case these assumptions are violated (Cassel, Hackl & Westlund, 1999), and can be used with more complex models containing a larger number of latent variables.. It does not, however, compute a single index of model fit, such as the GFI or RMSEA in covariance-based SEM. PLS path modeling focuses on prediction whereas covariance-based SEM is more often used for theory testing by

comparing the relative fit of several theoretical models to the data. Furthermore, in PLS path modeling, individual scores for variables are estimated and available for subsequent data analyses, such as mediation analyses (e.g. Baron & Kenny, 1986). This is not possible in covariance-based SEM because of factor indeterminacy.

Regardless of the estimation algorithm, an important distinction needs to be made between *reflective* and *formative indicators* in structural equation modeling (Bollen & Lennox, 1991; MacKenzie, Podsakoff & Jarvis, 2005). Reflective indicators can be understood as being determined by, or to reflect, an underlying latent variable (graphically represented as an arrow from the latent variable to the indicator). Formative indicators are used to jointly form or cause the latent variable (graphically represented as an arrow from the indicator to the latent variable), i.e., indicators are understood as defining characteristics of the latent component variable. Psychological instruments usually employ reflective indicators because they rely on classical test theory (Bollen & Lennox, 1991). Reflective indicators are, however, not appropriate in many cases, especially when the constructs explored are conceptually heterogeneous and multi-dimensional. For example, job satisfaction is often conceptualized as a combination of a number of distinct facets (satisfaction with payment, supervision, coworkers, etc.), and overall job satisfaction of a person is constituted only by all these indicators as a group. In a similar way, the overall balance of expected costs and benefits is only constituted by all costs and benefits together and should not be conceptualized to reflect an underlying true score (cf. Simon et al, 1998). Usually the term *scale* refers to a latent variable based on reflective indicators, whereas the term *index* refers to a latent variable based on formative indicators. Weights are based on zero-order correlation coefficients or factor loadings for reflective indicators, but on multiple regression coefficients for formative indicators.

As McKenzie, Podsakoff, and Jarvis (2005) note, "the distinction between reflective- and formative-indicator models can be generalized to higher order factor structures." For example, even if several first-order constructs related to intrinsic motivation (such as enjoyment or experienced competence) might represent distinct dimensions of this construct, they are likely to overlap and share common variance. In PLS path modeling, *second-order constructs* can be integrated using a two-step procedure. Case values for each first-order construct can be estimated in separate models (Wold, 1982, p. 40), and then be integrated as indicators of a second-order construct in the complete model.

Model specification

A path model was developed based on the Klandermans Model of social movement participation and the Job Characteristics Model to test the relative predictive power of the proposed factors (*norm-oriented motives*, *reward motives*, *collective motives*, *identification,* and *task characteristics*) on satisfaction and engagement for Wikipedia. With regard to the measurement models, only identification was conceptualized as a reflective measure because items were adopted from a scale designed to reflect an underlying true score of identification. All other predictors were conceptualized as formative because their respective manifest variables were supposed to jointly constitute the constructs instead of reflecting an underlying true score. For example, no single underlying true score or homogeneous loadings may be assumed for the costs and benefits component of the Klandermans Model because the overall relation is only defined by a combination of several costs and benefits.

Although empirical research confirms the discriminative validity of different aspects of intrinsic motivation (cf. Waterman, Schwartz, Goldbacher, Green, Miller & Philip, 2003), their respective measures usually correlate considerably. To avoid instable parameter estimates due to

multicollinearity, experience of flow, enjoyment, and experienced competence were conceptualized as first-order factors forming a second-order factor of intrinsic motivation. Case values for first-order factors were estimated in a separate model, and then used as manifest variables of a more global latent variable representing *intrinsic motivation* in the complete model.

Similarly, general satisfaction with Wikipedia engagement, growth satisfaction, and satisfaction with others were conceptualized as forming a second-order factor of *satisfaction*. Again, case values were estimated in a separate model and then used as manifest variables in the complete model. The extent of engagement in Wikipedia was conceptualized as an index constituted both by measures of time spent for Wikipedia and articles on contributors' watchlists.

Results

Data analyses were conducted with SmartPLS 2.0 (Ringle, Wende, & Will, 2006) and missing values were replaced by means. Sample size ($N = 106$) was adequate for conducting a PLS analysis, meeting both the necessary observation to indicator ratio heuristic (at least 10:1 for the formative latent variable with the largest number of indicators), and the path to indicator ratio heuristic (at least 10:1 for the endogenous with the largest number of connected exogenous variables) proposed by Chin and Newsted (1999). It should be noted, however, that the relatively small sample size in the present study limits the statistical power to detect small effects of single predictors in the structural model in the presence of all remaining predictors. Cohen (1988) suggests to interpret values of $f^2 = 0.02$, 0.15, and 0.35 as small, medium, and large effects. Because PLS path estimates are based on regression analyses, effect sizes of single predictors can be obtained by comparing the explained amount of variance when a predictor is either included or not included in the model ($f^2 = (R^2_{incl} - R^2_{excl}) / (1 - R^2_{incl})$; Cohen, 1988, p. 410).

PLS Path Model

Measurement model

Although PLS does not require rigid distributional assumptions for estimation and optimization, normality is desirable for statistical inferences (Marcoulides & Saunders, 2006). Following a data screening, the number of articles on participants' watchlists was ln-transformed because of its skewed distribution. Following that procedure, no indicator in the measurement model exceeded the critical values for skewness or kurtosis suggested by Curran, West and Finch (1996). Means and standard deviations are reported in Table 1.

< Please insert Table 1 about here>

Different indicators are used to assess the quality and utility of reflective and formative latent variables. Indicators in reflective measurement models can be assessed using common quality criteria such as coefficient alpha, composite reliability (CR), or the average variance extracted (AVE; Fornell & Larcker, 1981) which should exceed the .50 threshold. The only latent variable with a formative measurement model in our analysis was identification, and quality criteria were satisfactory (coefficient alpha = .77, CR = .87, AVE = .69). For assessing indicators in formative measurement models, different quality criteria are required. Because excessive multicollinearity of indicators makes it difficult to separate the influence of several indicators on the latent variable (Bollen & Lennox, 1991), the variance inflation factor (VIF) of each indicator should be close to 1. As Table 1 shows, VIFs in the measurement models varied between 1.02 and 1.45. In general, these results suggest that multicollinearity between indicators is not a major problem in this study. Specific model-depended cutoff-values (Craney & Surles, 2002), however, suggest that low weights of indicators of task characteristics with a VIF above 1.34 should be

interpreted with caution. Table 2 reports descriptives and zero-order correlations for the resulting latent variables.

< Please insert Table 2 about here>

Structural model

The structural model was evaluated on the basis of R^2 for each endogenous latent variable, structural paths, and effect sizes of exogenous latent variables. The stability and statistical significance of the structural path estimates were assessed using the bootstrapping resampling method (with $N = 106$ cases, 1000 resamples and individual sign changes; cf. Tenenhaus, Vinzi, Chatelin & Lauro, 2005).

As shown in Figure 1, exogenous variables in the model explained substantial amounts of variance of satisfaction ($R^2 = .62$) and engagement ($R^2 = .28$), and at least some variance of intrinsic motivation ($R^2 = .17$).

< Please insert Figure 1 about here >

For the satisfaction ratings, the components of the Klandermans Model together accounted for a partial $R^2 = .27$, or 44% of the total explained variance in the latent variable (cf. Table 3). More specifically, significant predictors of satisfaction among these components included costs and benefits ($\beta = .26$, $p < .05$, $f^2 = .16$) and identification with Wikipedia ($\beta = .19$, $p < .05$, $f^2 = .07$), consistent with Hypotheses 2 and 4. Although lower in effect size, norm-oriented motives were also significant ($\beta = .12$, $p < .05$ for a directional test), whereas collective motives failed to reach significance. As expected in Hypothesis 6, the combined effect of norm-oriented and collective motives was smaller ($f^2 = .04$) in comparison to cost-benefit considerations and identification. Moreover, perceived task characteristics explained a major part

of the variance in satisfaction ratings ($\beta = .52$, $p < .001$, $f^2 = .54$), as was expected in Hypothesis 8.

For the measured engagement of Wikipedia contributors, the four components of the Klandermans Model together accounted for a partial $R^2 = 13$, or 46%, of the total explained variance. However, the only significant predictor of engagement among these components was the costs-benefits index, and this relation was negative rather than positive ($\beta = -.31$, $p < .05$, $f^2 = .12$). These results are surprising in two ways. First, the negative relation of the costs-benefits component contradicts Hypothesis 1, as well as the majority of results from research on the motivation of F/OSS developers (e.g., Ghosh, 2005; Hertel et al., 2003). The cross-sectional design of this survey, however, does not allow a causal interpretation of this association.[3] Very active contributors might be simply more likely to experience opportunity costs, such as lack of time for other activities, that result in a more unfavorable relation of costs and benefits.

Second, contrary to Hypothesis 3 the effect of identification on engagement failed to reach significance, despite its significant and positive zero-order correlation reported in Table 2. This might be due to the limited statistical power in the present study. With respect to the remaining components of the Klandermans Model, and consistent with Hypothesis 5, neither norm-oriented motives nor collective motives were significant predictors of engagement, and their combined effect was small ($f^2 = .02$).

< Please insert Table 3 about here >

Finally, the direct effect of perceived task characteristics on engagement failed to reach significance ($\beta = .22$, $p = .11$) despite the medium-sized and significant zero-order correlation reported in Table 2. Perceived task characteristics, however, had a medium-sized effect on intrinsic motivation ($\beta = .41$, $p < .001$, $f^2 = .21$), which in turn had a small to medium-sized effect

on engagement ($\beta = .23$, $p < .05$ for a directional test, $f^2 = .06$). Intrinsic motivation alone accounted for a partial $R^2 = .08$, or 28% of the explained variance of the engagement measure, revealing the expected importance of intrinsic motivation for Wikipedia engagement. Even though these findings already suggest a mediating effect of intrinsic motivation (Hypothesis 7), a more formal test was conducted in a separate follow-up analysis.

Mediation Analysis

To test Hypothesis 7 proposing that intrinsic motivation mediates the effect of task characteristics on engagement for Wikipedia, a mediation analysis was conducted with case values of latent variables obtained in the PLS analysis. Using the bootstrap procedure provided by Preacher and Hayes (2004) and following the steps suggested by Baron and Kenny (1986 ; cf. Shrout & Bolger, 2002), the bivariate regression of engagement on task characteristics was significant ($\beta = .32$, $p = .001$). Second, perceived task characteristics were a significant predictor of intrinsic motivation ($\beta = .42$, $p < .001$; see above). Third, the effect of intrinsic motivation on engagement when controlling for perceived task characteristics was significant ($\beta = .25$, $p = .02$). Finally, the effect of task characteristics when controlling for intrinsic motivation was clearly reduced but still significant ($\beta = .21$, $p < .05$), indicating partial mediation. The Sobel test of this mediation was significant ($z = 2.15$, $p < .05$) and confirms Hypothesis 7 that intrinsic motivation (partially) mediates effects of perceived task characteristics on the reported engagement of Wikipedia contributors.

Item-Level Analyses of Perceived Task Characteristics

In order to explore which of the task characteristics most strongly affected the task experience of the participating Wikipedia contributors, the measurement model of perceived task

characteristics as reported in Table 1 was analyzed in more detail. Due to its conceptualization as a formative model, interpretation of the model should be based on weights instead of loadings as long as multicollinearity is low. Weights were significant for autonomy (w = .51), task significance (w = .46), and skill variety (w = .40). All other weights failed to reach significance.

The negligible weight of feedback from others (w = .02), however, was due to multicollinearity among manifest variables. Because its VIF of 1.42 exceeded the model-dependent critical value of 1.34, its high loading marked this manifest variable as reflective of the construct measured by the latent variable (Bagozzi, Fornell & Larcker, 1981; Diamantopoulos & Winklhofer, 2001). Moreover, dealing with others did not contribute significantly to the overall perception of task characteristics despite the highly interactive nature of Wikipedia. In sum, the results support the higher importance of autonomy and task significance compared to the remaining task characteristics, consistent with Hypothesis 9.

Further Motives Reported By Wikipedia Contributors

Based on the additional open format questions, an inductive content analysis was conducted to analyze further motives reported by Wikipedia contributors. A total of 44 statements were identified and categorized into nine categories (κ = .87) by two raters. The most frequently mentioned category was *task enjoyment*, which contained 9 statements (20%), for instance “I like working with text” or “I enjoy writing.” Since task enjoyment is part of the intrinsic motivation construct, this result further underlines the importance of task-related motives for Wikipedia engagement. A second category was labeled *sharing information*, summarizing statements such as “power to share knowledge” or “cover topics that are omitted in other encyclopedias.” This category contained five statements (11%) and resembles the collective motives component of the Klandermans Model, suggesting that collective motives also

play a role for the Wikipedia engagement. Please note that collective motives also yielded the highest mean values in the survey despite their non-significant effects in the path model. We will address these findings further in the discussion section. A third category included statements such as "create a heritage for our children" or "timeless project to collect knowledge" and was labeled *generativity.* This category also contained five statements (11%). The fourth category was labeled *growth and self-enhancement* with statements such as "compensation for unrealized career aspirations" and "gaining knowledge for further projects" (four statements or 9%). The fifth and sixth categories with three statements (7%) each, were labeled as *community-related motives* or *interest in the project*. Two statements (5%) were categorized as referring to *useful leisure activities* as the seventh category. Six statements (14%) were categorized as *specific motives* including such diverse statements such as "if I won't do it, who else will?", "vanity", "sense of order", or references to F/OSS principles. Finally, a ninth category was labeled as *dissatisfaction* and contained seven statements (16%) that could be reasons for contributors to terminate their engagement. These statements included "vandalism", "excessive discussions with trouble-makers or extremists", "blockings of users", or "bad server performance."

Whereas the task enjoyment and sharing information categories overlap with motives already considered systematically in our survey, the third category (generativity) refers to aspects developed in life-span psychology (e.g., McAdams & de St. Aubin, 1992). Interestingly, statements from this category were as frequently mentioned as statements related to sharing information, suggesting that generativity might be another important motive for contributors to Wikipedia. Although related to the need for efficacy proposed as explanation of participation in online communities (Kollock, 1999), this generativity motive goes beyond mere individualistic motives and contains also a societal dimension.

For exploratory reasons, we calculated nonparametric correlations between the dummy-coded categories and motivational factors in the survey for those contributors who specified additional motives ($n = 34$). Four of these correlations were significant ($p < .05$). The generativity category was positively related to identification ($\tau = .29$) and perceived task characteristics ($\tau = .35$), whereas the dissatisfaction category was negatively related to perceived task characteristics ($\tau = -.29$) and engagement ($\tau = -.35$). These findings might suggest that the task characteristics of Wikipedia engagement potentially facilitate the fulfillment of generativity motives, whereas dissatisfaction due to diverse problems is associated with decreasing engagement.

Discussion

This study explored the motivation of Wikipedia contributors by integrating models from social sciences and from work psychology. Whereas the Klandermans Model of social movement participation (Klandermans, 1997, 2003; Stürmer & Simon, 2004) covered influences of norm-oriented motives, individual costs and benefits, collective motives, and identification with Wikipedia, the Job Characteristic Model (Hackman & Oldham, 1975, 1980) covered the influences of perceived task characteristics and intrinsic motivation both on engagement and on satisfaction with the engagement for Wikipedia. Moreover, additional motives reported by Wikipedia contributors were collected in an open format.

Results supported our research model to a large extent. As expected, satisfaction with the engagement for Wikipedia was determined by the net balance between costs and benefits, by the identification with the Wikipedia community, and by perceived task characteristics. Contrary to our expectations, however, the relation between the net balance of costs and benefits and the reported engagement was negative rather the positive. An explanation might be the lack of

external incentives in the case of Wikipedia, leading to a less favorable evaluation of costs and benefits, and requiring a high tolerance for opportunity costs for contributors. On the other hand, and again consistent with our expectations, the engagement reported by Wikipedia contributors was positively related to intrinsic motivation, which partially mediated the effect of perceived task characteristics on engagement. Among the perceived task characteristics, task autonomy, significance of the activity, and skill variety contributed most strongly the overall task experience in Wikipedia engagement (see Wehner & Güntert, 2005, for similar results in the context of volunteer civic engagement). The effect of feedback from others on the overall task experience was largely attenuated by multicollinearity among task characteristics. Moreover, personal feedback might be more prominent in volunteer activities involving direct face-to-face interactions (e.g., youth work) than in the computer-mediated collaboration for Wikipedia. Finally, the three most prominent categories of additional motives mentioned by Wikipedia contributors in the open questions were related to task enjoyment, information sharing, and generativity motives.

Building on research on the motivation of F/OSS developers, we could determine similarities and differences between the motivation of contributors to Open Source projects and Wikipedia. Although structural similarities (peer review process, free license, political background, etc.) exist, and some of the participants contribute both to F/OSS projects and Wikipedia, other motivational processes seem to differ. Most notably, F/OSS projects provide clear individual incentives for contributors such as better software for personal use, career advantages etc. (Gosh, 2005; Hertel et al., 2003; Lerner & Tirole, 2002) whereas corresponding incentives are much lower or lacking completely for Wikipedia contributors. This is reflected in the negative relation between individual costs and benefits and engagement that is in contrast to

findings in F/OSS projects. In this respect, Wikipedia is an even more extreme example of voluntary engagement in Internet-based projects. Highly engaged Wikipedians must have a high tolerance for experienced opportunity costs, but the activity itself might counter this effect by providing other (intrinsic) incentives. Methodological reasons, however, might also help to explain the difference between this result and findings in F/OSS projects. For example, it is possible that only few contributors report an unfavorable net balance of costs and benefits, but that these contributors are those who contribute most. In this case, purely descriptive analyses could be misleading.

Nevertheless, descriptive analyses supplement regression based analyses. Although not qualifying as a significant predictor in the path model of the present study, the collective motives class of the Klandermans Model yielded the highest average importance ratings of all components (cf. Tables 1 and 2). These findings are consistent with results reported by Nov (2007) who found no or only weak bivariate correlations between time spent for Wikipedia and Open Source ideology or personal values, respectively. However, this study did not test unique effects in a multivariate regression analysis or path model. Apart from potential ceiling effects, this pattern of results might point to a threshold process in which potential contributors first have to agree with the general goals of Wikipedia (as measured by collective motives) in order to participate at all. However, this first agreement does not predict the degree of later engagement or satisfaction.

In the future, longitudinal research would allow to determine the role and interactions of different components of the Klandermans Model including collective motives at different stages of Wikipedia engagement. For example, perceived costs and benefits might be more important in the beginning of Wikipedia activities whereas identification might become more important at

later stages (cf. Gosh, 2005, and Finkel & Muller, 1998 for related results for F/OSS and political movement participation). Several repeated measurements could also reduce the influence of common-method bias that might be present in cross-sectional research.

The sample characteristics of the present study might be another limitation because participants were very involved in Wikipedia. For instance, the average time spent on Wikipedia engagement per day (M = 133 minutes) and the number of administrators in the sample (37%) was quite high. Thus, the reported results might not be the same for occasional contributors to Wikipedia. Although the quality of contributions from occasional authors is sometimes very high (Anthony et al., 2007), a large number of contributions and copy-edits to Wikipedia are made only by a small number of individuals who are also very active in the Wikipedia community (Spek et al, 2006; Priedhorsky et al., 2007).

Moreover, future research might analyze the impact of perceived task characteristics distinctively for the different roles and functions of the participants in the Wikipedia project (such as authors, administrators, software developers). Such work might provide more detailed insight in these different activities, together with more specific measures such as objective data from log files, or results obtained using diaries or Experience Sampling Methods. This would allow to tap into motivational processes more directly and more strictly establish causality between motivational processes and engagement.

The results reported are interesting both for Wikipedia as well as other collaboration projects concerned with sharing information and collaborative writing. The Wikipedia project might benefit from a thorough understanding of the motivation of their participants in order to attract and retain their volunteer contributors even better. Reducing the costs associated with high engagement might facilitate long-term engagement of qualified and experienced contributors.

Similarly, improvements to the experience of editing and correcting articles, for example by increasing experienced autonomy and task significance, might attract more of the millions of visitors to become volunteer contributors.

Moreover, our results might also be fruitful for knowledge management systems in business organizations. For instance, the extent and quality of employees' contributions to knowledge management systems in business organizations depend heavily on their individual initiative and motivation. Although the incentive structure clearly differs between business organizations and voluntary work in Open Content communities, there still might be some lessons to be learned from each other. Based on the results reported in this study, companies who are interested in increasing the individual contribution rates to knowledge management systems might emphasize the significance of these activities for others, for instance by better communicating the consequence of good (and bad) contributions for work processes. Moreover, the strong influence of task characteristics in our study emphasizes factors that increase the intrinsic value of the contributing activities. Apart from autonomy, the technical systems have to be designed accordingly (cf. Arazy, Ji, & Patterson, 2006; Osterloh, Frost & Frey, 2002; Venkatesh, 1999). For instance, the use of wiki software (Majchrzak, Wagner, & Yates, 2006) might provide employees with a more pleasant task experience than more cumbersome software solutions, and increase intrinsic motivation to contribute.

This study provides on of the very first quantitative, empirical views into the motivational processes within the largest Open Content project, trying to explain why so many persons with different educational and occupational backgrounds are working for free in a collaborative writing project, and to extract general insights on motivation in Internet-based cooperation that might be applied to other projects. In doing so, we combined conceptual models from two

research communities that are usually rather unconnected (i. e., social science and work psychology) in order to strive for a complete picture of the underlying processes. Of course, this initial step has to be replicated, supplemented, and extended by future work.

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Footnotes

[1] See http://en.wikipedia.org/w/index.php?title=Wikipedia&oldid=174369778, retrieved November 28, 2007.

[2] See http://www.comscore.com/press/release.asp?press=1808, or http://alexa.com/data/details/traffic_details/wikipedia.org, retrieved October 20, 2007.

[3] Interview with Slashdot.org on July 28, 2004, full text available at http://interviews.slashdot.org/interviews/04/07/28/1351230.shtml?tid=146&tid=95&tid=11.

[4] In this study we will use the term *engagement* rather than *participation* because it more strongly implies a behavioral and continuous (i. e., how much?) rather than dichotomous measure (i. e., participation vs. no participation) of contributions to Wikipedia. However, it should not be confused with the concept of *work engagement* (Schaufeli et al., 2002) that refers to intrinsic motivation or cognitive involvement.

[5] See http://en.wikipedia.org/w/index.php?title=Wikipedia:Wikipedians&oldid=174189312, retrieved November 28, 2007.

[6] As of May 30, 2005, a total of 143 contributors to the German Wikipedia were listed as administrators (http://de.wikipedia.org/w/index.php?title=Wikipedia:Administratoren&oldid=6168932). Compared to 3687 active user accounts in May 2005 (http://stats.wikimedia.org/EN/TablesWikipediansEditsGt5.htm), this quota of 4% users with administrator rights is well below the 37% quota in the present sample.

[7] A bivariate regression of the costs/benefits component on engagement yielded $\beta = .-28$, $p < .01$, $R^2 = .08$. In general, the direction of paths in the structural model only have minor effects on estimation results in PLS path modeling.

Table 1

Descriptives, Loadings, Outer Weights and Variance Inflation of Manifest Variables in the Measurement Model

			Loading	Weight	
Items	***M***	***SD***	r_{ij}	w_{ij}	**VIF**
Norm-related Motives					
Relevant others	4.10	1.51	1.00	1.00	1.00
Costs and Benefits					
Benefits exceed costs	4.53	1.74	.86***	.77***	1.10
Job / school qualification	3.76	1.90	.33†	.18	1.04
Learning	5.84	1.17	.45*	.31†	1.11
Loss of time	4.44	1.34	-.31	-.27	1.05
Unpaid work	3.10	1.96	-.19	-.28	1.05
Collective Motives					
Freedom of information	6.20	1.25	.99***	1.01***	1.02
Quality improvement	6.36	0.93	.02	-.12	1.02
Identification (reflective)					
Community	5.13	1.40	.88***	.46***	
Pride	5.04	1.67	.87***	.46***	
Typical Wikipedian	4.41	1.49	.72***	.27***	
Task characteristics					
Skill variety[c]	4.64	1.31	.51**	.40*	1.16
Task identity	4.61	1.36	.30†	.20	1.05
Task significance	4.15	1.50	.76***	.46**	1.34
Autonomy	5.56	1.15	.71***	.51**	1.21
Feedback from others	3.45	1.55	.51**	.02	1.42
Dealing with others[c]	4.18	1.50	.28†	.05	1.18
Intrinsic Motivation[b]					
Time distortion	5.66	1.36	.84***	.75***	1.04
Enjoyment[a]	5.45	0.87	.57***	.28	1.20
Experienced competence[a]	5.44	0.84	.56**	.37†	1.17

Satisfaction[b]					
Growth satisfaction[a]	5.53	0.87	.98***	.86***	1.45
General satisfaction[a]	5.49	1.11	.53***	.05	1.32
Satisfaction with others[a]	4.91	1.06	.59**	.23	1.22
Engagement					
Leisure time / day	114 min.	93 min.	.87***	.64**	1.23
Working time / day	23 min.	28 min.	.48[†]	.22	1.09
Articles on watchlist (ln)	5.33	1.54	.75**	.45*	1.20

Notes. All responses were collected on a seven-point Likert scale, except for measures of engagement. The variance inflation factor (VIF) is only relevant for manifest variables in formative measurement models.

[a]First-order latent variable. [b]Second-order latent variable. [c]Aggregate value.

[†]$p < .05$, one-tailed. *$p < .05$, two-tailed. **$p < .01$, two-tailed. ***$p < .001$, two-tailed.

Table 2

Descriptives and Zero-Order Correlations Between Latent Variables in the Structural Model

		M[a]	***SD***[a]	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	Norms	4.10	1.51							
2	Costs and Benefits	4.65	0.87	.15						
3	Collective Motives	6.17	1.47	.07	.26**					
4	Identification	4.87	1.28	.23*	.14	.35**				
5	Task Characteristics	4.81	0.80	.17†	.07	.24*	.34***			
6	Intrinsic Motivation[b]	5.53	0.76	.25**	.06	.31***	.46***	.42***		
7	Satisfaction[b]	5.42	0.80	.30**	.38***	.39***	.48***	.66***	.40***	
8	Engagement			.15	-.28**	-.01	.23*	.32*	.34***	.16

Notes. [a]Although all calculations were conducted using *z*-standardized measures, unstandardized means and standard deviations are reported in the original metric for easier interpretation. These descriptives were re-constructed from original data based on results from the PLS analysis. Only means and standard deviations of latent variables based on Likert-type manifest variables are reported.

[b]Second-order latent variable.

†$p < .05$, one-tailed. *$p < .05$, two-tailed. **$p < .01$, two-tailed. ***$p \leq .001$, two-tailed.

Table 3

Unique Variance Components (partial R²*) of Satisfaction and Engagement Accounted For by Components of the Klandermans Model, Task Characteristics, and Intrinsic Motivation.*

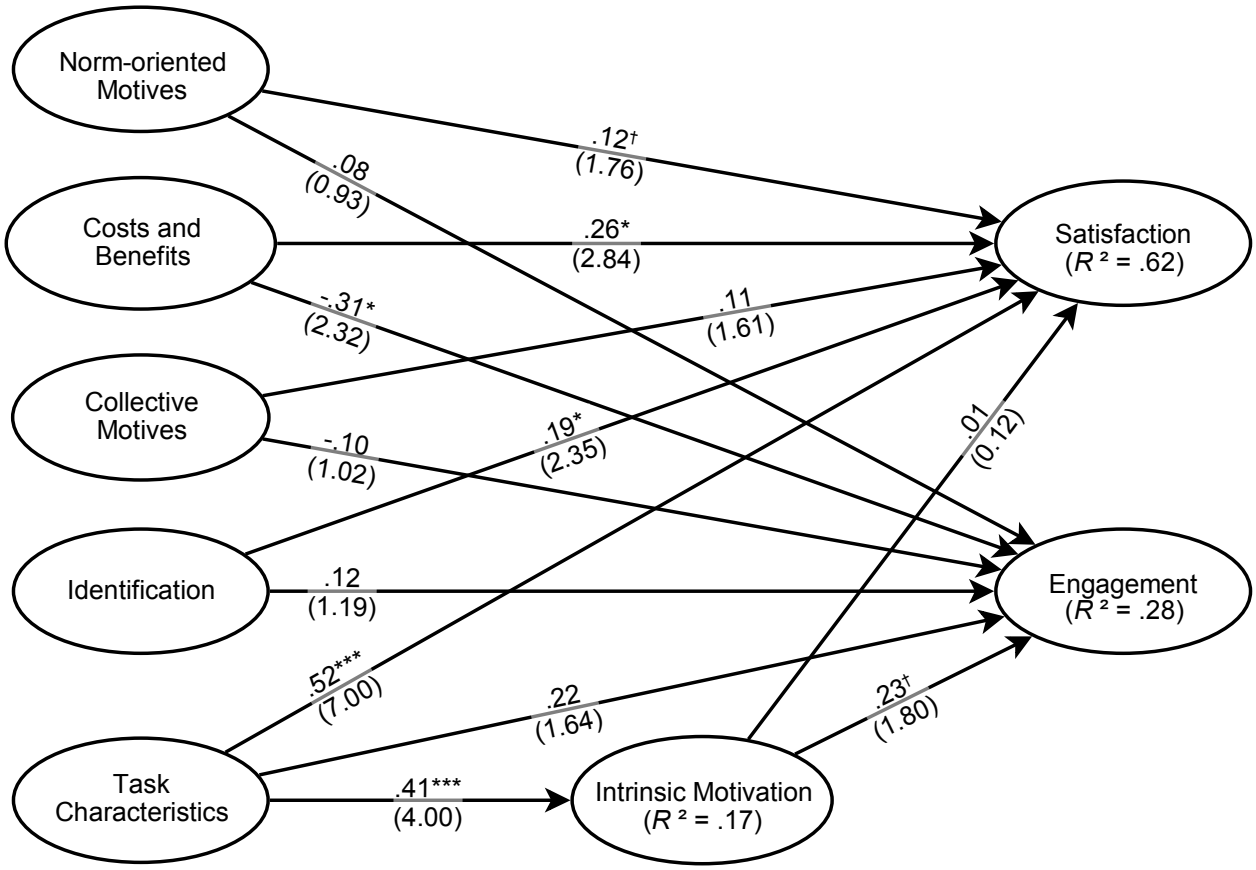
	Satisfaction (R^2 = .62)		**Engagement (R^2 = .28)**	
	R^2_{part}	% R^2	R^2_{part}	% R^2
Social Norms	.04	6	.01	4
Costs and Benefits	.10	16	.09	31
Collective Motives	.04	7	.00	0
Identification	.09	15	.03	10
Task Characteristics[a]	.35	56	.07	26
Intrinsic Motivation	.00	0	.08	28

Notes. [a]Only direct effects of task characteristics are reported here because partial R^2 is based on direct path coefficients and zero-order correlations. Deviations of summed percentages from 100% are due to rounding errors.

Figure Captions

Figure 1. PLS path analytic model: Influence of predictors from the Klandermans Model of social movement participation, task characteristics, and intrinsic motivation on satisfaction and engagement. To allow for additional effects of intrinsic motivation not specified in the hypotheses, an additional path from intrinsic motivation to satisfaction was included in the model. Bootstrapped *t*-values are listed in brackets below path coefficients.

$^{\dagger}p < .05$, one-tailed. $*p < .05$, two-tailed. $**p < .01$, two-tailed. $***p < .001$, two-tailed.


Norm-oriented Motives
Costs and Benefits
Collective Motives
Identification
Task Characteristics
Intrinsic Motivation (R^2 = .17)
Satisfaction (R^2 = .62)
Engagement (R^2 = .28)
.12† (1.76)
.08 (0.93)
.26* (2.84)
-.31* (2.32)
.11 (1.61)
-.10 (1.02)
.19* (2.35)
.01 (0.12)
.12 (1.19)
.52*** (7.00)
.22 (1.64)
.23† (1.80)
.41*** (4.00)