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Completed Research Paper

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Abstract

While the question how community design influences user behaviors in online communities has recently attracted considerable research, few studies empirically evaluate the influencing factors of specific user behaviors. Building on Ren et al.'s (2007) conceptual framework of identity-based vs. bond-based attachment in online communities, this study evaluates the influence of numerous antecedents on user attachment as well as attachments' mediating role for explaining consumer behavior. Using data from a large-scale survey, we find that network effects, intergroup comparison and social categorization have a positive and significant effect on common identity attachment while this is not the case with in-group interdependence. Conversely, common bond attachment is driven by collectivism, interpersonal similarity and social interaction, while personal information has no effect on common bond attachment. Most importantly, the analysis results show that common identity attachment is the primary driver for user behaviors in online communities.

Keywords: Online communities, member attachment, common identity, common bond, design

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Introduction

Online communities are a relatively new way to build relationships among physically remote individuals. They enable to meet friends or make new acquaintances, to exchange opinions and media such as texts, videos or pictures. Armstrong and Hagel (1996) were some of the first that propagated the benefits of this new form of community for business applications. A decade later, many enterprises have acknowledged the potential of online communities and use this new channel to recognize clients' wishes early on, or to allow colleagues and clients' expert knowledge to be incorporated into the product design and/or the service delivery process (Lakhani and Hippel 2003). The number of virtual communities is continually increasing. With a growth rate of more than 100%, online communities such as MySpace are competing with established Internet portals such as Google and Yahoo. However, some communities seem to be more successful than others. Against this background, the question how community design is related to user behavior in online communities has recently attracted considerable research (Kim 2000; Preece 2000; Ren et al. 2007; Ren and Kraut 2009; Ren et al. 2009; Spencer 2006; Wang et al. 2009).

One of the most salient contributions comes from Ren et al. (2007) who develop a comprehensive and nuanced theoretical framework of identity-based vs. bond-based attachment to online communities based on social science theories. Common identity and common bond attachment refers to the different reasons for being in a community, that is, because users like the community as a whole (identity-based attachment), or because they like individuals in the group (bond-based attachment) (Ren et al. 2007). Ren et al. (2009) test part of this model by showing with a field experiment that common identity attachment as well as common bond attachment increase commitment compared to a baseline control condition. In a similar vein, Ren and Kraut (2009) design a simulation model to test the value of different types of moderation in online communities. The authors find that removing off-topic messages increases members' information benefits at the expense of their opportunities for developing online relationships.

These studies provide empirical support for several central tenets of Ren et al.'s (2007) model. However, to the best of our knowledge most of the original specified relations in Ren et al. (2007) are still yet-to-be-tested research hypotheses. Specifically, the relationship between identity-based and bond-based attachment and their numerous antecedents as well as the attachment types' mediating role has not yet been empirically evaluated.

As a consequence, this paper evaluates the complex cause-and-effect relationships in Ren et al.'s (2007) model simultaneously. More precisely, using data from two large-scale surveys gathered at two different points in time to account for common method bias, we evaluate the influence of a number of theoretically validated antecedents such as in-group interdependence, intergroup comparison, and social interaction on common identity and common bond attachment in online communities. At this, we supplement Ren et al.'s (2007) original model by introducing two additional antecedents of attachment: network effects and collectivism. Likewise, we evaluate how the two different attachment styles influence a number of user behaviors in online communities including on-topic and off-topic discussion, generalized and direct reciprocity, membership robustness and loyalty to the online community. As such, the present study provides valuable insights into the complex relationships that underlie online community users' behavior and yield important implications for community design.

The rest of the paper is organized as follows. In section two, we formulate a set of hypotheses regarding antecedents of common identity and common bond and hypothesize how these two attachment styles influence user behaviors in online communities. In section three, we describe the data collection, and measurements used. Next, we describe the methodology, analysis set-up and report the findings. The paper concludes with a discussion of the study's major findings, limitations and potential avenues for future research.

Theoretical Framework

As a basis for understanding the antecedents and consequences of identity-based and bond-based attachment, we primarily draw on Ren et al.'s (2007) seminal model and augment it, in line with economic and social psychological literature. In what follows, we develop hypotheses regarding (1) the relationships between potential antecedents and identity-based as well as bond-based attachment, and (2) the two types of attachment's relationships with potential behavioral consequences.

Antecedents of Common Identity Attachment

Network Effects

Online communities allow for large network sizes and effects due to spontaneous, interactive exchange among community members across geographic distances (McAffee 2006). The literature on network effects indicates that network size has a considerable impact on market share, shaping customer choices and technology competition (Lee et al. 2006). Studies on social networks have found that open networks, with many weak ties and social connections, are more likely to introduce new ideas and opportunities to their members than closed networks with many redundant ties (Granovetter 1973, 1974; Scott 1991). A large number of studies have also emphasized the relevance of network size and effects for the sharing of information (Tsai, 2002; Chae and Koch, 2005), However, since most studies on antecedents of group attachment styles deal with offline communities, we could not find a single quantitative empirical study on the influence of network size on attachment (bond-based or identity-based) to an online community. From network theory we can assume that a virtual community needs a critical mass of users who generate contents and canvass new members in order to be successful (Culnan 2005; Preece and Maloney-Krichmar 2003). If the number of members grows, the potential contact possibilities increase and the number of potential contributions multiplies. This in turn can increase the usefulness of the community for the members (O'Murchu et al. 2004) and fosters identity-based rather than bond-based attachment with the community since the establishment of bond-based attachment seems to be more dependent on interpersonal social relations than network size. Hence,

H1a: Network effects are positively related to identity-based group attachment

In-group Interdependence

Sherif and Sherif (1953) first analyzed the relationship between in-group interdependence and social identity and conclude that a common fate strengthens the awareness of group identity. In-group interdependencies most often emerge when there is a common goal (Cartwright 1968), common reward or an external threat (Flippen et al. 1996). Group members behave in a co-operative way because they are dependent on one another with regard to the result of their actions inasmuch as they have a common destiny (Bouas and Arrow 1995; Chen 1996; Kramer and Brewer 1984). Hence,

H1b: In-group-interdependence is positively related to identity-based group attachment

Intergroup comparisons

Social identity theory implies that identity can be deduced from group membership (Ashforth and Mael 1989; Tajfel et al. 1971). Consequently group comparisons are decisive for the identification of individuals with social groups to which they belong (Yuki 2003). Whether the comparison group is indeed physically present is not important for the development of identification with a group (Utz 2003). As Tajfel et al. (1971) demonstrated, it is the self-categorization process that leads to the development of a social identity. In online communities intergroup comparison is often conceptualized in a more competitive viewpoint on this construct's nature by demonstrating superiority of the group: "For example, postings on the Frequently Asked Questions (FAQ) on apache.org, home of the Apache web server opensource development project, compare the speed, performance, and market share of the Apache server with other commercial servers, fostering the common identity of those who work on Apache software. The Wikipedia project site uses a similar technique, for example by highlighting competition with other encyclopedias." (Ren et al., 2007, p.387). Hence,

H1c: Intergroup comparison is positively related to identity-based group attachment.

Social categorization

According to self-categorization theory (Turner et al. 1987) an individual has both a personal and various social identities that may come to the fore in different situations (Rogers and Lea 2005). Research suggests that social identity can be fostered by objective similarity (e.g., regarding ethnicity and race, age, religion, education, job and gender), perceived similarity (e.g., regarding interests, convictions and attitudes) or degree of familiarity (e.g., quantity and quality of communication) (Durrett and Levin 2005; Makela et al. 2007; McPherson et al. 2001;

Mollica et al. 2003). The most common experimental method designed to manipulate intergroup comparison is called the minimal group paradigm (Tajfel and Turner 1986), whereby groups are created using trivial and sometimes almost meaningless tasks. Summarizing fifteen years of psychology research using the minimal group paradigm, Tajfel and Turner (1986) conclude that "the trivial, ad hoc intergroup categorization leads to ingroup favoritism and discrimination against the outgroup." Hence,

H1d: Social categorization is positively related to identity-based group attachment

Antecedents of Common Bond Attachment

Personal information

Research into interpersonal relations assumes that direct contact with other group members leads to stronger bonds between members, thus reinforcing group cohesion (Buchan et al. 2006). Collins and Miller (1994) ascertained that people who reveal personal information are more popular with their fellow human beings and that the process of self-revelation leads to mutual sympathy, which is an important precondition for social bonds. Members of social networking communities could, for instance, discover commonalties by revealing personal interests or hobbies, which in turn increases the probability of social interaction (Ren et al. 2007). In addition, it becomes easier for the members to trust other community participants when they know more about the personality of these members (Ridings et al. 2002). Based on the predictions of the above-mentioned theories, the following hypothesis can be formulated:

H2a: Personal information is positively related to bond-based group attachment.

Interpersonal Similarity

Some of the most robust findings from psychology are that selection decisions are influenced by the desire for similarity (Bacharach et al. 2005; McPherson et al. 2001; Mollica et al. 2003; Sommers 2006). From an economic point of view, this can be explained with reduced costs of adaptation of one's mental models and representations as well as increased ease of communication. Furthermore, similarity is rewarding because one's self-image is positively confirmed and the need to belong is supported. Similarity between an online community's members thus may create sympathy and thereby provides the basis for social relationships with other community members. Therefore,

H2b: Perceived interpersonal similarity is positively related to bond-based attachment.

Collectivism

One of the fundamental components of interpersonal cooperation seems to be the degree of individualism or collectivism a person has internalized as a guiding norm (Brosig 2002; Frank 1988; Zhang et al. 2007). It is therefore not surprising that annually more than 100 publications use these dimensions for the analysis and discussion of cultural differences (Triandis 2001). Individualism can be understood as the degree to which persons view a situation as competition and place emphasis on maximizing their individual payoff. Collectivism reflects both a cooperative understanding of the situation and prioritizing maximizing group payoffs. According to Frank (1988), there are two types of individuals: cooperative individuals who cooperate even in anonymity, and individualistic persons who maximize their own payoff. Buchan et al. (2006) find evidence that collectively oriented participants show more trust and trustworthiness than do individualistically oriented participants. Buchan et al. (2006) and Yuki (2003) show that social categorization processes hardly play a role for attachment in individuals who are high in their collectivistic orientation. Intact social bonds with other people are much more important for collectivists than for individualists. The pursuit of harmony, group orientation and a strong social interdependence between individuals shape the group attachment process of collectivistic oriented individuals. It is, therefore, possible for individuals characterized by collectivism to tend to view interpersonal relationships as the basis for the formation of bond-based attachment. Yuki (2003) sees a relationship between the collectivist viewpoint of group attachment processes and a common bond according to Prentice et al. (1994). This leads to the following hypothesis:

H2c: Collectivistic orientation is positively related to bond-based attachment.

Social Interaction

Social interaction seems to be important for establishing social similarity, shared values, and expectations of collaborative interpersonal relationships (Jarvenpaa and Leidner 1999; Nardi and Whittaker 2002; Nohria and Eccles 1992; O'Hara-Devereaux and Johansen 1994). Social Interaction can increase so called "other regarding preferences" such as altruism and fairness (Buchan et al. 2006), which in turn can lead to increased bond-based attachment. Also, social interaction can provide opportunities for self-disclosure and friendship (Preece and Maloney-Krichmar 2003) and can thus increase common bond attachment. Third, there are indications that social interaction can appeal to peoples' moods and feeling of self-content by appealing to their preferences, such as their sense of humor (Keltner and Bonanno 1997), which can in turn lead to positive emotions about themselves and others, which might increase their bond-based attachment. Hence,

H2d: Social interaction is positively related to bond-based attachment.

Behavioral effects of common identity and common bond attachment on online community users

On-topic and Off-topic discussion

Sassenberg (2002) finds that on-topic communities behave more in accordance with rules than off-topic communities. From their literature review Ren et al. (2007) conclude that members that experience common identity with their community will be more likely to engage in on-topic discussions whereas community members that feel bond-based attachment will be more tolerant of off-topic discussions. Hence,

H3: Common identity attachment is positively related to on-topic discussion

H4: Common bond attachment is positively related to off-topic discussion

Generalized and direct reciprocity

The norm of reciprocal behavior is considered a universally applicable norm in all cultures (Gouldner 1960). It is constructed from the following two behavior rules: People should not harm those who have helped them and people should help those who have helped them. Since common identity is associated with being committed to the community's purpose it is more likely that this type of attachment is related to generalized reciprocity (Ren et al. 2007). Contrary, members who have bond-based attachment to the community, are more likely to exchange help with particular others (Ren et al. 2007). Hence,

H5: Common identity attachment is positively related to generalized reciprocity

H6: Common bond attachment is positively related to direct reciprocity

Robustness

Prentice et al. (1994) argue that the type of group attachment can influence the stability of a group. They expect that common-identity attachment is related to more stability over time in respect of membership change than common-bond attachment. They assume that a common-bond group will become uninteresting quite rapidly when the friends leave whereas common identity attachment is independent of specific bonds. Hence,

H7: Common identity attachment is positively related to robustness to membership turnover.

In-group loyalty

Finally, since both types of group attachment lead members to perceive a group as cohesive and to evaluate their group more favorably than other groups, Ren et al. (2007) assume that common identity attachment and common bond attachment is related to in-group loyalty. However in Ren et al. (2009), the authors find that the identity-based design is more effective in increasing commitment. Similarly, their laboratory experiment also shows that identity-oriented designs lead to greater self-report commitment than the bond-oriented designs. Hence,

H8: Common identity attachment exerts a stronger influence on in-group loyalty than common bond attachment

Figure 1 summarizes the hypotheses we have abstracted from the literature on the antecedents and behavioral consequences of identity and bond-based attachment to online communities.

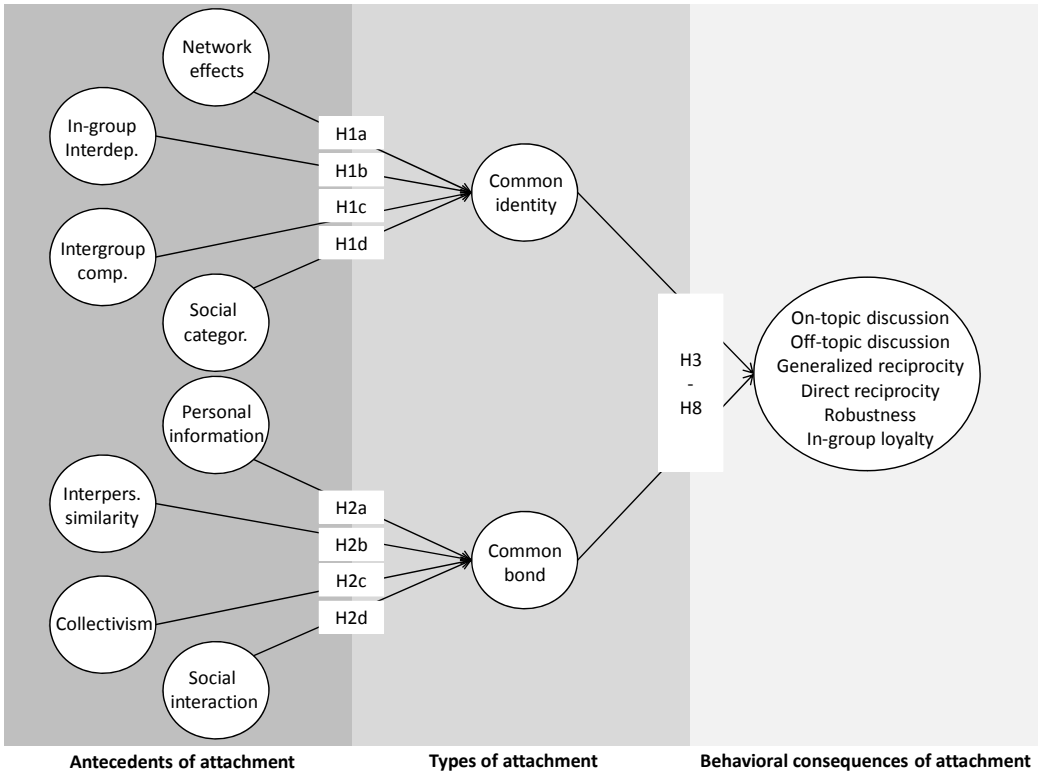

Figure 1. Theoretical framework of antecedents and behavioral consequences of attachment types

Measurements and Data

Construct Measurements

To operationalize the constructs of this study, we primarily relied on measures commonly used in prior research. As all measures denote manifestations of the underlying construct (Bollen and Lennox 1991), reflective items - as opposed to formative ones (Diamantopoulos et al. 2008) - were used in all measurement models. All items were measured using 7-point Likert-type scales (1=strongly disagree, 7=strongly agree).

Constructs related to antecedents of common identity and common bond attachment

To measure the degree to which a user sees increased direct benefit from the community by the existence of other community members, we made use of Sahay and Riley's (2003) three-item measure of *network effects*. The three questions are: 'I joined this community because of its high membership numbers,' 'An increase in membership size leads directly to more benefits for me,' and 'I have the feeling that I communicate with more and more people because of an increasing membership size'.

Following Henry et al.'s (1999) conceptualization and operationalization of *in-group interdependence*, the following three items were used to measure the construct: 'All members need to contribute to achieve the community's goals,' 'This community accomplishes things that no single member could achieve,' and 'In this community members need to cooperate to complete community tasks, e.g. software development'.

To measure *intergroup comparison*, we focus on the perceived superiority members attribute to their favorite community. The following items were selected from previous studies by Ellemers et al. (1999), Utz (2003) as well as Yuki (2003): 'Compared to other similar communities, this community is much more tolerant,' 'Compared to other similar communities, this community is much more flexible,' 'Compared to other similar communities, this community is much more creative,' 'Compared to other similar communities, this community is much more intelligent,' 'I think this community has a lot to be proud of,' and 'People in other similar communities generally admire this community'.

To measure *social categorization*, we selected three items based on Cameron's (2004) three-factor model of social identity, that were specifically applicable to our setting. In addition, we supplemented these with items capturing prototypicality (Utz 2003) as well as perceived in-group homogeneity (Yuki 2003) resulting in the following item set: 'I often think about the fact that I am a member of this community,' 'In general, being a member of this community is an important part of my self-image,' 'The fact that I am a member of this community often enters my mind,' 'I am a typical member of this community,' 'Most people in the community are similar to each other in their values,' 'Most people in this community are similar to each other in their preferences,' and 'Most people in the community behave in a similar way'.

Following Postmes et al. (2005) as well as Pinsonneault and Heppel (1998), *personal information* was measured by means of the following set of items: 'The people I interact with in this community are personally identifiable to me,' 'I believe other community members can identify me,' and 'This community offers me the opportunity to get more information about the other members'.

To measure *interpersonal similarity*, we extracted the following three items that relate to the social attraction of community members and which have been developed by McCroskey and McCain (1974): 'I think I could become friends with some members of this community,' 'Members of this community would fit into my circle of friends,' and 'I sometimes feel I know some members of this community personally'.

Collectivism was a four-item measure first used by Oyserman (1993). The items are 'When I meet someone from my nation or group, I know we will have common goals and aspirations,' 'If I lose touch with my group, I will be a different person,' 'In general, I accept the decision made by my group,' and 'When I meet someone from my own nationality or religion, I know we will have common goals and interests'.

In their evaluation of antecedents and effects of trust in virtual communities, Ridings et al. (2002) provide item sets to capture community members' desire to get information as well as the responsiveness of others which we adapted for measuring the *social interaction* construct. Specifically, we used the following items: 'In general, I actively interact with other members of this community,' 'In this community I share information about a particular subject with other members,' 'In this community I share my skills and abilities with other members,' 'I can always count on getting a lot of responses to my posts/messages,' and 'I can always count on getting responses to my posts/messages fairly quickly'.

Common identity and common bond

Common identity as well as *common bond* attachment were measured by means of six and three items, respectively, which have been used in Prentice et al.'s (1994) study and by many other academic researchers subsequently. The questions for common identity attachment are: 'Belonging to this community is very important for me,' 'It would feel very good to be described as a typical member of this community,' 'I often mention this community when I first

meet someone,' 'I feel strong attachment to this community,' 'I often acknowledge the fact that I am a member of this community,' and 'I am a typical member of this community'. The questions for common bond attachment are: 'I feel very close to the other members of this community,' 'Many members of this community have influenced my thoughts and behaviors,' and 'Many of my friends come from this community'.

Criterion variables

Both, *on-topic* and *off-topic* were based on the scales developed by Ridings et al. (2002) to capture the participants' desire to get on-topic information (three items) and the members' desire to confide personal off-topic information (three items). An example item for the first is 'I come to the community website to get information on a particular topic,' and for the latter 'The posts/messages on the community website often contain private topics'.

To operationalize *generalized reciprocity* as well as *direct reciprocity*, we made use of Gallucci and Perugini's (2003) personal norm of reciprocity questionnaire. Specifically, we adapted the following three items for the measurement of generalized reciprocity which were applicable to the study setting: 'To help somebody is the best policy to be certain that she/he will help you in the future,' 'In this community most of the members comply to the existing rules and norms,' and 'In this community I help other members, so I will be helped in the future'. To measure direct reciprocity, the following items were used: 'I am ready to undergo personal costs to help somebody who helped me before,' 'If someone helps me, I am pleased to help him/her,' and 'When someone does me a favor, I feel committed to repay him/her'. As Gallucci and Perugini's (2003) scale was originally developed in the context of an information game, we supplemented the scale adding an additional item ('Members of this community generally like to answer posts/messages').

In accordance with Ren et al. (2007), three items were formulated to measure *robustness* in respect of membership change: 'If my friends left this community, I would leave as well,' (reversed item) 'I would stay active in this community, even if my friends there would become inactive,' 'This community would still be attractive to me if my friends left it'.

Lastly, *in-group loyalty* was measured using a six-item scale adapted from Mowday et al. (1979): 'I talk up this community to my friends as a great community to be in,' 'I feel very loyal to this community,' 'I am proud to tell others that I am part of this community,' 'I really care about the fate of this community,' 'I am willing to put in a great deal of effort in order to help this community be successful,' and 'For me this is the best of all possible communities to be in'.

Data and Sample

The data gathering was done by means of two online questionnaires. To avoid systematic distortions in the replies, an original list of some 470 online communities was firstly drawn up by means of an Internet search. This list represented a wide selection of all possible online communities with regard to their community focus as well as their size and geographical distribution. A link to the online questionnaire could eventually be posted to 226 of these communities or the participants could be contacted directly via email.

To account for common method bias (e.g., Podsakoff et al. 2003), the measurement of the independent and dependent variables was done at two different points in time. It was also pointed out on the first page of the questionnaires that this investigation is a purely scientific study, that there are no correct or false replies to the questions and that the questionnaire would be analyzed anonymously. Although this approach cannot solve all problems relating to common method bias, the quality of the data obtained should be enhanced to a one-time survey.

Of the total of 1,900 persons who started with the first survey, 1,013, thus 53% of the participants, fully completed their questionnaires. 922 interviewees, who had made their e-mail addresses available, were approached for the second survey, 147 of whom answered all questions related to antecedents and types of attachment in full.[2] Contingency tests in respect of different socio-demographic characteristics (e.g., age, gender, level of education) as

[2] In light of the relatively high number of missing values in several indicator variables with more than 50% missing, the application of standard imputation methods would have led to biased parameter estimates (Cassell et al. 1999). As a consequence, we decided to follow a conservative research approach by deleting missing values listwise.

well as behavioral characteristics (e.g., hours spent in online communities) did not indicate any significant effects, so we do not regard the shrinking size of the panel a debilitating factor.

The percentage of women and men remained relatively balanced with approximately 45% female and 55% male participants in both the main and follow-up investigation. The average age of the interviewees is nearly 26, with the youngest being 15 years old and the oldest 65. The majority of the respondents (about 60%) are between 20 and 30 years of age. Most of the participants in the survey report a higher education: 41.6% are academics, 38.3% have a university-entrance qualification, 20.1% have a lower educational level, or did not indicate their level of education. Working persons (24.9%) and students (49.0%) constituted the major part of the sample survey. 25.5% of the interviewees report to be from Germany, 40.3% from China and 22.1% from Bulgaria; the remaining participants stem from USA (4.7%), France (3.4%) or other countries (3.4%).

The respondents also had to indicate which community they were most actively engaged in. Most respondents reported that they were actively engaged in Kayuan, a general interest community for Chinese students and expatriates working in Germany, offering social networking facilities and several discussion boards. The site was founded in 2002 and counts approximately 120,000 users (2008). Likewise, several respondents indicated that they used Facebook and StudiVZ. Facebook is a social networking website launched in February 2004 that is operated and privately owned by Facebook Inc, with more than 500 million active users in July 2010. Largely comparable to Facebook is StudiVZ, a social networking platform for college and university students in Europe. StudiVZ claims to be one of the biggest social networks in Europe, with (reportedly) over 15 million members as of September 2009.

Overall, 24.5% of the communities can be classified under social networks (e.g., Facebook, MySpace, StudiVZ), and 23.8% under discussion forums (e.g., Teenzona, hardwareBG, forum for German law). Other than originally expected, we realized that the majority of communities (about 40%) cannot be distinctly categorized around a specific purpose or activity (e.g., Kaiyuan, 6park, and Net-iris). Such general interest communities offer for example the chance to make personal relationships as well as the chance to talk about topics of interest. Given the difficulty in mutually exclusive community distinctions, we decided not to make group comparisons between common bond and common identity communities but to analyze antecedents and consequences of common bond and common identity attachment across all respondents.[3]

The average time of the interviewees' membership of a community is approximately two years. Approximately 22% of the participants in the study constitute inexperienced users with a membership of less than six months. Around 45% of the interviewees have been a member of an online community for one to two years. The remaining 33% can be regarded as experienced users, since they have belonged to a community for at least three or more years. On average, the respondents spend about 10 hours per week in their most active community. Most of the respondents (approximately 66%) have between 10 and 20 contacts in their online community. Roughly 26% of the participants have between 20 and 100 contacts, while only 8% have more than 100 friends or acquaintances in their online community.

Analysis and Results

Methodology and Models

To test the hypotheses, we used structural equation modeling on the data. When estimating structural equation models, researchers can revert to covariance-based methods (Jöreskog 1977) or the variance-based partial least squares (PLS) approach (Wold 1974). Drawing on the findings of comparisons of the two approaches by, for example, Hair et al. (2011), Lohmöller (1989), Reinartz et al. (2009), and Tenenhaus (2008), we chose to apply PLS path modeling because of the complexity of the research model and the limited number of observations.[4] As the PLS path modeling algorithm consists of several ordinary least squares regressions for separate subparts of the focal path model, the complexity of the overall model hardly influences sample size requirements (Henseler 2010).

[3] Nevertheless, the application of a latent class detection approach allows us to examine the dataset for potential sources of heterogeneity (see additional analyses section).

[4] Following Stewart's (2009) notion and in order to check for robustness, we also estimated the models using generalized structured component analysis (GeSCA) on the data which has recently been proposed by Hwang and Takane (2004). The analysis yielded highly similar results.

Consequently, PLS path modeling is truly beneficial when applied to models with complex cause-effect relationships like the present one as it generally avoids improper solutions or non-convergent solutions (e.g., Chin and Newsted 1999; Krijnen et al. 1998). In a recent contribution, Reinartz et al. (2009) show that that the PLS path modeling approach is a very sensible methodological choice if sample size is restricted as it achieves higher levels of statistical power compared to its covariance-based counterpart. Furthermore, PLS path modeling is extremely robust in face of inadequacies often encountered in empirical research such as skewed distributions of manifest variables, multicollinearity between latent variables, and misspeciation of the structural model (e.g., Cassel et al. 1999).

To compare the model set-ups, we established and evaluated structural equation models for each criterion variable separately. More precisely, we estimated six models, one with on-topic discussion (model 1), off-topic discussion (model 2), generalized reciprocity (model 3), direct reciprocity (model 4), robustness (model 5), and, finally, in-group loyalty (model 6) as the criterion variable. For parameter estimation, we used the statistical software application SmartPLS (Ringle et al. 2005), applying the factor weighting scheme (Hair et al. 2011). Table A1 in the Appendix provides an overview of descriptive statistics and correlations among the constructs considered in this study.

Results

Methodological considerations that are relevant to the analysis include the assessment of the measures' reliability, convergent and discriminant validity, as well as determining the model's overall goodness-of-fit. Table 1 shows the minimum reliability and validity estimates for all constructs related to antecedents and types of attachment across all six models considered. The related results for the behavioral consequences of attachment are shown in Table 3 which also includes goodness-of-fit measures as well as parameter estimates for the structural models. The reliability of constructs using reflective indicators is assessed by means of Cronbach's α and composite reliability ρ_c. All constructs achieve α and ρ_c values higher than the generally stipulated threshold of 0.70 (Nunally and Bernstein 1994). Consequently, the results indicate a high degree of construct reliability.

All indicators' loading estimates achieve high levels across all model set-ups (i.e., above 0.70) and are significant suggesting that all indicators contribute well to determining the corresponding constructs (Henseler et al. 2009). Accordingly, the average variance extracted (AVE) values across all models are very acceptable. The analysis results (Tables 1 and 3) reveal that (minimum) AVE scores calculated across all model set-ups are uniformly above 0.50, thus providing support for the constructs' convergent validities.

To assess the discriminant validity of the constructs, two approaches were applied. First, we examined the indicators' cross loading which revealed that no indicator loads higher on any opposing endogenous construct (Henseler et al. 2009). Second, we applied the Fornell and Larcker (1981) criterion and compared the square root of the constructs' AVEs with the construct correlations. This analysis shows that across all model set-ups and constructs, each latent variable shares more variance with its own block of indicators than with another latent variable representing a different block of indicators.

Table 1. Construct Reliability and Convergent Validity Estimates

	min(α)	**min(ρ_c)**	**min(AVE)**
Network effects	0.731	0.838	0.636
In-group interdependence	0.857	0.907	0.765
Intergroup comparison	0.879	0.908	0.624
Social categorization	0.829	0.875	0.585
Personal information	0.840	0.904	0.758
Interpersonal similarity	0.832	0.900	0.749
Collectivism	0.805	0.873	0.634
Social interaction	0.866	0.904	0.654
Common identity	0.878	0.908	0.623
Common bond	0.765	0.848	0.585

Table 2 provides the path coefficient estimates for the relations between the different antecedents and common identity/common bond (Figure 1), as well as model fit measures.

Criteria applied for evaluating the goodness-of-fit of the endogenous latent constructs include R^2 and the cross-validated redundancy measure Q^2 (Henseler et al. 2009). The analysis shows that the R^2 values of the two mediating constructs "common bond" and "common identity" are very acceptable. Likewise, all Q^2 values are significantly larger than zero, providing support for the exogenous variables' predictive relevance.

With respect to the structural model, results are very consistent across all model set-ups, providing support for the research model's robustness. Specifically, network effects, intergroup comparison and social categorization have a positive and significant ($p \leq 0.01$) effect on common identity while this is not the case with in-group interdependence. Thus, we find support for hypotheses H1a, H1c, and H1d. Common bond is primarily driven by interpersonal similarity, collectivism and social interaction, while personal information has no significant positive effect on the interpersonal bonds in online communities which supports hypotheses H2b, H2c, and H2d (see Table 2).

Table 2. Model Estimates for Relations Between Antecedents and Types of Attachment

Hypothesis tested	Relation tested	Model 1: On topic	Model 2: Off-topic	Model 3: GR	Model 4: DR	Model 5: Robustness	Model 6: Loyalty
H1a	Network effects → Common identity	0.231***	0.244***	0.226***	0.232***	0.255***	0.223***
H1b	In-group interdependence → Common identity	0.066	0.057	0.081	0.059	0.037	0.067
H1c	Intergroup comparison → Common identity	0.338***	0.332***	0.332***	0.335***	0.340***	0.330***
H1d	Social categorization → Common identity	0.322***	0.310***	0.325***	0.331***	0.319***	0.339***
H2a	Personal information → Common bond	0.069	0.067	0.056	0.070	0.062	0.073
H2b	Interpersonal similarity → Common bond	0.216**	0.226**	0.218**	0.221**	0.222**	0.225**
H2c	Collectivism → Common bond	0.179***	0.174**	0.213***	0.175***	0.185**	0.173***
H2d	Social Interaction → Common bond	0.354***	0.345***	0.344***	0.356***	0.351***	0.350***
	R^2 Common bond	0.388	0.384	0.394	0.392	0.395	0.394
	R^2 Common identity	0.544	0.525	0.551	0.544	0.540	0.550
	Q^2 Common bond	0.209	0.204	0.215	0.205	0.161	0.212
	Q^2 Common identity	0.315	0.315	0.315	0.314	0.248	0.328
	N	146	140	141	144	140	144

GR: generalized reciprocity, DR: direct reciprocity
*** significant at $p \leq 0.01$, ** significant at $p \leq 0.05$, * significant at $p \leq 0.10$

Table 3 provides path coefficient estimates for the relations between common identity/common bond and the behavioral consequences, model fit as well as reliability and validity measures for the criterion variables. Again, all Q^2 values are above zero, indicating the common and identity bond's predictive relevance for the criterion constructs (Henseler et al. 2009). While in-group loyalty exhibits a very high R^2 value, all other criterion variables achieve considerably lower values. This is, however, not surprising, considering the numerous potential determinants of outcome variables such as membership robustness or generalized reciprocity.

Most importantly, the results clearly show that common identity is the primary driver for the consequences of attachment in online communities, exerting a positively significant effect on the criterion variables across almost all models. For example, common identity exerts a pronounced positive influence on in-group loyalty (0.679), on-topic discussion (0.366), and membership robustness (0.303). Only off-topic discussion is not positively affected by common identity. In contrast, common bond has only a rather limited influence on attachment consequences with significant effects only on direct reciprocity (0.270).

As a consequence, we find support for hypotheses H3, H5, H6, and H7. To test whether common identity attachment exerts a significantly stronger influence on in-group loyalty than common bond attachment, we used the permutation-based multi-group comparison approach for paired samples as proposed by Sarstedt and Wilczynski (2009). The analysis shows that the effect of common identity on in-group loyalty is significantly stronger than of common bond ($t_{143}=4.093$; $p \leq 0.001$) thus providing support for H8.

Table 3. Model Estimates for Relations between Types of Attachment and Behavioral Consequences

Relation tested	Model 1: On-topic (H3)	Model 2: Off-topic (H4)	Model 3: GR (H5)	Model 4: DR (H6)	Model 5: Robustness (H7)	Model 6: Loyalty (H8)
Common bond → Criterion variable	0.027	0.116	0.116	0.270**	0.154	0.144
Common identity → Criterion variable	0.366***	0.105	0.284***	0.233*	0.303***	0.679***
Cronbach's α Criterion variable	0.892	0.701	0.804	0.809	0.700	0.885
ρ_c Criterion variable	0.933	0.804	0.884	0.875	0.773	0.914
AVE Criterion variable	0.823	0.582	0.718	0.636	0.567	0.643
R^2 Criterion variable	0.146	0.038	0.133	0.200	0.170	0.598
Q^2 Criterion variable	0.108	0.002	0.093	0.108	0.037	0.361
N	146	140	141	144	140	144

GR: generalized reciprocity DR: direct reciprocity
*** significant at p≤0.01, ** significant at p≤0.05, * significant at p≤0.10

Following Albers (2010), we also evaluated the total effects of the attachment types' antecedents on the criterion variable(s). The analyses reveal that for most types of criterion variables (except off-topic discussion), intergroup comparison and social categorization exert the greatest influence on the users' behaviors with total effects ranging between 0.035 and 0.224 (intergroup comparison) as well as 0.077 and 0.231 (social categorization).

Additional Analyses

Model extensions

As the current study supplements Ren et al.'s (2007) original model by introducing two additional antecedents of attachment (network effects and collectivism), we extended the original model set-up by relating these two antecedents to both common identity and common bond.[5] The analyses show that across all six models, collectivism exerts a significant (p≤0.01) positive influence on common identity with path coefficients ranging between 0.153 (model 1: on-topic) and 0.167 (model 3: generalized reciprocity, and model 5: robustness). On the contrary, network effects do not significantly (p≤0.10) influence common bond.

We also estimated full models in which we related all antecedents to both, common identity and common bond. Table 4 presents the results for the criterion variable on-topic discussion.[6] The results show that the central tenets of Ren et al.'s (2007) model remain unaffected by an extension of the model. With merely one exception (interpersonal similarity → common bond), all path relationships in the original model remain significant when the model is extended. Because of the predictive character of the PLS path modeling approach, the path coefficients are deflated but remain significant which underlines the approach's high level of statistical power (e.g., Reinartz et al. 2009). On the contrary, only one path (personal information → common bond) turns significant in the more complex model. Most importantly, we do not experience any sign changes that might lead to a trade-off situation when making decisions on the community design. Overall, the results provide a strong empirical support for Ren et al.'s (2007) model.

[5] We would like to thank the reviewer team for this suggestion.

[6] The analyses for the remaining criterion variables differ only marginally and are available from the authors upon request.

Table 4. Model Estimates for Full Model (Criterion Variable: On-topic Discussion)

Relation tested	Estimates Full Model	Original estimates
Network Effects → Common Bond	0.141	
Network Effects → Common Identity	0.150***	0.231***
In-group interdependence → Common Bond	0.029	
In-group interdependence → Common Identity	0.064	0.066
Intergroup Comparison → Common Bond	0.170	
Intergroup Comparison → Common Identity	0.362***	0.338***
Social categorization → Common Bond	0.000	
Social categorization → Common Identity	0.300***	0.322***
Personal Information → Common Bond	0.201**	0.069
Personal Information → Common Identity	-0.036	
Interpersonal Similarity → Common Bond	-0.022	0.216**
Interpersonal Similarity → Common Identity	0.219***	
Collectivism → Common Bond	0.072	0.179***
Collectivism → Common Identity	-0.033	
Social Interaction → Common Bond	0.283***	0.354***
Social Interaction → Common Identity	0.113*	
Common Bond → On-topic discussion	0.020	0.027
Common Identity → On-topic discussion	0.266***	0.366***
R^2 Common bond	0.409	0.388
R^2 Common identity	0.570	0.544
R^2 On-topic discussion	0.146	0.146

*** significant at $p \leq 0.01$, ** significant at $p \leq 0.05$, * significant at $p \leq 0.10$

Heterogeneity check

Though the analysis on the aggregate data level can provide insight into the complex relationships between the two types of attachment and their various antecedents and behavioral consequences, it still makes the simplifying assumption that all observations come from a single, homogeneous population. However, individuals from different types of communities may be heterogeneous in their perceptions and evaluations of unobserved constructs which might account for distinct group-specific structural model path coefficient estimates.

We carried out a latent class analysis which allows uncovering heterogeneous data structures by analyzing the data on an aggregate level. More precisely, we applied the finite mixture PLS (FIMIX-PLS) procedure (Hahn et al. 2002) which is the most comprehensive and most commonly used approach for carrying out response-based segmentation tasks in PLS path modeling (e.g., Sarstedt 2008; Sarstedt and Ringle 2010). The approach combines the strengths of the PLS method with the advantages of the maximum likelihood estimation when deriving market segments with the help of finite mixture models.

The analysis did not reveal any heterogeneity as the models selected (based on a joint consideration of AIC_3 and CAIC; Sarstedt et al. 2011) exhibited continuously low entropy values of below 0.50, indicating fuzzy segment membership (Ringle et al. 2010). Thus, we can assume that one global model represents all observations well (e.g., Hair et al. 2011; Rigdon et al. 2010; Ringle et al. 2010).

Discussion

Contributions of the study

Based on Prentice et al.'s (1994) work, many researchers found that the type of attachment an individual has towards a community, either bond-based or identity-based, is one of the most important factors that influences his membership in a community (Amichai-Hamburger 2005; Dholakia et al. 2004; McKenna and Bargh 1998; Michinov et al. 2004; Postmes and Spears 2000; Postmes et al. 2002; Prentice et al. 1994; Ren et al. 2007; Sassenberg 2002; Sassenberg and Boos 2003; Utz 1999; Utz 2003; Utz and Sassenberg 2002). However, very few studies look empirically at antecedents that influence those two types of attachment in an online community, and how these attachment styles in turn influence different user behaviors.

Addressing this gap in research, this study set out to assess the relation between a number of theoretical validated antecedents (network effects, in-group interdependence, intergroup comparison, social categorization, personal information, interpersonal similarity, collectivism and social interaction) and common identity and common bond attachment in online communities and how the two different attachment styles influence a number of user behaviors in online communities (on-topic and off-topic discussion, generalized and direct reciprocity, membership robustness and loyalty to the online community).

Most importantly, in accordance with Ren et al. (2009), we find that common identity attachment is the primary driver for user behaviors in online communities. In contrast, common bond attachment has only a rather limited influence. Likewise, we find that network effects, intergroup comparison and social categorization have a positive and significant effect on common identity attachment while this is not the case with in-group interdependence. Conversely, common bond attachment is primarily driven by interpersonal similarity, collectivism and social interaction, while personal information has no effect on common bond attachment in online communities. Additional analyses of the antecedents' total effects reveal the increased importance of intergroup comparison and social categorization on the users' behaviors.

The results for in-group interdependence and personal information are in contrast to the predictions of the literature. The former result might be explained by the fact that we surveyed users from voluntary online communities (as opposed to work online communities). Those communities seldomly demand real in-group interdependence, i.e. users of voluntary online communities do rarely work on team products where they depend on each other's contributions. Even most Open Source Software communities do only depend on one project manager (often termed as benevolent dictator) and face a rather inactive community (Krishnamurthy, 2002).[7] However, a potential way to analyze the importance of in-group interdependence for the evolution of common identity attachment in voluntary online communities would be to consider highly rated virtual world guild members such as in World of Warcraft (Ducheneaut et al. 2006). Members of a top rated guild heavily depend on each other as they have to cooperate in order to advance in the game.

The non-significant result regarding the relation between personal information and common bond attachment might be explained by the fact that not all personal information is related to liking, trust and respect between the community members. Hence a better operationalization for measuring the influence of personal information on common bond attachment could be to evaluate how much liking, trust and respect is associated with the personal information. Interestingly, the data clearly point in the direction that only personal information that is perceived as similar to one's own interests and preferences is helpful in building bond-based relations.

In sum, we believe that our study makes a number of contributions. First, we test a comprehensive cause-and-effect model that has not been tested before in this breadth and coverage. Second, we contribute to the discussion in the management of online communities' literature, by testing whether established findings from social sciences apply in the context of online communities. Third, our result regarding the influence of common identity and common bond attachment on user behaviors answers the call for research put forward by Ren et al. (2007, 2009). Ren et al. (2009) state that "thus far, few scholars have taken theoretically-motivated positions on design for online communities (for one exception, see Kollock 1998), and there is little research to examine this approach empirically." Furthermore,

[7] Krishnamurthy (2002) analyzed the 100 most active Open Source Software projects in the "mature" phase in SourceForge.net and found that most open source projects are developed by individuals and not communities.

we added two additional constructs (network effects and collectivism) to the original model of Ren et al. (2007) for which we find significant positive relationships with common identity and common bond attachment.

In view of the many online communities on the Internet, the relevance of design principles increases. From the results, some recommendations could be deduced for community moderators. Online communities which value on-topic information exchange, generalized reciprocity norms, robustness to member turnover and in-group loyalty should focus on establishing common identity attachment to the community. Common identity attachment can be built by creating a big community with many connection possibilities, a positive intergroup comparison and superior social categorization compared to other communities. This could be done by emphasizing the community's uniqueness compared to other communities or by only allowing a specific group to participate in the community that fulfills a signal others do not. Many communities use hidden clues such as secrets which are not revealed to outsiders, but are expected to be discovered or deduced by the aspiring new member (Raymond 1998). Raymond (1998) gives the following examples for hacker related communities: "1) Password-like specific mysteries. As one example, there is a Usenet newsgroup called alt.sysadmin.recovery that has a very explicit secret; you cannot post without knowing it, and knowing it is considered evidence you are fit to post. The regulars have a strong taboo against revealing this secret. 2) The requirement of initiation into certain technical mysteries. One must absorb a good deal of technical knowledge before one can give valued gifts (e.g., one must know at least one of the major computer languages). This requirement functions in the large in the way hidden clues do in the small, as a filter for qualities (such as capability for abstract thinking, persistence, and mental flexibility) which are necessary to function in the culture. 3) Social-context mysteries. One becomes involved in the culture by attaching oneself to specific projects. Each project is a live social context of hackers which the would-be contributor has to investigate and understand socially as well as technically in order to function. Concretely, a common way one does this is by reading the project's Web pages and/or e-mail archives. It is through these project groups that newbies experience the behavioral example of experienced hackers."

Online communities which are on the other hand more interested in off-topic discussion and the building of specific reciprocity should foster common bond attachment. Common bond attachment is primarily driven by social interaction but also to interpersonal similarity, and collectivism. Hence, it is advisable to give members the possibility to learn more about similar interests and social interaction. In this regard, there is a large choice of possible functions available in online communities, for example, the use of liking and knowledge tests, etc. In this way, members learn more about similar interests or hobbies without revealing too much personal information.

The strong influence of collectivism on common bond attachment could have an interesting implication for online communities' strategy. Some online communities in the USA only became successful when an increasing number of users from collectivist countries started participating. Orkut, for example, was long unknown in the USA until the community made a breakthrough in Brazil (Boyd and Ellison 2007).

Finally, since common identity attachment seems to predict more of the criterion variables than common bond attachment this could indicate that online community moderators should strengthen the members' identity with the community as such. However, interestingly enough, many originally identity-based communities, such as Flickr, Last.FM and YouTube, have introduced features during the last few years that nurture social interaction between their members.

Limitations of the study

Like others, this study has some limitations that have to be taken into account with regard to the interpretation and generalizability of the results. Results from non-experimental and non-longitudinal research design can only be interpreted causally with great caution (e.g., Biddle and Marlin 1987; Cliff 1983). Every time when questions are investigated for which there is no sufficient archived data available - as is the case in this study - researchers must resort to subjective measures of the involved persons (Kumar et al. 1993). A subjective evaluation was also required for this study, since only the participants themselves can provide information about the subjectively experienced and perceived attachment and criterion variables. When asking single respondents there is a specific risk of data distortion through retrospection as well as in the operationalization of the constructs. When respondents are asked to evaluate the same construct, once in retrospect, and once currently (Huber and Power 1985), the retrospective evaluation might influence the current evaluation. There is little risk of the answers' retrospective distortion in this study, as different constructs are queried in respect of the past and present (Morgenstern and Barrett 1974).

Furthermore, the questions that applied to the antecedents of common bond and common identity were clearly separated from those that applied to the user behaviors. In keeping with Huber and Power's (1985) suggestions, those persons who had the greatest expertise with regard to their community attachment, the community members themselves, were selected for the survey. Regarding the latter aspect, we had to operationalize few constructs in a way that might not capture the theoretical domain in full but had to focus on one potential outcome of the theoretical construct (e.g., we measure intergroup comparison by asking about the perceived superiority of the group as well as interpersonal similarity with perceived friendship). Likewise, the measurements used for social categorization and common identity are conceptually strongly related. As we opted for a field survey rather than an experimental set-up - which would have allowed for controlling the degree of social categorization - this is a limitation of this study. There is another risk of bias whenever respondents are prompted to make generalized statements about "patterns of behavior, after summarizing either observed (actual) or expected (prescribed) organizational relations" (Seidler 1974). In this study, however, the respondents supplied information in keeping with their personal views, opinions, behavior patterns, their subjective evaluation of the community attachment, and their user behaviors.

Potential avenues for future research

Overall, our results raise further questions about the design of online communities. More research with similar samples is needed to assess the representativeness of the current findings. An especially fruitful avenue for further research on the design of online communities seems to be the issue of the interplay between common bond and common identity attachment. This seems even more relevant since we found in many communities a blurring in the articulated goals of the community (i.e., it is increasingly difficult to categorize a community as common identity or common bond group since a lot of community designers implemented all sorts of features that allow for common bond as well as for common identity attachment).

It might also be of interest to re-examine our results regarding the influence of in-group interdependence on common identity attachment, for example, by specifically analyzing top rated virtual world guild members. Another area that would merit further investigation would be to examine the relation between personal information and liking, trust and respect since opportunities for self-disclosure seem not be related to common bond attachment. Likewise, given that common identity attachment seems more important regarding a number of user behaviors, future studies should look at more antecedents of common identity attachment.

Lastly, future research should consider the hierarchical nature of the data.[8] It is important to note that the data can be viewed as a hierarchical system of individuals and communities, with individuals and online communities defined at separate levels of this hierarchical system.[9]As a consequence, variables can be defined at separate levels of this hierarchical system (Hox and Kreft 1994). Whereas modeling hierarchical data structures in covariance-based structural equation modeling has been studied for several years (e.g., Mehta and Neale 2005; Muthén 1994; Preacher et al. 2010), no research has been conducted on multilevel modeling in the context of PLS path modeling. Thus, future research should approach this complex topic to allow for interactions between variables that describe properties of individuals and variables that describe properties of online communities.

[8] We would like to thank the associate editor for this remark.

[9] The same holds for individual communities (e.g., Facebook, LinkedIn) and types of communities (e.g., social networks, discussion forums).

Appendix

Table A1. Descriptive Statistics and Construct Correlations

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Network effects	3.898	1.595															
2. In-group interdependence	4.234	1.799	0.179***														
3. Intergroup comparison	4.881	1.384	0.096	0.551***													
4. Social categorization	3.959	1.383	0.202**	0.576***	0.709***												
5. Personal information	4.685	1.677	0.195**	0.185**	0.336***	0.374***											
6. Interpersonal similarity	4.880	1.413	0.094	0.328***	0.583***	0.568***	0.476***										
7. Collectivism	3.872	1.405	0.235***	0.324***	0.391***	0.496***	0.131	0.271***									
8. Social interaction	4.856	1.363	0.100	0.459***	0.603***	0.544***	0.376***	0.587***	0.266***								
9. Common identity	4.101	1.406	0.328***	0.486***	0.626***	0.627***	0.279***	0.428***	0.489***	0.493***							
10. Common bond	3.923	1.237	0.099	0.441***	0.453***	0.455***	0.274***	0.442***	0.390***	0.490***	0.548***						
11. On-topic discussion	4.630	1.715	0.281***	0.468***	0.382***	0.452***	0.066	0.171**	0.331***	0.409***	0.370***	0.249***					
12. Off-topic discussion	4.051	1.370	0.214***	-0.029	0.134	0.096	0.254***	0.068	0.147*	-0.042	0.133	0.106	-0.069				
13. Generalized reciprocity	4.728	1.437	0.222***	0.396***	0.352***	0.402***	0.184**	0.191**	0.344***	0.302***	0.328***	0.282***	0.436***	-0.055			
14. Direct reciprocity	5.367	1.071	0.093	0.318***	0.487***	0.391***	0.283***	0.410***	0.319***	0.542***	0.385***	0.331***	0.470***	0.050	0.512***		
15. Robustness	4.818	1.328	0.148*	0.279***	0.384***	0.381***	0.003	0.127	0.154*	0.311**	0.293***	0.132	0.497***	-0.164**	0.302***	0.371***	
16. In-group loyalty	4.395	1.364	0.195**	0.569***	0.690**	0.699**	0.244**	0.434**	0.465**	0.551**	0.748**	0.501***	0.548***	-0.018	0.401***	0.517***	0.493***

*** significant at p≤0.01, ** significant at p≤0.05, * significant at p≤0.10

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