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Through a Glass Darkly: Information Technology Design, Identity Verification, and Knowledge Contribution in Online Communities

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A variety of information technology (IT) artifacts, such as those supporting reputation management and digital archives of past interactions, are commonly deployed to support online communities. Despite their ubiquity, theoretical and empirical research investigating the impact of such IT-based features on online community communication and interaction is limited. Drawing on the social psychology literature, we describe an identity-based view to understand how the use of IT-based features in online communities is associated with online knowledge contribution. Specifically, the use of four categories of IT artifacts—those supporting virtual co-presence, persistent labeling, self-presentation, and deep profiling—is proposed to enhance perceived identity verification, which thereafter promotes satisfaction and knowledge contribution. To test the theoretical model, we surveyed more than 650 members of two online communities. In addition to the positive effects of community IT artifacts on perceived identity verification, we also find that perceived identity verification is strongly linked to member satisfaction and knowledge contribution. This paper offers a new perspective on the mechanisms through which IT features facilitate computer-mediated knowledge sharing, and it yields important implications for the design of the supporting IT infrastructure.

Key words: computer-mediated communication and collaboration; perceived identity verification; online communities; design of IT infrastructure; questionnaire surveys
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1. Introduction

New organizational forms spawned by developments in information technologies (IT) continue to intrigue researchers and practitioners. The focus of this paper is on such a form—an online community—that describes a group of people who communicate and interact, develop relationships, and collectively and individually seek to attain some goals in an IT-supported virtual space (Lee et al. 2002). Paradoxically, although the past few years have witnessed a significant growth in the number of online communities,[1] empirical studies reveal that very few are successful at retaining their members and motivating member knowledge contribution. For example, the vast majority (91.2%) of communities on MSN (www.msn.com) had fewer than 25 members, and the communities averaged between 1 and 20 posts (Farmham 2002). Communities can be a significant source of value for participants and, in the case of sponsored communities, for the subsidizing firms. However, to the extent that such value can only be realized when ongoing participation is motivated and appropriately supported (Butler 2001, Finholt and Sproull 1990), a natural question that arises then is, how can voluntary knowledge contribution be promoted between strangers interacting through technology-mediated communication?

[1] It is difficult to establish the total number of online communities. These communities could be communities open to the public, or private communities (e.g., a community for the employees of a company). As examples, MSN has more than 300,000 communities. Google Groups hosts more than 54,000 forums. Bigboards.com is a Web directory that lists most active online communities ranked by their post count, member count, traffic, etc. As of August 2006, it listed 1,839 forums with more than 500,000 posts.

Mediation by technology creates several challenges for effective social interaction. It is widely acknowledged that mediated communication suffers from social cue deficiencies (Rice 1984, Short et al. 1976, Sproull and Kiesler 1986) because the transmission of important contextual cues such as body language and physical surroundings cannot easily and conveniently be realized through computer channels. In the disembodied virtual environment, a lack of synchronicity and immediacy can attenuate the effect of social norms on behavior and result in more social loafing (Latané 1981). Furthermore, communication in an online community typically involves a large number of participants with different social backgrounds and perspectives. The establishment of mutual understanding to comprehend conversations and knowledge contribution is inevitably more difficult than face-to-face communication in a small group (Chidambaram and Tung 2005, Whittaker et al. 1998). Finally, redundancy and communication overload (Kraut and Attewell 1997) can also reduce participation in the community and discourage knowledge sharing.

In spite of these challenges, evidence suggests that individuals do engage in prosocial behaviors such as knowledge contribution in online communities (e.g., Hertel et al. 2003). In this paper, our goal is to examine the role of the technology infrastructure of an online community in facilitating knowledge contribution. The literature on online knowledge sharing posits that a variety of drivers motivate this behavior: the anticipation of extrinsic benefits (economic rewards), intrinsic benefits (e.g., sense of self-worth, social norms, and social affiliation) (Bock et al. 2005, Kankanhalli et al. 2005), and social capital (Chiu et al. 2006, Wasko and Faraj 2005). We theorize that a key driver of knowledge contribution behavior in an online community is the accurate communication and verification of identity that can, in turn, yield extrinsic benefits such as recognition, and intrinsic benefits such as an amplified sense of self-worth. Individuals participating in both offline and online social interaction seek to be understood as the person they believe themselves to be (Donath 1999, Swann 1983). Indeed, the importance of identity in a technology-mediated context has been suggested by others (e.g., Berman and Bruckman 2001, Turkle 1995) and is succinctly summarized by Donath (1999) in her study of Usenet newsgroups: "For most participants, identity—both the establishment of their own reputation and the recognition of others—plays a vital role" (p. 30). We argue that the extent to which individuals believe they are able to successfully communicate their online identity (i.e., who he or she is in an online community), relates—both directly and through mediation by satisfaction—to knowledge contribution in the community.

The role of technology is central to our theorizing. Because technology is the foundation and medium through which community members interact, it is one of the key determinants of the dynamics of the community. While Walther's influential research suggests that communicators can develop social relationships despite constraints imposed by lean media (Walther 1992, Walther et al. 2001), a significant number of studies also suggest that technologies and social systems evolve together, and that technologies may lead to different outcomes with regard to member behavior and ongoing community activities (e.g., Fulk 1993, Poole and DeSanctis 1990, Walther et al. 2001, Yates and Orlikowski 1992). For example, the Human-Computer Interaction (HCI) literature points out that software built to support real-time conversation (e.g., instant messaging), social feedback (reputation systems), and social networks allows users to create new social relationships (Boyd 2003). However, much of this work investigating community design does not provide a theoretical explanation for these effects, although community infrastructures with increasingly sophisticated IT are being put in place. To bridge the gap between online community research and practice, we elaborate the mechanisms through which community features such as a rating system and user profiles influence online community members' knowledge-sharing behavior. Specifically, we investigate how perceived identity verification is enabled by the use of IT in an online community.

We propose and test a theoretical model examining the effects of the use of four community IT artifacts—virtual copresence, persistent labeling, self-presentation, and deep profiling—on community members' perceived identity verification by others. Although prior research has alluded to these impacts (e.g., Wynn and Katz 1997), no study we are aware of has established and tested the underlying causal mechanism, or empirically verified the relationship between perceived identity verification and member knowledge contribution. Our findings, based on primary survey data collected from more than 650 users of two distinct online communities, support the assertion that technology design is a crucial determinant of important community outcomes. These findings yield important implications for research and practice.

2. Theoretical Background and Research Hypotheses

2.1. Knowledge Contribution in Technology-Mediated Contexts

A growing literature addresses issues surrounding knowledge contribution in technology-mediated contexts from a variety of social-psychological perspectives. For instance, research by Whittaker et al. (1998) reveals that knowledge contributions in Usenet (an Internet-based worldwide network of discussion groups) tend to be dominated by a small number of members, in contrast to the more equal level of participation in face-to-face interaction (O'Conaill et al. 1993). Constant et al. (1996) examine the use of e-mail for help seeking and giving within an organization and find that citizenship behavior and the desire to benefit the organization are the major motivations for helping behavior. In studies of online communities of professionals Wasko and Faraj (2005) note that reputation, altruism, generalized reciprocity, and community interest may be important motivations underlying member knowledge contribution. Likewise, in their study of individual contributions to product reviews of an Internet store Peddibhotla and Subramani (2007) identify social affiliation, professional self-expression, reputation benefits, and social capital as key motivations. More recently, a study by Jeppesen and Frederiksen (2006) reports that user experience, recognition from the site, and individual attributes (such as being a hobbyist) tend to positively influence contribution. Chiu et al. (2006) also affirm the influence of social capital and outcome expectancy on an individual's willingness to share knowledge online.

A common theme underlying the research summarized above is that the design of the community is assumed to be given or immutable. A second stream of research has manipulated the social-psychological factors underlying knowledge contribution and integrated them into the design of the community to promote contribution (Ling et al. 2005, Ludford et al. 2004). For example, Ling et al. construct a community that reminds users about the uniqueness of their contribution and find that this feature increases participation significantly. In a study comparing different online communication networks, such as e-mail lists versus Usenet, Rafaeli and Sudweeks (1997) find that the manner in which postings are organized and disseminated influences member participation. Research also suggests that design factors such as increasing an individual member's visibility may amplify contributions (Subramani 2004), while the use of moderators may discourage them (Whittaker 1996).

As noted earlier, technology provides the foundation and mechanisms for communication and interaction in an online community. It follows, then, as acknowledged in the studies above, that specific features of this foundation are also likely to facilitate or constrain how actors within the community relate and interact with each other. Researchers have observed that a mediated environment can help knowledge accumulation by processing and presenting information in new and flexible ways, and by changing or distorting the social context to promote equal conversation (Connolly et al. 1990, DeSanctis and Gallupe 1987, Jessup et al. 1990). For instance, reputation systems that rate participants on the quality of their contributions provide a readily available inventory of "experts" to knowledge seekers. However, in spite of the ubiquitous use of many community artifacts, limited theoretical understanding exists for why and how these technologies promote knowledge contribution online. Our research seeks to address this gap.

We adopt a perspective from social psychology theory rooted in the concept of identity (Erickson 1968) to theoretically link the technology features available in an online community to member knowledge contribution. We suggest that this relationship is mediated by a proximal driver of knowledge contribution in an online environment: perceived identity verification. In the discussion that follows, we first establish the pivotal role of identity in both offline and online contexts. Second, we describe the concept of perceived identity verification, distinguishing it from similar constructs in extant literature. Finally, we present the research model underlying the study.

2.2. Perceived Identity Verification and Knowledge Contribution

Identity is "the individual's self-appraisal of a variety of attributes along the dimensions of physical and cognitive abilities, personal traits and motives, and the multiplicity of social roles including worker, family member, and community citizen" (Whitbourne and Connolly 1999, p. 28). Fundamentally, identity is a multifaceted and complex answer to the question, "Who am I?" Identity communication reflects an individual's effort to express and present one's identity to others with the goal of achieving a shared understanding. The importance of effective identity communication is underscored in Goffman's (1967) influential self-presentation theory that argues that people desire to explain themselves to others regarding their identities before concentrating on work or other goals that may bring them together. By reaching a consensus regarding identities, people feel understood and obtain a sense of continuity and coherence (Swann et al. 2000). Such understanding is argued to be a crucial determinant of smooth and conflict-free social discourse and engagement in face-to-face settings (De La Ronde and Swann 1998, Swann 1983, Swann et al. 1992); individuals are fundamentally motivated to present their identities in everyday social life (Jones et al. 1981, Jones and Pittman 1982).

Scholars have identified at least three reasons why identity communication is as salient for interaction in online settings as in embodied environments for all the parties engaged in the interaction. First, information acquisition is more efficient when the expert is identifiable. Knowing the identity of knowledge contributors helps knowledge seekers recognize source credibility. As argued in the elaboration likelihood model, information seekers perceive knowledge as more useful and pay greater attention to it when source credibility is high (Chaiken et al. 1989, Sussman and Siegal 2003, Wells et al. 1977). Furthermore, experiments have shown that when select subjects are publicly and explicitly assigned an expert role, a decision-making group recalls more uniquely held more information provided by the assigned expert (Stasser et al. 1995, 2000). Thus, without knowing the identity of the knowledge contributor, knowledge adoption is difficult, indicating a less-efficient knowledge exchange (Nickerson 1999, Poston and Speier 2005).

Second, from a relationship-building perspective, people with similar interests or attitudes, in similar social groups or with similar experiences, are more likely to communicate and build relationships with each other (Newcomb 1961). Effective identity communication can help community members find similar others with whom to build relationships (Jensen et al. 2002). Finally, effective identity communication facilitates and promotes knowledge contribution. As emphasized by research on prosocial behavior in a virtual environment, people help strangers not only because of altruism, but also for reputation (Donath 1999, Wasko and Faraj 2005), future reciprocation (Ackerman 1998), and self-esteem (Bock et al. 2005, Wasko and Faraj 2005, Hertel et al. 2003, Kollock 1999). Many studies have provided evidence that recognition and acknowledgment from group members increases a focal person's overall participation (Hertel et al. 2003, Stasser et al. 1995, Thomas-Hunt et al. 2003). Thus, establishing one's online identity provides significant motivation for knowledge contributors not only by helping them enhance their reputations and self-esteem, but also by amplifying the possibility of future reciprocation (Axelrod 1984, Donath 1999).

While the communication of identity is a central goal in social discourse (e.g., Wynn and Katz 1997), it is equally important that the communicator and receiver achieve a shared understanding of self. In other words, the representation of identity that is communicated and understood must accurately reflect what the individual believes she is. Self-verification theory, rooted in cognitive dissonance theory, suggests that people are more satisfied and likely to participate in a relationship when their salient identities are confirmed by others in a group (Swann 1983, Swann et al. 1989). Individuals experience tension and psychological discomfort when their self-view, even if it is a negative self-view, disagrees with others' appraisals. Consider, for example, a person who perceives herself as noncreative while others characterize her as creative. In such a situation, the inconsistent expectations of others create anxiety and unpleasant pressure for the focal person, lead to misunderstandings between communicators, and ultimately result in withdrawal behaviors (e.g., not participating in the relationship). By contrast, an individual perceiving others' consensus on her identity can develop a sense of understanding, coherence, and security (Goffman 1959, Swann et al. 2000), which promotes prosocial behavior and positive attitudes.

We define *perceived identity verification*, a key concept in our theorizing, as the perceived confirmation from other community members of a focal person's belief about his identities.[2] Conceptually similar constructs have been investigated in the self-verification literature. Influential work by Swann et al. (2000), where group members describe their own identities and rate each others' identities, finds that a higher fit between focal persons' self-view and their partners' evaluation yields a closer relationship. Related concepts have also been adapted in organizational psychology research. For example, *interpersonal congruence* is a group-level construct defined as "the degree to which group members see others in the group as others see themselves" (Polzer et al. 2002, p. 298). Polzer et al.'s field study shows that interpersonal congruence fosters harmonious interaction and creative performance in work groups.

In contrast to these other constructs, perceived identity verification in this study is conceptualized as a perceptual construct. There are both theoretical and operational reasons why such a conceptualization is appropriate. First, although it is possible that people may perceive more self-confirmation than actually exists (Swann et al. 2004), there is significant empirical evidence indicating that perceptions drive actual behavior, regardless of their accuracy. For example, the person-organizational fit literature shows that subjective fit perceptions determine job choice and turnover (e.g., Cable and Judge 1996). The literature on cognitive dissonance in interpersonal contexts (Matz and Wood 2005) likewise argues that it is the individual's beliefs about what group members think that determines how much consonance occurs. Thus, how the individual's salient referents actually perceive him is less important; what *is* important is the individual's perceptions of others' assessment.

Second, we focus on the perceived confirmation of identities from others rather than the objective agreement between an individual's self-view and others' appraisal, because the operational requirements for assessing the latter would be overwhelming. Studies of self-verification and interpersonal congruence have typically investigated dyads or small groups of three or four members, but an online community can be relatively large. In such a context, it is difficult if not impossible for an individual to determine the true beliefs of salient referents; thus, she forms perceptions about others' beliefs (e.g., Walther 1992, Whittaker et al. 1998). Moreover, from a measurement point of view, the extant concept and operationalization of self-verification in face-to-face settings cannot be applied directly to the online context. For instance, the Swann et al. (2000) studies ask subjects to rate each other to obtain a measure of actual agreement. It is impractical to request each subject to rate individually the hundreds of other respondents in an online context.

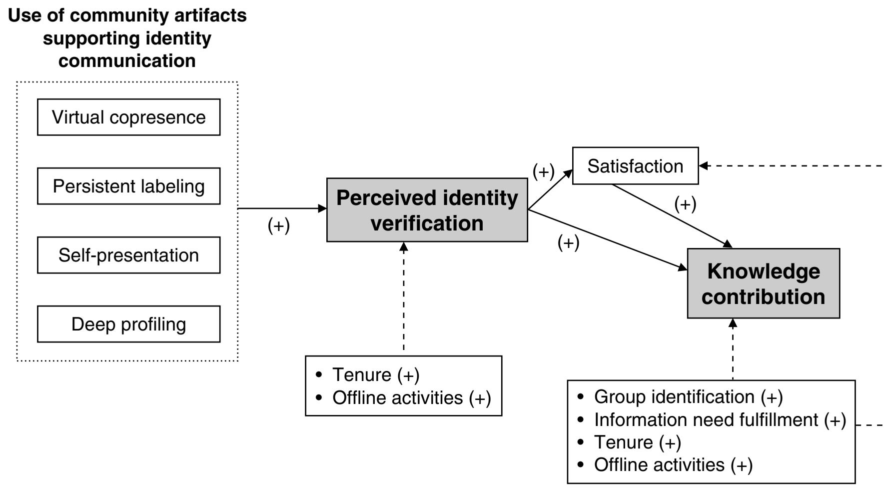
2.3. Research Hypotheses

Building on the concept of perceived identity verification, our research model is shown in Figure 1. We propose that the use of four categories of community IT artifacts—virtual copresence, persistent labeling, self-presentation, and deep profiling—amplify perceived identity verification, which, in turn, relates to knowledge contribution, directly and indirectly, mediated by satisfaction. Control variables (community tenure, offline activities, group identification, and information need fulfillment) identified in prior research as significant drivers of knowledge contribution are included in our model so that we may isolate the explanatory power of perceived identity verification. The theoretical rationale for the proposed hypotheses is developed below.

2.3.1. The Consequences of Perceived Identity Verification. The key dependent construct we focus on is knowledge contribution. Evidence from the self-verification literature indicates that people prefer interacting with partners who verify their identi-

[2] Although it is possible that an individual's online identity (perhaps fictional) could be different from her offline (real) identity, this distinction is not of relevance to our theorizing. Our focus is on the relationship between a person's perceived online identity verification and her online social interaction, not a person's real identity and her online behavior.

Figure 1 **Theoretical Model**



ties than with those who do not (e.g., Swann et al. 1989). For instance, experiments by Chen et al. (2004) find that people prefer to interact with identity-verifying partners instead of with nonverifying partners. Additionally, numerous studies provide evidence that acknowledgment from group members increases a person's contribution (Hertel et al. 2003, Stasser et al. 1995, Thomas-Hunt et al. 2003). When an individual believes that other members of the online community understand and confirm his self-view, this engenders feelings of cognitive consonance in the interpersonal discourse (Matz and Wood 2005), and motivates the focal individual to continue the interaction and contribute to it. Hence, we test

Hypothesis 1 (H1). *An online community member's perceived identity verification is positively related to her knowledge contribution.*

In addition to the direct effect of perceived identity verification on knowledge contribution, we propose a second pathway that is mediated by satisfaction. Satisfaction indicates whether a member is content with his access to the community resources. Self-verification theory, described earlier, indicates that people seek confirmation of their identities (Swann 1983). Empirical tests of this theory find a strong relationship between identity verification and satisfaction (De La Ronde et al. 1998, McNulty and Swann 1994, Swann 1983, Swann et al. 2004). For example, in a longitudinal study, Swann et al. (2000) find that personal identity (academic ability, skill at sports, social competence, and creative ability) verification heightens participants' feelings of connection to their group, reduces interpersonal conflict, and amplifies satisfaction with the group interaction. Individuals in an online community whose identities are recognized and verified by others feel better understood and are more likely to believe they will be treated in desired ways. They interact with others more easily with fewer misunderstandings and conflict because the interaction partners' expectation matches the focal person's self-view. In other words, individuals believe that they can better predict and control the proceeding of the social interaction when their identities are verified (Chen et al. 2004). We therefore test

Hypothesis 2 (H2). *An online community member's perceived identity verification is positively related to her satisfaction with the community.*

Membership in a community is fundamentally a social relationship (Donath 1999). Significant research suggests that satisfaction with social relationships promotes relationship continuance and commitment (Clugston 2000, Givertz and Segrin 2005). Individuals who are satisfied are more likely to affectively and normatively commit to the relationship and engage in behaviors that will maintain a healthy relationship, such as providing help or accommodating others' needs (Rusbult and Buunk 1993). To the degree that contributing knowledge to the community helps maintain a better relationship and extends the resources available to all parties, satisfaction with the community is likely to yield greater knowledge contribution.

Hypothesis 3 (H3). *An online community member's satisfaction with the community is positively related to his knowledge contribution.*

2.3.2. Technology and Perceived Identity Verification: The Role of Community Artifacts. As suggested in Figure 1, we posit that features of the technology on which the community is constructed, i.e., community IT artifacts, are proximal determinants of perceived identity verification. Why and how do technology features allow for the accurate portrayal of self? To answer this question, we first turn to theoretical explanations from the literature examining the portrayal of self in face-to-face interactions, and the challenges associated with achieving a shared understanding.

In nontechnology-mediated groups, people form impressions about others using a rich range of visual and auditory cues through an information-processing activity that is used to construct attributions. Attribution theory argues that individuals use such available social information to infer the personality and identity of others (Heider 1958, Jones and Davis 1965, Kelley 1972). Due to information asymmetry, the focal person and other group members may make different identity attributions (Ross 1977), thereby creating cognitive dissonance and reducing the effectiveness of group communication. Inevitably, such attribution differences are expected to be particularly strong in computer-mediated contexts because fewer identity cues are available than in face-to-face communication (Bock et al. 2005, Postmes et al. 2000). Moreover, information related to behavioral contexts and constraints is also masked because of the asynchronous and distant interaction between online community members, further exacerbating the potential for attribution differences.

Several interventions have been proposed to address these challenges. First, increasing individual accountability, or the expectation that one is responsible for justifying one's feelings and behavior to others (Lerner and Tetlock 1999), may mitigate attribution differences (Tetlock 1985, Wells et al. 1977). Accountability attenuates attribution bias because people pay greater attention to social cues and engage in more-effortful search for relevant evidence in the attribution process when they perceive more responsibility. A feeling of accountability can be achieved by inducing a sense of the copresence of others or by increasing the identifiability of individuals (Lerner and Tetlock 1999). In other words, the attributions that individuals make are more careful and accurate when they feel the presence of others or when they know that others can identify them. Second, mechanisms that aid in the exchange of perspectives of actors and observers help reduce attribution difference. In several studies, when more behavioral contexts were brought to the observers' attention, their comprehension of the actors was significantly amplified (e.g., Regan and Totten 1975). Thus, technology that supports accountability and aids interaction for participants in the exchange of perspectives so that they may reach a "common ground" for shared understanding (Clark and Brennan 1991, Preece and Maloney-Krichmar 2003) is likely to be instrumental in alleviating attribution biases.

Individuals use a variety of tactics to communicate who they are, i.e., their identities. Goffman (1959) suggests that the presentation of identity is through social interaction. He also speculates that physical copresence is essential to identity expression. An individual needs both to fill the duties of the social role and to communicate the activities and characteristics of the role to other people in a consistent manner (Goffman 1967). Leary (1996) examines multiple identity expression tactics, including self-description (i.e., telling others about oneself), attitude statements, public attribution, nonverbal behavior (e.g., emotional expression, physical appearance, and body language), social associations, conformity and compliance, the physical environment (e.g., the setting of the office or home), and other behavioral tactics (e.g., helping behavior). Computer-mediated communication offers new avenues for people to express themselves; some self-presentation tactics discussed above are applicable to mediated communication as well. For instance, a new form of identity communication is the use of a personal Web page (Miller and Mather 1998). Moreover, along with the introduction of new IT features in online communities, efficient identity formation (e.g., through reputation systems) is now possible.

Table 1 Community Artifacts Reducing Attribution Difference and Increasing Perceived Identity Verification

	Virtual copresence	Persistent labeling	Self-presentation	Deep profiling
Intervention	• Accountability (induce a sense of co-presence)	• Accountability (increase identifiability)	• Perspective exchange	• Perspective exchange
Definition	• Artifacts that induce a subjective feeling of being together with others in a virtual environment	• The use of a single label to present (identify) oneself	• The means by which the focal person presents herself online	• The digital organization of social information with which community members can identify the focal person
Sample community artifacts	• Instant messenger • Chat room • "Who is online" feature • "Who is doing what" feature • Interactive tools (e.g., real time posting)	• User ID	• User name • Signature • Avatar or nickname • Profile • Personal page • Interactive tools	• Member directories • Reputation or rankings (designs that allow users to rate each other based on criteria such as trustworthiness) • Feedback • "Who did what" feature • Interaction archive and searching tools

To summarize, technology features play two important roles: One, they support identity communication through self-presentation. Two, they help reduce attribution differences so that the sender and receiver can achieve a shared understanding. Based on an extensive review of the literature and close observation of a large number of online communities, we identified four categories of community artifacts that can potentially reduce attribution difference and enhance self-presentation (see Table 1). In addition to the artifacts found in the literature, we reviewed popular online community (forum) software (e.g., phpBB, Invision Power Board, vBulletin, etc.) and summarized their features. We also observed communities developed by individual companies, such as Dell, HP, etc. to ensure that no technology feature that is currently widely available in online environments was overlooked.

Though there is no established framework identifying IT features facilitating identity communication and verification, these four categories are rooted in the current literature on why and how people present and communicate their identities, both online and offline. First, Goffman (1967) writes that for people to engage in self-presentation they must feel the copresence of others. According to the research on accountability reviewed earlier, copresence enhances a sense of accountability and therefore reduces attribution differences. In an online community, this is supported by system features facilitating virtual copresence. Second, in contrast to face-to-face communication where people identify others by their faces, in online communities each individual is identified by a unique and persistent user ID. A unique and persistent user ID guarantees that other community members can build up their attribution about the focal person over time (persistent labeling).

Third, as reviewed earlier, Leary (1996) includes self-description, social association, attitude expressions, and other nonverbal behavior as self-presentation tactics used by individuals offline. In an online community, this is supported by system features facilitating self-presentation (e.g., a personal homepage). Finally, attribution theory and research on mental models (e.g., Heider 1958, Jones and Nisbett 1972) also discuss how people make their attributions about others based on the social information available. In an online community, this is supported by system features facilitating social information recording and exchange, i.e., deep profiling. Together, these four categories of IT features explain why individuals want to present themselves (virtual copresence), who is presenting (persistent labeling), how to present oneself (self-presentation), and what identity information is available (deep profiling). Next, we elaborate on these four categories of community artifacts and their effects on identity verification.

Virtual Copresence. Goffman (1959) defines *copresence* as physical colocation in which individuals become accessible and available to each other. He also suggests that a sense of copresence is a requirement for both the perceiver and the perceived to engage in identity communication. Without copresence, individuals may feel that their identity expression cannot be observed and perceived. If we adopt a broader definition of copresence, electronic proximity can also engender a sense of copresence. Indeed, Slater et al. (2000) and other researchers (e.g., Biocca et al. 2003) define *virtual copresence* as a subjective feeling of being together with others in a virtual environment.

Nash et al. (2000) and Lombard and Ditton (1997) review the factors that promote a sense of presence or copresence in a virtual environment. First, interactivity and the speed of interaction can affect presence (Khalifa and Shen 2004). For instance, using synchronized communication tools such as chat room and instant messenger may give rise to a sense of being together. Second, medium vividness—whether users can sense the presence of each other in a manner similar to the real world—influences a sense of copresence. For example, some online communities explicitly show which members are currently connected online, or provide information about what an online user is doing, e.g., reading a message or typing a reply. The use of such features may improve an individual's sense of copresence with other community members.

As reviewed earlier, a sense of accountability can be manipulated by the presence of others. Simply put, when a person believes that others are present, she exerts more effort in seeking social information such as others' reactions to her pronouncements. This information helps individuals better comprehend their own identities as seen by others (Erickson et al. 2002, Erickson and Kellogg 2000, Gerhard et al. 2002, Lerner and Tetlock 1999), which in turn may attenuate the attribution difference between members and lead to a high perceived identity verification. Furthermore, a feeling of copresence also motivates individuals to engage in more identity communication, facilitating the elimination of others' ignorance and bias toward themselves. Hence, we propose,

Hypothesis 4 (H4). *An online community member's use of community artifacts facilitating virtual copresence is positively related to his perceived identity verification.*

Persistent Labeling. Research on deindividuation suggests that people would be less concerned about their image and more likely to behave in a socially undesirable manner when communicating anonymously due to reduced accountability: they believe that the likelihood of being identified and evaluated is low in the absence of the physical body as a source of social legibility (Siegel et al. 1986). Even though the revelation of real-world identity (e.g., name or race) is not required for most online communities, users maintaining a permanent ID (label) online may perceive more accountability than those without a persistent label. Members who keep a label for a relatively longer time have usually gained more identity capital and are more identifiable—in other words, they are able to communicate their identity with greater fidelity. Moreover, intuitively, individuals who change their ID frequently are less likely to be recognized by others. One who believes she is able to communicate her identity successfully is more likely to perceive higher identity verification than one whose identity is masked from others. Therefore, we test

Hypothesis 5 (H5). *An online community member's use of community artifacts supporting persistent labeling is positively related to his perceived identity verification.*

Self-Presentation. People frequently use stereotypes to infer other community members' dispositions. However, an individual's actual identity can be very different from the stereotyped one. Self-presentation is a process to communicate one's identity, helping others form a more sophisticated and accurate understanding of "Who am I?" After observing an online sport community, Blanchard and Markus (2004) point out the importance of forming online identity through features such as signatures, and underscore the significance of identity communication for all members of the community. Others (Dominick 1999, Papacharissi 2002, Schau and Gilly 2003, Walker 2000) also argue that identity communication can be accomplished through the use of a personal Web page. In addition to signatures and personal Web pages, screen names and *avatars* (a visual symbol that usually reflects some personality) are frequently used in online communities for self-presentation purposes. For example, when we observed online communities to find out how individuals use community features, we encountered a member who explained in a post why he chose his screen name "tgskeeve":

> My personality was reminiscent to the bungling wizard "The Great Skeeve" in Robert Asprin's "Myth" series.... It's frightening how much Skeeve and I thought alike (ethic, philosophies, etc). I decided on

the handle.... This way I have been identifiable by others.

The selection of avatars expresses an individual's personality or social attitude, helping other members understand the social identity (the social categories that a person belongs to) or personal identity (distinguishing features that a person views as unchangeable) of the focal person (Golder and Donath 2004, Smith et al. 2000). Popular avatars include pop or movie stars, or customized avatars designed by the user. Some people use their own photos, which present appearance cues that are more physical. Self-presentation can also be accomplished through user profiles that may include any identity information about a user, such as photos, background, experience, interests, and habits.

Asymmetric information causes asymmetric attributions, i.e., others' lack of information of the focal person's environmental and personal characteristics. Experiments have found that providing the same information to both parties eliminates attribution differences (Hansen and Lowe 1976). A focal person actively using the community artifacts described above makes available her behavioral contexts, social associations, dispositional traits, and value systems to other community members, which, according to prior studies, may reduce attribution differences and lead to a high perceived identity verification.

Hypothesis 6 (H6). *An online community member's use of community artifacts facilitating self-presentation is positively related to his perceived identity verification.*

Deep Profiling. For efficient identity communication, personal and social identity information needs to be available to community users to construct a mental representation about others. Even though many identity cues typically found in the physical world are missing, computer-mediated communication could have some advantages over face-to-face communication. For instance, in an online community with a ranking system (i.e., a user can be rated by others based on her expertise, trustworthiness, contribution, or other criteria) or an interaction archive (where previous social interactions among members are recorded and available to all members), or both, a great deal of social and identity information is already available to the new users. As a result, the pace of relationship building and interpersonal recognition can be accelerated in communities offering such features. Furthermore, ranking systems and archives serve as an extended memory of social information, helping users, especially new members of a community, to learn about and understand a focal person's identity.

Following the logic of attribution theory, community artifacts in this category help reduce attribution differences and promote perceived identity verification by others. Community archives record context information of previous social interactions that is more accurate than traditional mechanisms such as word of mouth. As explained earlier, a lack of awareness of an actor's behavioral contexts may result in attribution difference. Therefore, interaction archives with context information help observers understand the identity of the focal person. Additionally, user directories and efficient archive search tools help users find others' identity information more easily. For example, many forums allow users to search for posts by a particular member. This feature helps other members find rich identity information about the focal person such as what his expertise is (i.e., where does he always post an answer) and who he likes to interact with frequently. Therefore, we test

Hypothesis 7 (H7). *Other online community members' use of community artifacts supporting deep profiling is positively related to the focal person's perceived identity verification.*

2.4. Control Variables

Besides the use of community artifacts proposed in Hypotheses 4–7, we control for the effects of two other variables that may influence the level of perceived identity verification. First, individual tenure in an online community can have a positive effect on perceived identity verification. Members who have been with an online community for a longer time are shaping and communicating their identities in day-to-day interactions with other members, and therefore may perceive a higher confirmation between self-views and others' views. Second, identity communication can be broadened and reinforced during face-to-face communication, where community members are able to express and obtain more identity cues

(Fulk et al. 1987). Thus, offline activities may be positively related to perceived identity verification.

Knowledge contribution can potentially be affected by group identification, a construct that builds on the theory of social identity (Tajfel 1978, Tajfel and Turner 1986). Individuals may engage in more pro-social behavior (i.e., knowledge contribution) in order to benefit the group and to be perceived positively by group members (e.g., Constant et al. 1996, Ellemers et al. 2004, Simon et al. 2000). In addition, people tend to be more satisfied with the group with which they identify (i.e., favoring in-group over out-group members), which subsequently may influence knowledge contribution.

A second variable that can potentially influence knowledge contribution is information need fulfillment (Dholakia et al. 2004, Flanagin and Metzger 2001). When individuals fulfill their information need, they are more likely to reciprocate others' favor by contributing knowledge. Moreover, human behavior is goal oriented and people tend to be satisfied when their information acquisition goal is realized in an online community. Finally, people who have been with a community for a long time and who have met with other members offline frequently might be more engaged in community development and more likely to help contribute to the group—hence, we include them as control variables as well. To summarize, we exclude the variance explained by four variables—group identification, information need fulfillment, tenure, and offline activities—in the outcome of knowledge contribution.

3. Research Methodology

3.1. Data Collection

We tested the hypotheses using primary survey data collected from two online communities. The first research site, QuitNet (at quitnet.com), is an online emotional support community for people who want quit smoking. It was launched on the Web in 1995 by a smoking cessation counselor, and was later supported by the Boston University School of Public Health. About 3,000 messages are posted on QuitNet every day. According to the site, it has more than 60,000 smokers and ex-smokers all over the world that interact online. The second research site, IS300 (at is300.net), is an online community for owners and potential owners of the Lexus IS300 sport sedan. It launched online in 1999, and has about 26,000 registered members (active and inactive). The two research sites selected represent two distinct types of online communities categorized by Armstrong and Hagel (1996): a community of relationship or emotional support (QuitNet) and a community of common interest or information exchange (IS300). Through the inclusion of two communities, we sought to extend the generalizability of the findings by exploring the importance of perceived identity verification and the similarity of member behaviors across different settings.[3]

To minimize the possibility of common method variance, we collected data using Web-based surveys in two stages (Podasakoff et al. 2003). The first survey included questions measuring the usage of various community IT features and perceived identity verification; the follow-up survey, adminstered two weeks later, included the measurement of satisfaction and knowledge contribution. Both communities agreed to advertise our study to their members. The study was announced through QuitNet's private message systems on March 15, 2005, only to U.S. users so that variance caused by other factors such as language and culture could be minimized. Two weeks after the first survey, we sent a link to the follow-up survey to users who completed the first survey. After another week, a reminder was sent to those who had not filled out the follow-up. In total, 500 complete responses from QuitNet were received. According to QuitNet, there were 3,769 unique U.S. users logged on to QuitNet during the data collection period, yielding an effective response rate of 13.3%. The data collection at IS300 followed a similar procedure with a response rate of 21.0%.

[3] The other two types of communities classified by Armstrong and Hagel (1996) are communities of fantasy and communities of transaction. People participate in communities of fantasy for role playing, where they can pretend to be somebody else and temporarily escape reality. Such communities are game oriented and rely less on the prosocial behavior of individual members. Communities of transaction such as Amazon.com and eBay.com facilitate business transactions and delivery. They likewise rely less on the prosocial behavior of individual members to succeed. Because the focus of this study is on knowledge contribution, we did not study these two types of communities.

Table 2 Demographic Information of Respondents

	QuitNet ($N = 500$)	IS300 ($N = 166$)
Gender*		
Male	105 (21.5%)	155 (95.1%)
Female	383 (78.5%)	8 (4.9%)
Age*		
18–25	29 (5.9%)	82 (49.7%)
26–35	122 (24.6%)	65 (39.4%)
36–45	147 (29.7%)	12 (7.3%)
46–55	153 (30.9%)	5 (3.0%)
>55	44 (8.9%)	1 (0.6)
Education*		
2 years high school	8 (1.6%)	1 (0.6%)
4 yrs high school	118 (23.6%)	20 (12.0%)
2 years college	165 (33.0%)	51 (30.7%)
4 years college	97 (19.4%)	52 (31.3%)
>4 years college	111 (22.2%)	41 (24.7%)
Internet experience (years)*	8.33 (S.D. = 3.90)	9.38 (S.D. = 2.82)
Tenure (months)	12.10 (S.D. = 15.53)	24.34 (S.D. = 15.39)

*Due to missing values, the sum of numbers may be smaller than sample size.

Table 2 presents the demographic profile of the respondents. The QuitNet sample is dominated by women with a higher average age than the IS300 sample, while an overwhelming majority of IS300 respondents are men. Respondents from both communities are well educated (approximately 70% in QuitNet and more than 80% in IS300 have college degrees) and have significant Internet experience (more than eight years for both communities). Finally, all respondents have been members of their respective online communities for a substantial period of time (one year for QuitNet and two years for IS300).

To test for possible nonresponse bias, we compared means for all the major variables and demographics for early respondents and late respondents (Oppenheim 1966).[4] The results of t-tests for the demographic profiles, perceived identity verification, community tenure, satisfaction, group identification, etc. are not significant. The only significantly different construct is knowledge contribution, suggesting, not surprisingly, that the more active participants tend to respond earlier.

3.2. Operationalization of Key Constructs

Survey items are provided in the appendix. They are either adapted from existing scales or developed for this study. To develop the scales for this study, we conducted exploratory interviews with seven community members not in our sample from five different communities to identify what IT-based features they used. We also conducted a pilot test with 50 individuals to validate the new instrument.

We measure four exogenous variables: the use of community artifacts supporting virtual copresence, persistent labeling, self-presentation, and deep profiling. These four variables are measured with multi-item instruments that ask respondents to rate the extent to which they use each community feature listed in Table 1. The use of virtual copresence and self-presentation artifacts should not be treated as unidimensional because individuals may use multiple community features to communicate their identities. The use of one artifact may not imply the use of another one, although it would increase the overall level of feature usage. For example, a user may use chat room intensively but not use instant messenger. Hence, the use of any artifact combines to define a construct (which are formative indicators), instead of as the manifestation of a unidimensional construct (which are reflective indicators) (Bollen 1989).

As virtual copresence and self-presentation are modeled as formative constructs, the recommendations by Diamantopoulos and Winklhofer (2001) on formative index construction are followed. Unlike scale development for reflective measures, the validation of formative indicators uses different criteria. Because the latent variables are determined by their indicators instead of vice versa, failure to consider any aspect of the latent variable will lead to an exclusion of relevant indicators and therefore part of the latent variable itself (Nunnally and Bernstein 1994). To address this issue, we conducted an extensive literature review and exploratory interviews with researchers, industry professionals, and online community members to ensure that the indicators selected cover the complete content domain of the latent variables.

The other two independent variables, persistent labeling and deep profiling, are more appropriately

[4] Sample attrition from the first to second phase of data collection was 113 for QuitNet and 49 for IS300. T-tests for differences in artifact use across those that completed only the first survey and those that completed both surveys yields a significant difference for only one artifact—virtual copresence in QuitNet. None of the differences are significant for IS300.

measured using reflective items. As shown in the appendix, respondents were asked whether they use a single-user ID or multiple IDs. These two items measuring persistent labeling should be highly correlated. For the measurement of deep profiling, the indicators are likely to be correlated as reflective items as well, because, as opposed to measuring the use of features directly, deep profiling is measured as a focal person's perception of others. The focal person may not know exactly what specific deep profiling features others use, but she probably has a general sense regarding the overall use of other members.

We used a modified Twenty Statements Test (TST) introduced by Kuhn and McPartland (1954) to capture salient identities of each community member. The TST asks respondents to fill in the blank for 20 statements such as "I am ——." It is an open-ended identity measure that has been adapted and used in numerous studies (e.g., Hong et al. 2001, Rhee et al. 1995) and validated by Kuhn and McPartland (1954) and Driver (1969) using independent criteria. The TST specifically acknowledges that an individual can have multiple identities and that different identities may become dominant in different contexts. We asked respondents to complete statements like "In *** (the name of the community), I am ——." Also, consistent with previous studies, we reduced the number of items from 20 to 5 to minimize the effects of fatigue. After completing the TST, the respondents were asked to rate their perception of other community members' verification of those five identities separately, using two items (see appendix). We used two items for each solicited identity, yielding 10 items in total. Factor analysis showed that only the items for the first two identities load on their corresponding factors, most likely because the first two identities were most salient for the subjects. Hence, four items used to measure perceived identity verification are retained.

Finally, we adopted the knowledge contribution measures integrated from Wasko and Faraj (2005), and Koh and Kim (2003).

4. Results

4.1. Statistical Technique

The theoretical model is multistage, suggesting the need for a structural equation modeling technique that simultaneously tests multiple relationships. We use PLS as the main statistical technique. PLS is widely accepted as a method for testing theory in early stages, while LISREL is usually used for theory confirmation (Fornell and Bookstein 1982). Furthermore, LISREL cannot handle formative constructs as conceptualized for some of the study's variables (Chin 1998, Fornell and Bookstein 1982). Finally, PLS places minimal demands on variable distributions. Some of our variables are not strictly normal distributed, which may cause problems for factor-based covariance approaches using software such as LISREL and AMOS (Chin et al. 2003).

4.2. Measurement Model

To validate the measurement model, reliability, discriminant validity and convergent validity were assessed for the reflective indicators. Table 3 shows the descriptive statistics of major variables and Cronbach's α. Note that virtual copresence and self-presentation were measured with formative indicators, and thus the assessment of α and factor analysis is not applicable (Edwards 2001). Overall, the reliability of the measurement scales is good. All αs are greater than 0.7 except one ($\alpha = 0.68$), which is very close to the recommended cutoff. Means for most variables except offline activities are similar across the two sites. IS300, members (Mean = 2.74) generally had more offline activities than QuitNet members (Mean = 1.47). Self-reported perceived identity verification in both communities is slightly below neutral (Mean = 3.84 and 3.50, respectively).

Table 3 Descriptive Statistics and Measurement Reliability

	QuitNet			IS300		
Construct	Mean	S.D.	Cronbach's α	Mean	S.D.	Cronbach's α
Knowledge contribution (KNO)	5.32	1.17	0.89	5.56	1.10	0.91
Satisfaction (SAT)	6.42	0.72	0.68	6.19	0.81	0.76
Perceived identity verification (PIV)	3.84	0.88	0.91	3.50	1.02	0.89
Virtual copresence (VC)	3.83	1.18	NA	3.32	1.05	NA
Persistent labeling (PL)	6.53	0.94	0.82	6.56	0.90	0.83
Self-presentation (SP)	3.93	1.15	NA	3.77	1.23	NA
Deep profiling (DP)	4.67	1.14	0.77	4.15	1.25	0.82
Group identification (GI)	4.89	1.32	0.90	4.32	1.32	0.90
Information need (INF)	3.97	0.88	0.89	4.09	0.92	0.90
Offline activities (OFF)	1.47	1.03	0.88	2.74	1.78	0.94

Table 4 Result of Factor Analysis with a Promax Rotation

	KNO	SAT	PIV	PL	DP	GI	INF	OFF
KNO1	0.78, 0.82							
KNO2	0.78, 0.85							
KNO3	0.93, 0.85							
KNO4	0.91, 0.85							
SAT1		0.84, 0.86						
SAT2		0.66, 0.67						
PIV11			0.86, 0.84					
PIV21			0.86, 0.82					
PIV12			0.87, 0.90					
PIV22			0.77, 0.86					
PL1				0.90, 0.85				
PL2R				0.94, 0.95				
DP2					0.89, 0.89			
DP3					0.89, 0.67			
DP4					0.70, 0.90			
GI1						0.86, 0.74		
GI2						0.79, 0.84		
GI3						0.93, 0.90		
GI4						0.82, 0.86		
GI5						0.66, 0.79		
GI6						0.80, 0.78		
INF1							0.74, 0.79	
INF2							0.88, 0.88	
INF3							0.87, 0.82	
INF4							0.87, 0.96	
INF5							0.82, 0.80	
OFF1								0.80, 0.82
OFF2								0.91, 0.90
OFF3								0.89, 0.92
OFF4								0.88, 0.93

Notes. Loadings are reported in order of QuitNet, and IS300. Loadings smaller than 0.40 are not reported. Total variance explained: 73.50% for QuitNet and 77.69% for IS300.

KNO = knowledge contribution; SAT = satisfaction; PIV = perceived identity verification; PL = persistent labeling; DP = deep profiling; GI = group identification; INF = information need fulfillment; OFF = offline activities.

Table 4 provides the rotated loadings of principal components factor analysis. Because we expected the underlying factors to be correlated, we utilized a Promax rotation. (Further analysis found very similar loadings using a common Varimax rotation method.) For easier comparison, loadings are reported side by side for the two sites, in order of QuitNet and IS300. The results indicate that indicators load more strongly on their corresponding construct (≥ 0.66) than on other factors in the model (≤ 0.40). Table 5 shows the correlations between constructs, Fornell consistency, and the average variance extracted (AVE). To assess discriminant validity, AVE should be larger than the correlations between constructs, i.e., the off-diagonal elements in Table 5 (Chin 1998, Fornell and Larcker 1981). All constructs meet this requirement. Similar to Cronbach's α, composite reliability is a measure of internal consistency. Unlike Cronbach's α, the composite reliability takes into account the actual loadings used to construct factor scores, and thus is a better measure of internal consistency. All composite reliability values (for reflective measures) are greater than 0.80, indicating good internal consistency.

We use an alternative reflective measure of perceived copresence adapted from a previous study (Biocca et al. 2003; see our appendix) to validate our formative construct. The significant correlation (0.39 for QuitNet and 0.48 for IS300, $p < 0.01$) between perceived virtual copresence and the use of IT artifacts supporting virtual copresence provides additional

Table 5 Construct Correlations, Discriminant Validity, and Reliability

	Composite reliability	SAT	KNO	PIV	VC	PL	SP	DP	GI	INF	OFF
QuitNet											
SAT	**0.87**	**0.76**									
KNO	**0.92**	0.52**	**0.75**								
PIV	**0.90**	0.35**	0.50**	**0.70**							
VC	**NA**	0.25**	0.39**	0.35**	NA						
PL	**0.90**	0.20**	0.21**	0.15**	0.084	**0.83**					
SP	**NA**	0.26**	0.45**	0.34**	0.39**	0.11*	NA				
DP	**0.87**	0.24**	0.47**	0.44**	0.37**	0.16**	0.43**	**0.68**			
GI	**0.92**	0.39**	0.33**	0.25**	0.31**	0.05	0.32**	0.29**	**0.67**		
INF	**0.92**	0.32**	0.22**	0.11*	0.20**	0.03	0.27**	0.19**	0.44**	**0.70**	
OFF	**0.92**	0.05	0.26**	0.18*	0.23**	−0.10*	0.34**	0.23**	0.13**	0.02	**0.75**
IS300											
SAT	**0.90**	**0.81**									
KNO	**0.94**	0.57**	**0.79**								
PIV	**0.92**	0.27**	0.54**	**0.73**							
VC	**NA**	0.24**	0.30**	0.28**	NA						
PL	**0.87**	0.05	0.15	0.19*	0.08	**0.77**					
SP	**NA**	0.24	0.39**	0.28**	0.41**	−0.01	NA				
DP	**0.90**	0.20*	0.42**	0.39**	0.41**	0.13	0.57**	**0.75**			
GI	**0.92**	0.28**	0.22**	0.35**	0.33**	0.15	0.31**	0.34**	**0.67**		
INF	**0.93**	0.27**	0.15	0.07	0.24**	0.25**	0.27**	0.10	0.34**	**0.72**	
OFF	**0.96**	0.25**	0.48**	0.44**	0.41**	0.14	0.40**	0.43**	0.26**	0.25**	**0.85**

Notes. Composite reliability: $\rho_c = (\Sigma\lambda_i)^2/((\Sigma\lambda_i)^2 + \Sigma\Theta)$; AVE $= \Sigma\lambda_i^2/(\Sigma\lambda_i^2 + \Sigma\Theta)$; $\Theta_i = 1 - \lambda_i^2$.

**Correlation is significant at the 0.01 level (two-tailed); *Correlation is significant at the 0.05 level (two-tailed).

SP = self-presentation; KNO = knowledge contribution; SAT = satisfaction; PIV = perceived identity verification; VC = virtual co-presence; PL = persistent labeling; DP = deep profiling; GI = group identification; INF = information need fulfillment; OFF = offline activities.

supporting evidence for the validity of the formative virtual copresence indicators (Diamantopoulos and Winklhofer 2001).

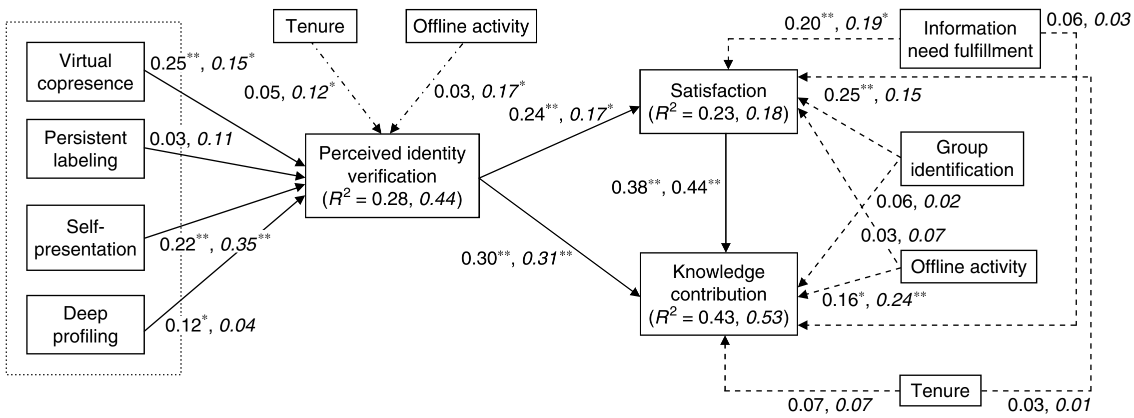
4.3. Hypothesis Tests

We use PLS Graph Version 3.00 to test the structural model.[5] Following Chin (1998), bootstrapping was performed to test the statistical significance of path coefficients. As shown in Figure 2, exogenous variables explain considerable proportions of the variance—28% and 44% for perceived identity verification and 43% and 53% for knowledge contribution. Data from QuitNet support Hypotheses 1, 2, 3, 4, 6, and 7. Data from IS300 support Hypotheses 1, 2, 3, 4, and 6. In both communities, perceived identity verification significantly and positively relates to knowledge contribution (H1) directly, indirectly, and mediated by satisfaction (H2, H3). This is consistent with self-verification theory that individuals always want to be understood as who they think they are, regardless of whether the interaction is occurring in a virtual or physical world. Both communities also support the posited links between self-presentation (H6) and virtual copresence (H4) and perceived identity verification. However, the relationship between persistent labeling and perceived identity verification (H5) is not supported in either community. Furthermore, the relationship between deep profiling and perceived identity verification (H7) is significant for QuitNet but not for IS300.

To investigate the salience of perceived identity verification further, we applied Baron and Kenny (1986)'s method to verify its mediating role in the relationship between community IT artifacts and knowledge contribution. Two additional PLS models were run, one containing only direct paths, and the other containing both direct and mediated paths. Considering the increased number of paths, only data from QuitNet

[5] Although the distribution of the constructs is similar across the two communities, the structural model with community type included as a control yielded a significant coefficient for community type. Therefore we elected not to pool the data (see Figure 2).

Figure 2 PLS Results



Notes. Coefficients are reported in order of QuitNet, and IS300 (path coefficients for IS300 shown in Italic). We decided not to combine the results from two communities because (1) they are two different types of communities according to Hagel and Armstrong (1997) and hence, the potential for different impacts of technology artifacts and perceived identity verification exists; (2) we added SITE as a dummy variable in regressions and it has significant coefficients with both perceived identity verification and knowledge contribution.
*Denotes significance at the $p < 0.05$ level.
**Denotes significance at the $p < 0.01$ level.

were used for this test due to the relatively small sample size from IS300. Table 6 shows the PLS path coefficients. Although there are direct links between the use of some IT artifacts and the mediating and dependent variables, their magnitude decreases when perceived identity verification is added to the model. Hence, according to Baron and Kenny (1986), the perceived identity verification construct is in fact a strong mediator. In addition, we conducted the Sobel test (MacKinnon et al. 2002, Sobel 1982) to further evaluate the mediating effect of perceived identity verification, and found significant z-values for all dependent and independent variable pairs, indicating strong mediation.

4.4. Addressing Common Method Variance

Common method variance is a potential threat to internal validity, particular to research using surveys that collect responses in a single setting. We addressed this threat in a variety of ways. First, as noted earlier, data were collected in two stages, with predictor and outcome measurement separated in time. Second, a factor analysis was performed to test for the potential of common method variance in the data set. According to Harman's one-factor test, the threat of common method bias is high if a single factor can account for a majority of covariance in the independent and dependent variables (Podasakoff et al. 2003). Our factor analysis did not detect a single factor explaining a majority of the covariance. Third, the number of posts during the two weeks before the survey was collected from the sites and its correlation with self-reported knowledge contribution was assessed. There is a significant correlation (0.22 for QuitNet and 0.33 for IS300, $p < 0.01$) between self-reported knowledge contribution and the number of posts, further underscoring the reliability of knowledge contribution measures.

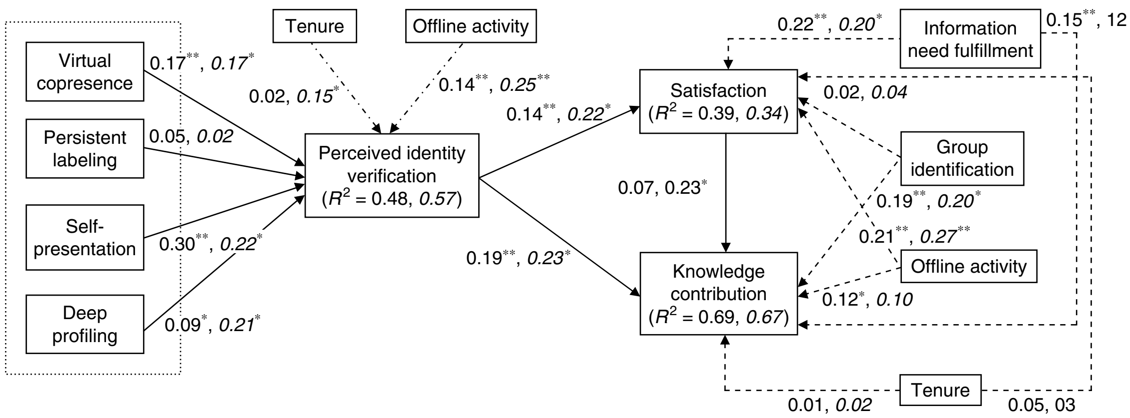
Finally, following the procedure recommended by Podsakoff et al. (2003), we included a common method latent variable in our research model and refitted the structural model in PLS Graph. The path coefficients and R^2 are shown in Figure 3. The result indicates that, while the method factor does improve R^2 significantly based on a pseudo F test (see Subramani 2004), it accounts for only a small portion

Table 6 Path Coefficients of PLS (Test for Mediating Effects)

	Nonmediated model		Model with perceived identity verification as mediator	
Dependent variable	Satisfaction	Knowledge contribution	Satisfaction	Knowledge contribution
Virtual copresence	0.28**	0.14*	0.18*	0.03
Persistent labeling	0.11	0.06	0.12	0.02
Self-presentation	0.23**	0.47**	0.14*	0.21**
Deep profiling	0.04	0.10*	0.00	0.08

*Denotes significance at the $p < 0.05$ level; **denotes significance at the $p < 0.01$ level.

Figure 3 PLS Results with Common Method Variance Partialed Out



*Denotes significance at the $p < 0.05$ level. **Denotes significance at the $p < 0.01$ level.

of variance (Carlson and Kacmar 2000). More specifically, 13%–26% of the variances are accounted for by the method factor, similar to the level (16%–42%) observed by Williams et al. (1989). This suggests that common method variance is not likely to be the only source of variance in the dependent variables. The introduction of the method factor also does not change the significance of the majority of the hypotheses. The only differences are that the hypothesis for deep profiling (H7) is supported in both communities in this model, whereas in the model without a common method factor, deep profiling is not significantly related to perceived identity verification for the Lexus community, and the link between satisfaction and knowledge contribution (H3) is not significant for QuitNet.

5. Discussion and Implications

5.1. Discussion

Despite the rapid growth of online communities and the wide use of various community technologies, a systematic theory relating the design of community technology to knowledge contribution behavior is lacking. The goal of this study was to propose and test such a theory. To this end, we developed a theoretical model centering on the key motivating role of perceived identity verification in knowledge contribution, and argued why and how the use of community IT features influences perceived identity verification. Surveys were conducted in two online communities (one emotional-support community and one common-interest community) to provide empirical support for the structural model. Although scholars have addressed the issue of identity formation and knowledge contribution in online communities, much of the extant research is either qualitative and ethnographic in nature (e.g., Jacobson 1999), or is research in which technology features have not been a central concern. This study represents one of the first attempts to quantitatively measure the impact of community infrastructure design and identity verification in computer-mediated communication.

Overall, the findings provide strong empirical support for the proposed relationships. The first important conclusion is that in both communities perceived identity verification from other people has important consequences with regard to members' perceptions of satisfaction and their knowledge contribution behavior. In other words, when individuals felt that other community members verified their salient identities (personal or social, or both), they were more satisfied with their community experiences, and more likely to participate in knowledge contribution. This finding extends previous evidence linking self-verification to satisfaction and group identification in an offline context (e.g., Swann 1983). The fact that identity verification is also important for computer-mediated communication indicates that a need for mutual understanding is important not only for face-to-face communication (e.g., De La Ronde and Swann 1998, Goffman 1959), but also for smooth online social interaction, where an individual may choose not to disclose his real name.

In everyday parlance, the word "identity" sometimes is used interchangeably with the word "name" or other identification information. However, throughout this paper, the identity that we refer to is a different and considerably richer concept defined in social psychology that includes an individual's personality, social background and roles, and value systems. In an online context, community members do not need to be known by their real names, but by their screen names, together with their online personality, social roles, and value systems. The perceived mutual understanding of such online identity is found to predict satisfaction and knowledge contribution.

Another aspect of the findings that is consistent with previous research on identity is that individuals assume multiple identities in the same online community. Participants' answers to the question "In this community, who are you?" surfaced both personal identities and social identities (see Brewer and Gardner 1996 for a discussion of personal and social identity). Sample personal identities are "helpful," "quiet," "happy," "scared," "encouraging," "knowledgeable," "funny," "healthy," and "active." Examples of social identities include "woman," "teacher," "lurker," "democrat," "daughter," and "nonsmoker."

In addition to establishing the links between perceived identity verification and satisfaction and knowledge contribution, our findings also show that the active use of some IT features supporting identity communication significantly relates to perceived identity verification ($R^2 = 0.28$ and 0.44). Though results from the two communities are slightly different in terms of significance level, overall the use of IT artifacts (and therefore their availability) is an important driver of online knowledge contribution. Data from both communities show support for the use of three out of four artifacts relating to perceived identity verification when common method variance is partialed out (Figure 3).

An unexpected finding is that data from both communities failed to support the hypothesis on persistent labeling. According to the interviews conducted before data collection and the observation of multiple online communities, we found that users usually change their ID or use multiple IDs for the following reasons: (1) The old ID did not work anymore (for example, the old ID was temporally banned or the old password was forgotten). (2) Two or three IDs were used simultaneously for some reason (e.g., to obtain more community space and resources). (3) An individual wanted to change her ID to reflect her current preference or mood. (4) The old ID was stolen or became a target of spam. In most instances, individuals informed other community members that they had changed ID or used multiple IDs. This possibly explains the weak link between persistent labeling and perceived identity verification. Being informed of the change of ID, other users would know to whom the new ID belonged before, and their understanding of the focal person's identity would likely not be influenced by the use of a different ID.

5.2. Limitations

Prior to discussing the implications of our findings, we acknowledge the limitations of this study. First, although we have a sample size that is more than adequate for testing the theoretical model, members from only two communities were surveyed. Hence, some of the findings reported here may not extend to other community settings. Furthermore, it is possible that identity communication and verification is somewhat context dependent. As indicated in our findings, path coefficients and significance are different for the two sites studied. Additional investigation with other types of online communities is necessary to generate findings that are more robust and generalizable.

Second, because of the cross-sectional design of this study, no causation can be determined. The significant paths between constructs can only be interpreted as correlational; the causal inferences are based solely on theoretical argumentation. We acknowledge the possibility of recursive relationships between our constructs. For instance, knowledge contribution may be an effective mean of self-presentation. However, it is also possible that individuals describe themselves in detail in their profiles and linked homepages or convey other evocative information through their screen names and avatars so they can be understood to some extent before participating. Further studies employing longitudinal or experimental designs would help illuminate the causal relationship between constructs. A longitudinal study that relates perceived identity verification to longer-term member activity and behavior would enrich our findings further, as well.

Finally, while we proposed that other online community members' use of community artifacts supporting deep profiling is positively related to the focal person's perceived identity verification (H7), we measured the focal person's perception of others' deep profiling instead, which may potentially be confounded with the perceived identity verification measure. However, earlier we noted that perceptions are key drivers of behavior, independent of their accuracy. Moreover, with hundreds of respondents from each community, it would be extremely difficult for an individual to have objective knowledge about every other community member, and for the researcher to collect the extent to which each individual deep profiles (e.g., checks another's posting history, ranking, and feedback) every other individual in the same community. Our empirical results indicate that the measures of deep profiling and perceived identity verification discriminate the two constructs adequately. Nonetheless, to the extent that it is feasible to obtain valid measures, future research should consider using ways of assessing of deep profiling that are more objective.

5.3. Contributions and Implications for Theory

This study makes several important contributions to the research literature. First, the concept of identity verification that has been studied in an offline environment was applied to an online setting and its motivational role in computer-mediated knowledge sharing was empirically investigated. Although many researchers have reflected on the importance of identity formation in online communities (Donath 1999, Turkle 1995), very few have quantified the concept and investigated it with a large sample. We theoretically integrate the identity verification construct into online community research. Empirical results and interviews show that perceived identity verification is a critical factor that motivates knowledge contribution. This understanding of the role of identity in computer-mediated communication can potentially shed light on collaboration in virtual teams or online communities of practice.

Second, the technology-based antecedents of perceived identity verification were explored and empirically tested. We particularly focused on online community design features that can help efficient and effective identity communication. Investigation of online community design can help us better understand what features of the community technology can efficiently motivate online knowledge contribution. Drawing on attribution theory and self-presentation theory, we provided a theoretical explanation for how the use of four categories of online community artifacts (virtual copresence, persistent labeling, self-presentation, and deep profiling) improves perceived identity verification. The empirical results suggest that these features (except persistent labeling) of online communities are critical for perceived identity verification, and thereafter, for knowledge contribution. This study bridges the gap between online community design practice and research by theoretically and empirically exploring why features such as rating systems and user profiles help motivate knowledge contribution.

Third, by testing the proposed theory in two representative but different types of online communities, we are confident that the key concept—perceived identity verification—can be applied to various kinds of online communities, including information-exchange communities and emotional-support communities. Although we find the site dummy variable to be significant, which implies the need for further investigation of the more nuanced impact of community types, our major hypotheses are supported in both communities. Finally, the framework developed in this study can be applied not only to online communities, but also to other research areas such as online knowledge creation, accumulation, and dissemination. The framework offers a fresh perspective on computer-mediated coordination and collaboration that has broader research implications and can serve as the foundation for future research. For example, it could be applied to enrich our understanding of the practice of online knowledge management using technologies such as WiKis and Webblogs that have recently attracted significant attention.

Fourth, the finding that perceived identity verification only partially mediates the effects of community IT features on knowledge contribution yields two implications. One, it suggests a need to seek further explanations for why technology affects knowledge contribution, and to extend the model with direct relationships or through additional mediators.

Though we primarily focus on the mediating effect of perceived identity verification in this paper, alternative theoretical perspectives may exist to explain the link between technologies and prosocial behavior. For example, symbolic interactionism argues that individuals adjust their reactions and attitudes according to their interpretation of others' behavior. Therefore, to interact smoothly, an accurate interpretation based on mutual understanding and shared social norms is necessary. Using the community artifacts facilitating communication promotes a sense of familiarity and interpersonal attraction, which may lead to prosocial behavior (e.g., Clark and Brennan 1991). And two, further research is required to understand what other factors can influence perceived identity verification such that knowledge contribution can be amplified through alternative mechanisms.

In sum, our findings of the important role of perceived identity verification in online knowledge contribution open up rich and exciting opportunities for theoretical extensions to the present model and practical development of new online community features. In essence, these findings suggest that there is a gap in previous research on prosocial behavior in computer-mediated communication. Formerly proposed factors such as group identification and generalized reciprocation (i.e., responding in kind to another who fulfills an information need) that we used as controls in the analysis cannot account for all the variance in individual behavior. Individuals' fundamental need for identity verification, which has been explored in an offline setting for decades, merits further investigation in online settings.

5.4. Implications for Practice

From a pragmatic perspective, organizations invest significant resources in developing the infrastructure for customer or employee online communities, with a goal of generating value. For example, eBay and Amazon rely on a strong customer community base to increase loyalty and satisfaction. Other organizations are investing extensively in online community infrastructures with the goal of facilitating employee communication and learning (Butler 2001). Virtual communities of practice are being constructed to facilitate peer-to-peer help (Constant et al. 1996), to foster new ideas and innovation (Teigland and Wasko 2003), and to build knowledge competencies (Saint-Onge and Wallace 2003). In contrast to prior work that has focused on factors such as group identification and reciprocation as drivers of knowledge contribution that are outside the control of community designers and administrators, this study yields pragmatic guidelines to promote active and successful online communities. In other words, the design of community infrastructures is informed by our findings.

While the specific community IT features described and studied in this paper are widely available in most online communities, the findings provide a general guideline for the development of new interactive features that support virtual copresence, self-presentation, and deep profiling beyond what is available now. For example, communities can consider allowing users to submit video clips that introduce themselves; design more-vivid online presentation mechanisms that are richer than a motionless avatar; visualize users' real-time activities in communities; and generate user profiles automatically from their past activities. Such features may simplify and encourage identity communication and verification and promote a more active online community. Although we did not find support for persistent labeling, we cannot conclude that practitioners should overlook its importance. As we discussed earlier, there are many possible reasons that people use multiple IDs; its impact requires further examination.

By understanding the key role of perceived identity verification in computer-mediated communication, this paper suggests that community design supporting effective identity expression and communication will lead to successful social structures in terms of voluntary knowledge contribution. As explained further below, managers of geographically distributed organizations can gain insight into the importance of identity management in a virtual team.

5.5. Future Research

IT and computer-mediated communication have become increasingly important due to the growing number of global organizations (Boudreau et al. 1998), and this importance will only continue to grow. The use of virtual teams is prevalent and, arguably, the performance of virtual teams can be directly or indirectly affected by the perceived identity verification of team members. For future research, it would be useful to quantitatively examine the impact of perceived identity verification on virtual teams. We believe that, for work-oriented virtual groups, perceived identity verification is also likely to be a significant predictor of team member contribution. Which type of identity (personal or group) is more critical in a virtual team setting? Prior research on work groups usually focuses on the positive effect of group identity, while we believe that the mutual understanding of individual identity is also a key factor for virtual team performance. This is a question worthy of further study.

Relatedly, additional work is needed to design new community functions, tools, or features supporting identity communication based on the theoretical framework proposed in this paper. Some HCI researchers are developing new community tools that can increase a sense of virtual copresence. For example, IBM has recently developed Babble and Loops, communication tools that provide visual feedback regarding who is currently present in a conversation.[6] Also, many communities use a reputation or ranking system to help individuals form their expert identity in particular areas. However, as highlighted throughout our discussion, identity is a significantly richer and more nuanced construct than reputation. Individual identity not only includes one's expertise, but also (online) social roles, personality, value systems, group affiliation, etc. Reputation or ranking systems commonly used today cannot capture such rich identity information, indicating the need to design new tools for facilitating richer and easier identity formation and communication online.

It would also be useful to apply the framework developed in this study to research computer-mediated knowledge creation and dissemination. For instance, Wikipedia relies on voluntary contributions and updates from a global community of users. Many researchers and practitioners are surprised by the speed and efficacy with which knowledge can be gathered from volunteers. There is increasing research interest in how the mechanisms underlying Wikipedia can be applied to organizational knowledge management. For future research, we can adopt a similar identity-based perspective to investigate whether identity verification promotes online knowledge creation, dissemination, and coordination.

Finally, the proposed framework focuses on the communication and verification of online identity. It would be interesting to examine the extent to which an individual's online identity is different from his real-world identity and the associated implications for effective identity communication. People who are dissatisfied with their identity in the real world or who want to try a new identity may well seek to establish a very different identity online. It would also be interesting to study the extent to which community members disclose their real identities online. Although we believe that people want to be understood and identified as who they are even in a virtual world, inevitably such desires must be traded off against privacy and safety concerns. Mechanisms that not only help individuals reveal their identity but also safeguard privacy are worth further study.

[6] More information about Babble and Loops is available online at http://www.research.ibm.com/SocialComputing/.

Appendix. Construct Measures and Sources

Use of Virtual Copresence Artifacts

(Adapted from Biocca et al. 2003 and Schroeder et al. 2001.)

Formative

I use instant messenger to talk to people from this community frequently.

I use chat room to talk to people from this community frequently.

I am usually aware of who are logged on online.

I pay attention to others' online or offline status in this community.

I find that people respond to my posts quickly.

I find that people respond to my private messages quickly.

Reflective Measure of Perceived Virtual Copresence (Used for Validation)

To what extent, if at all, did you ever have a sense of "being there with other people" in this community?

To what extent, if at all, did you have a sense that you were together with other members in the virtual environment of this community?

Use of Persistent Labeling

I consistently use a single ID to communicate with other members in this community.

I use more than one ID in this community (reversed).

Use of Self-Presentation

I tell my stories to other community members in this community.

I share my photos or other personal information with people from this community.

I express my opinions in my posts.
I present information about myself in my profile.
I use a special (or meaningful) signature in this community that differentiates me from others.
I use a special (meaningful) name or nickname in this community that differentiates me from others.
I let other community members visit my personal Web page.

Use of Deep Profiling
I think that other people consider my ranking (reputation) when they interact with me.
I think that other people search the archive to find out more about me.
I think that other people have read my previous posts.
I think that other people look at my profile to find out more about me.

Scale: Strongly disagree → Strongly agree (1–7 scale); or Never → Always (1–7 scale).

Perceived Identity Verification
(Adapted from Twenty Statement Test (TST) Kuhn and McPartland 1954.)
Below are five fill-in-the-blank areas for you to answer the question "In this community, who am I?" Simply type in an answer next to the numbered item and make each answer different (e.g., high, smart, happy, animal-lover, antisocial, dependable, conservative, student, computer geek, Linux expert, father, board master, Democrat, Catholic, woman, engineer, Asian, etc.). Answer as if you were giving the answers to yourself, not to somebody else. Write the answers in the order that they occur to you. There are no right or wrong answers.

1. In this community, I am ——.
2. In this community, I am ——.
3. In this community, I am ——.
4. In this community, I am ——.
5. In this community, I am ——.

Please think about your interactions with people in this community and indicate the extent to which others know that you define yourself as... (list the five responses just answered by the respondent one by one).
Other people in this community understand that I am (list the five items just answered by the respondent one by one).

Scale: Not at all → Very much (1–7 scale).

Satisfaction
(Adapted from Duffy et al. 2000)
All in all, I am satisfied with my experience in this community.
Overall, I am pleased to interact with other people in this community.

Scale: Strongly disagree → Strongly agree (1–7 scale).

Knowledge Contribution
(Adapted from Wasko and Faraj 2005, Koh and Kim 2003.)
I often help other people in this community who need help/information from other members.
I take an active part in this community.
I have contributed knowledge to this community.
I have contributed knowledge to other members that resulted in their development of new insights.

Scale: Strongly disagree → Strongly agree (1–7 scale).

Group Identification
(Adapted from Mael and Tetrick 1992.)
When someone criticizes this community, it feels like a personal insult.
This community's successes are my successes.
When someone praises this community, it feels like a personal compliment.
I'm very interested in what others think about this community.
When I talk about this community, I usually say "we" rather than "they"
If stories in the media criticize this community, I would feel bad.

Scale: Strongly disagree → Strongly agree (1–7 scale).

Tenure
On average, how many hours per week do you spend in this community?
How many months have you been a member of this community?

Offline Activities
(Adapted from Koh and Kim 2003.)
I contact other members from this online community by phone.
I meet other members from this online community in informal offline meetings.
I actively participate in the regular offline community meetings with other members.
I participate in a variety of offline activities held for this online community.

Scale: Never → Always (1–7 scale).

Information Need Fulfillment
(Adapted from Dholakia et al. 2004.)
The extent to which this online community helps you:
To get information
To learn how to do things
To generate ideas
To solve problems
To make decisions

Scale: Not at all → Very much (1–7 scale).

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