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Gender Differences in Enterprise Social Network Usage and Transformation over Time

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Short Paper

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Abstract

Digital social networks play an increasingly important role in organizations. Such enterprise social networks (ESN) allow users to form and join groups and the exchange of messages within or across such groups. ESN are said to improve communication and collaboration across boundaries, therefore increasing the flow of information, exchange of knowledge and establishment of social capital. In this paper, we investigate ESN and gender. For male and female ESN users, we analyze differences in terms of general activity, cross-gender interaction, communication style and network structure. We provide evidence of our research in progress using more than 107,000 messages posted by more than 7,000 users across over 650 groups on an ESN. We show results that indicate existing gender differences, e.g. in terms of language style and network structure, and describe the next steps to analyze cross-gender interaction and communication over time.

Keywords: Enterprise Social Networks, Gender, Social Network Analysis, Group Analysis, Transformation, Text Mining

Introduction

Enterprise social networks (ESN) have been introduced in many organizations (Chang et al. 2015). An increasing demand for ESN software implementation in the past years highlight the growing importance of such technology for knowledge-centric companies (Berger et al. 2014). Thompson (2015) postulates the assumption that the turnover of ESN software will more than double by 2019. ESN mainly consist of business-internal applications and represent the equivalent of online social networks within an organizational context (Wehner et al. 2017). Hence, ESN such as Yammer or Jive allow to exchange messages linked to (discussion) threads that are usually placed with specific groups targeted towards specific topics and purposes (Riemer and Tavakoli 2013). ESNs also support other functionality such as creating user profiles, liking posts or following people. The implementation and adaption of ESN can influence a working team's structure (Suh and Bock 2015) and an individual's appraisal by colleagues in a positive way, leading to an increase of an employee's work satisfaction (Mark et al. 2014). Finally, ESN boast a positive impact on the knowledge management within a business, whether through the identification of experts (Hemsley and Mason 2012) or through improving the task-oriented and company-wide contribution of information and experiences in the social network (Leonardi 2014).

Digital social networks have been shown to alter contribution behavior (Zhang and Wang 2012) and employee as well as organizational performance (Sykes et al. 2014; Zhang and Wang 2012). They can impact power relations (Bobsin and Hoppen 2015) though formal hierarchies still play a role (Behrendt et al. 2015). At the same time, previous literature has shown that ESN can help to significantly increase cross-hierarchical communication over time (Riemer et al. 2015). Also within the network different virtual communities, i.e. groups, might impact participation behavior among employees (Dholakia et al. 2004). This suggests that gender differences are also altered within an ESN. However, little work has been conducted to examine ESN in terms of gender differences aside from (Brell et al. 2016) studying the varying reasons for using ESN for males and females. One of the goals of ESN is to reduce boundaries (Leonardi et al. 2013). This implies having more communication across boundaries such as age, location and function (Friedman et al. 2014). However, it is unclear to what extent (or if at all) ESN helps to reduce boundaries between gender, e.g. whether same sex communication dominates between-sex communication as reported e.g. for virtual health communities outside organizations (Kordzadeh et al. 2014). The outcome is uncertain because organizations provide a different frame for virtual communities, e.g. there are various forms of power struggles and resistance within companies (Fleming and Spicer 2007) that are not present outside corporations and usage varies depending on the purpose of online social networks (Herring et al. 2014).

Existing IS theories, e.g. from adoption research, suggest that men and women may use technologies differently (e.g. Venkatesh et al. 2004). However, research on the manifestations of such differences in IS usage as well as the development of such differences in contexts, where men and women are brought together in a virtual environment, is still underrepresented. In this paper, we aim to test gender theories and to identify corresponding initial gender-related differences in ESN usage. We then investigate the role of IS for lowering potential barriers between male and female users, hence impacting processes of social construction as well as the integration of individuals in the network regardless their gender.

Gender differences in ESN usage can manifest themselves in several ways. In our study, we first explore the general *activity* in ESN, which refers to the percentage of possible male and female users actually utilizing the platform, the intensity of usage per individual, which also covers to what degree platform features are leveraged. Second, we study *cross-gender interactions*. Third, we also examine to what extent *communication* in ESN is dominated by male or female users, e.g. whether females take a more passive (responders) or active role (initiators), and whether females are integrated equally in the entire communication network of the organization. Moreover, we are interested to see to what extent ESN highlights lexical or sentiment-related differences of the communication style of males and females, which have been observed in other contexts (Thelwall et al. 2010). Fourth, we aim to investigate differences in *network structures* between male and female ESN users. Finally, we study the development of these differences as we assume, that ESN usage of males and females may converge to a certain degree over time when coming together in a virtual community. This study takes place in a large multi-national organization with more than 20,000 employees. Our data covers a two years period and contains more than 7,000 users across over 650 groups.

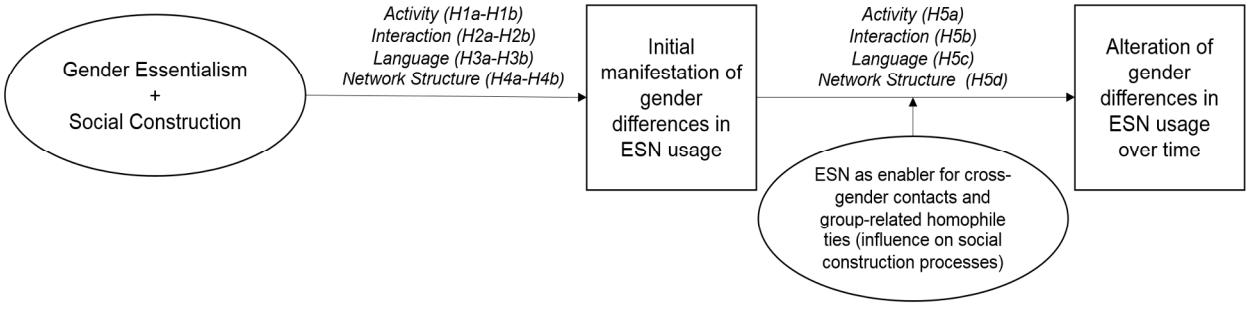
The paper is structured as follows: In the next section, we provide the theoretical background and related work to develop the relevant research hypotheses regarding gender-related differences of activity, interaction, communication and network structure of ESN usage. Afterwards, the research design will be described in detail. We then show preliminary results of our research. We conclude with a description of expected contributions, limitations and an outlook to further research.

Background and Hypotheses Development

Gender Theories and ESN

Gender theories are often split into three wide categories (Trauth 2013). We derive our hypothesis using two of them, i.e., gender essentialism and social shaping of gender, as depicted in the research model in Figure 1. Gender essentialism underlies the assumption that male and female are different by nature. As such, men's and women's behavior is seen as originating from inherent, group-level and bio-psychological factors, which is rather stable over time. Social shaping relies on the idea of social construction of gender and sex roles that are internalized by all women within society in the same way. Social construction as proposed by Fenstermaker and West (2002) emphasis the situational nature of gender that is also subject to constant assessment. Therefore, gender differences can change over time, in particular, given suitable enablers. It might be expected that after the launch of an ESN the forming and impact of groups might take some time. Thus, in our study, we aim not only to identify static gender-related differences in ESN usage but also respond to the call of McPherson et al. (2001, p. 415) to "observe the *dynamics* of network change over time through which networks and other social entities co-evolve." Hence, we start by identifying general differences of adoption rates, interaction, communication and network structure between men and women in ESN, and afterwards analyze the development of such differences over time. The prediction that the Internet would eliminate gender differences (over time) has not come true (Herring et al. 2014). However, ESN provide a special setting for interaction with strong influence of organizational aspects. Communication is persistent and observable by all employees within a corporation, which has impact on communication behavior (Gibbs et al. 2013). Thus, incorrect behavior based on gender is permanently recorded and more likely to have negative consequences for posters than during ordinary face to face conversations or in other online contexts. In ESN communication often takes place in groups (Riemer et al. 2013), where employees share common interests or functions, usually independent of gender. In ESN gender differences are less visible than in physical meetings. Gender dependent information such as voice pitch and non-verbal communication (Vrugt et al. 2004) are not available in ESN. In ESN such as Yammer or organizational collaboration platforms such as Skype for Business visual cues allowing to identify sex are often limited to a single portrait picture. Therefore, due to a lower observability of sex, monitoring of behavior and group structure that is likely to direct communication towards topics relevant to the groups (independent of gender), we expect that ESN are an enabler to at least partially overcome socially constructed gender differences over time.

Figure 1: Research Model



ESN activity

In previous IS research, men are said to have a higher acceptance rate of new systems compared to female users (e.g. Gefen and Straub 1997). In several studies, men were more likely to engage in task-oriented or instrumental behavior (Shen et al. 2010), resulting in a higher intention to adopt corresponding

technologies or features (Venkatesh et al. 2004; Morris et al. 2005). However, ESN are an organizational communication technology and hence can be classified as 'dual-purpose systems' (Wu and Lu 2013), which not only support work-related tasks but also serve as an infrastructure to socially connect and interact with other employees in the company. In research on behavior in internet usage, e.g. Thelwall (2008) showed a more widespread usage of social networks among females than among males. The same pattern was found regarding the usage of private e-mail or instant messaging (Banerjee et al. 2005). Herring et al. (2014) state that some social networks sites are preferred by male and others by female. With respect to corporations, e-mail communication was reported higher by female (Kleinbaum et al. 2013). Also, men tend to suffer more from social overload compared to women, potentially leading to a 'social network fatigue' (Zhang et al. 2016) and decreased activity. As a result, and based on previous literature, we assume women communicate more than men and that the usage of ESN features to support task-oriented behavior of men exceeds usage of women. We postulate:

Hypothesis 1a: In average, women communicate more frequently in ESN than men.
Hypothesis 1b: The adoption of task-oriented ESN features is larger for men than for women.

Interaction in ESN

The homophily principle of 'similarity-breeds-connection' (McPherson et al. 2001) suggests that people with matching characteristics such as age, religion or gender tend to communicate more with each other (McPherson et al. 2001). Or as Chipidza (2016) puts it, ties in any real network are more likely to form among people of same characteristics, which is based on the similarity-attraction principle, according to which interaction is more likely to take place between individuals with similar traits (Yuan and Gay 2006). According to the self-categorization theory, individuals can categorize others related to their traits such as gender, allowing them to perceive similarities, which are assumed to ease communication between corresponding individuals and hence lead to homophilous ties (Chipidza 2016). In the largest online social network, i.e. Facebook, only a minor homophily effect with respect to friendships has been found (Ugander et al. 2011). Regarding other social networks, homophilous interaction was e.g. documented in online health communities (Kordzadeh et al. 2014) and online games (Szell and Thurner 2013). Prior studies also indicated such behavior in the intra-organizational context (e.g. Brass 1985, Ibarra 1992). More recently, Kleinbaum et al. (2013) reported more same sex e-mail communication in organizations for female than for male. Therefore, we conjecture that also in ESN, members of the same sex interact relatively more with each other. Ibarra (1992) also stated that homophile ties among gender groups are stronger for men than for women in organizations, differing from (Szell et al. 2013) that claims stronger ties among women, which we also conjecture:

Hypothesis 2a: In the ESN, women communicate relatively more with women.
Hypothesis 2b: In the ESN, men communicate relatively more with men.

Communication Style in ESN

According to (Gefen and Straub 1997), men tend to communicate in a way that is based on social hierarchy and competition, while women tend to avoid having conversations dominated by an individual and hence tend to show a networking approach using discourse to achieve e.g. intimacy or cooperative behavior. In addition, female communication is more socially oriented towards creating a group in which all individuals are involved (Tannen 1994; Gefen and Ridings 2005). Female communication, compared to male communication, tends to emphasize two-way cooperation, to create consensus and complimentary behavior, leading to rapport and social knitting with other group members (Tannen 1994, Coates 1986; Yates 2001; Gefen and Ridings 2005). Also, according to Thelwall (2010), women tend to use positive emotions more frequently in their communication and furthermore seem to be more capable of encoding and decoding such positive emotions (McClure 2000; Hall et al. 2000). Kendall and Tannen (2015) summarizes multiple findings such as women use more emoticons and express more appreciation and support in some online contexts, whereas men challenge others more often and use more swear words. Therefore, we expect that in the context of ESN female communication tends to be more positive than male communication. We also expect that women communicate more team-oriented than men.

Hypothesis 3a: The sentiment of messages of female ESN users is more positive than those of male.
Hypothesis 3b: In ESN, women have a more team oriented communication style than men.

Network Structure in ESN

Corporations and their employees are often viewed and analyzed as a network of individuals (Freeman 2000, p. 350, Behrendt et al. 2015), where network structure has been linked to overall ESN success (Sasidharan et al. 2012). In such networks centrality indicates importance. Women have been reported to have positions that are less likely to connect unrelated groups in organizations and more tied to a single mentor (Burt 1993). Women (in senior positions in enterprises) have also reported more problems to gain access to informal networks (Singh and Vinnicombe 2004). Since females are still not at the same level as men in terms of salary and position (Goldin 2014), one might reason that men are more central in the network. Women are known to engage more in online social network platforms outside companies in terms of number of partners (Szell et al. 2013). In contrast to men, they also state gathering information on a broader social network as important motivation for usage (Krasnova et al. 2017). Thus, we postulate:

Hypothesis 4a: Women have more communication partners than men in ESNs.
Hypothesis 4b: Women exhibit less important roles with respect to network cohesion.

Gender-related ESN Transformation

In addition to the identification of gender-related differences in ESN usage, we aim to explore the role of ESN as a platform to overcome such potential barriers over time. Our following hypotheses base on two main assumptions. First, we assume that gender-related homophilous behavior decreases over time, if men and women are brought together in groups. Being part of the corresponding group becomes a trait that others can perceive as a similarity or matching characteristic (McPherson et al. 2001). In consequence, the impact of gender on different user behavior may decrease over time. Second, we assume that in gender-mixed groups, a process of assimilation will take place, in which interaction and communication between men and women may still be different but over time tend to align to a certain extent. This is in line with previous research, which showed that with the introduction of an ESN, communication between different hierarchy levels can increase, and hence formal and informal barriers can be overcome (Riemer et al. 2015). For the above described aspects of activity (H1), interaction (H2), language (H3) and networks (H4) we postulate the following in the context of ESN transformation:

Hypothesis 5a (Activity): Over time, the ESN activity gap between men and women decreases.
Hypothesis 5b (Interaction): Over time, the share of cross-gender communication in the ESN increases.
Hypothesis 5c (Language): Over time, the sentiment gap between messages of men and women decreases.
Hypothesis 5d (Networks): Over time, network measures of male and female users become more similar.

Research Method

To analyze gender differences in ESN, we conduct case study research using data from at least two large organizations. A case study "investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin 2009, p. 18). We believe that case study research of a large organization is a suitable candidate as research method, since it allows to observe behavior without interference of any kind as it naturally occurs. Second, we prefer a comprehensive, in-depth analysis to understand possibly complex phenomena in a network. Third, we target not just one organization but two and we focus on large organizations which significantly increases the chances of generalizability of our findings. In the following, we provide an overview of the case setting and the data collection. Then we describe the data analysis process and metrics.

Setting, Data Collection and Preparation

The selected case organization is a large multi-national organization employing more than 20,000 employees worldwide. Our data was collected using an ESN platform called Yammer having many features in common with platforms like Twitter or Facebook, e.g. users can follow other users, share or like messages. Groups are a key feature of ESN that are less prevalent in non-enterprise networks. Groups can be about different topics and different purposes. Each group is a collection of threads. A thread is a discussion, beginning with one initial message that is being replied to in a possibly recursive manner. In public groups, messages can be read by any member of the entire network and posted by members of the group. Private groups are not part of this study due to confidentiality and privacy reasons. All data was

anonymized, e.g. any user or client names were removed from the data. The ESN platform mainly evolved bottom up, i.e. users joined based on their own will.

Our data covers the period from introduction, i.e. January 2015, until Mid-January 2017 when 107,000 messages were posted on the platform across more than 650 public groups. Out of the 7,416 unique users who posted at least one message, 40% did not post more than two messages in 2016. Still, content consumption in ESN is likely to be significantly more frequent, e.g. Mattern et al. (2012) state as rule of thumb a ratio of 90-9-1 of users reading, modifying and creating content. Besides the (text-) body of the messages, additional columns comprise the following (meta) information: ID of the message, for replies the ID of the post it replied to, a timestamp, group ID, user ID and information about attached files. We excluded bot postings and messages that only contained meta-information, e.g. „User xyz has joined the network". Since gender information was not readily available in the export we provided a script to extract gender information based on employees' first names. Company employees ran the script on the data and gave us access to the gender information. The conversion is based on a well-established public library (Michael 2007) containing 40000 first names as well as their frequency for several countries and a classification into male, female and unknown. It has been used in multiple open source projects and scientific studies (e.g. Sloan et al. 2013). Using this dictionary, we obtained 4,928 male users, 1,681 female users and 807 remained unknown. We manually verified the correctness of a subset of our assignments using linguistic cues in the messages, i.e. posts of the form "I will clarify with [user:1520084299] as soon as he is in the office today". In this example, the user with ID 1520084299 is male due to the "he" pronoun. This verification approach allowed to identify 203 gender assignments out of which 13 males and 5 females were judged as "unknown" by the dictionary and only two were incorrectly assigned.

Data Analysis

Our analysis is based on aggregated messages of each individual as in (e.g. Riemer and Tavakoli 2013; Behrendt 2015). We also conduct analysis where each group is treated as an observation. In prior work metrics have been sometimes computed on the thread level (e.g. Kordzadeh et al. 2014), but group level analysis has been mainly neglected except for brief enumerations or categorizations (e.g. Riemer and Tavakoli 2013; Friedman 2014). To evaluate metrics for a group we aggregate metrics of posters in the group by only considering communication within groups. An overview of the metrics used in the initial phase of the study can be found in Table 1.

Table 1. Metrics and Description

Category	Metric	Description
Platform Feat.	Hash-/UserTags	Fraction of messages containing at least one hash-/usertag
Network	Closeness Centrality	Measures how near a node, e.g. user, is to all other users
	Degree Centrality	Number of different communication partners
Linguistic	Optimism	Score indicating positive communication
	Politeness	Fraction of messages containing "please" or "thank"
Interaction	Msgs	Number of messages sent by a user
	InitMsgs	Fraction of messages that started a conversation (thread)
	SameSexRepliedMsgs	Preference of communication to one sex

We excluded persons having three or less messages in metric evaluation for individuals. For group based metrics, groups with less than 30 messages or with three or less messages from one gender were removed. To get a metric for a group, we compute the mean score of all users for each gender separately, e.g. to obtain "Msgs" for males in a group we compute the average count of all messages sent by male posters in the group. Many of our computed metrics or variants thereof in Table 1 have been used in prior studies on ESN (Hacker et al. 2017). So far, we have added to the set of metrics for ESN mainly in the field of textual analysis, where we took metrics from Singh (2001), Newman (2008), Demers et al. (2009) and Schwartz (2013). To assess language characteristics can be interesting for researchers as well as practitioners. For example, overly negative communication might be an indicator for problems within a company, but also overly positive communication might be perceived negatively by employees (Smeltzer 1991) or it might conflict with certain values of an organization, such as being open (Linnenluecke and Griffiths 2010) and,

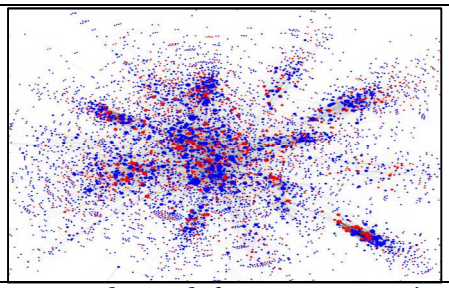
thus, also truthful. The optimism score corresponds to the net optimism score used by (Demers et al. 2009) in combination with a sentiment dictionary (Liu et al. 2012). We introduced a metric covering the preference of a user to communicate with same or other sex persons ("SameSexRepliedMsgs"). More precisely, we measure the deviation of replies to same gender initial messages of a thread from expected replies assuming gender equal behavior. For a male user, we compute: RepliesToMaleByMale / ReplyMsgsByMale - InitialMsgsByMale / InitialMsgs. The computation for females is analogous. A value of zero implies gender neutral behavior and values larger zero indicate same sex preference.

Social network analysis is commonly applied in IS and, more recently, in ESN (Behrendt et al. 2015). According to Freeman (2000, p. 350) the analysis "involves theorizing, model building, and empirical research focused on uncovering the patterning of links among actors". We describe the standard approach focusing on single users, followed by a proposal to use groups from ESN as the singular entity of analysis. A social network can be modeled as a graph, where, traditionally, a node represents a user and an edge between two users indicates a relationship between the two, such as friendship or message exchange. We focus on activity graphs (e.g. Behrendt et al. 2015), showing communication among users. The strength of an edge between two users is determined by the number of messages that they exchanged. We employ two centrality metrics as proposed by Freeman (1979), i.e. degree centrality and closeness centrality. In the future, we intend to use betweenness centrality (Freeman 1979) and eigenvalue centrality (Bonacich 1987). Degree centrality corresponds to the number of different communication partners. Closeness centrality states to what extent a node is in the center of the graph. It is the average length of the shortest paths between the node and all other nodes in the graph. We also suggest looking at the interrelations among groups of users as defined in the ESN in addition to individuals. In this exploratory study, we defined the strength of the relationship between two groups as the number of users posting in both groups. Node size corresponds to number of posters in a group. Groups vary in topic and purpose (Riemer and Tavakoli 2013). As such we might expect groups with related topics to be near each together. In turn, this might allow to visually observe, whether there is a strong prevalence for a topic by a *gender*.

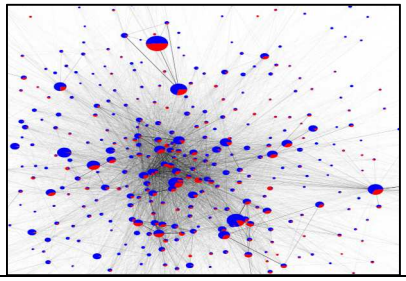
Preliminary Results

In this initial study, which is of more exploratory nature, we have computed the metrics for individuals and groups as shown in Table 2 and provided network graphs (Figure 2) to get an understanding of male and female ESN users within the organization.

Figure 2: Social network graphs with blue indicating male, red female



Activity Network Graph for user communication



Graph relating groups of the ESN

The activity network graph on the left in Figure 2 indicates that overall men and women are well mixed, e.g. there are no large separate clusters between male and female. However, it still suggests that women are communicating more with women, since in a perfect uniform distribution one would expect that the four nearest neighbors of a female contain three men and one woman. This is often violated, since across the graph there are many small clusters of a few women being close to each other. The star-shapedness of the graph highlights that besides a core set of members that are near each other, there are several other branches (formed by sets of members) that are more or less isolated clusters aside from some connections to the center. The graph in the right of Figure 2 indicates that most groups are gender-mixed groups. There are not any large clusters of groups of just one gender. This hints that both gender participate in all topics discussed in the network.

Table 2 shows the computed metrics of Table 1 based on using individual users as observations and each ESN group as observation. We performed standard t-tests with two independent samples for individual

users (male and female) and one sample t-test for groups, i.e. for a metric we used the difference of male and female per group as an observation. The results between individuals and groups are fairly consistent, i.e. if a metric for one gender is larger for individuals then it is also larger for the same gender when basing analysis on groups. However, we observed strong differences, when it comes to significance of results (p-value) and absolute differences between means for male and females. Generally, individual user analysis yields more statistically significant results, which might be partially explained due to the larger number of observations, i.e. we have several thousand individuals but only a few hundred groups. Therefore, we see a need for a second dataset to achieve more certainty. With respect to our hypotheses, we can accept hypotheses H1a that women communicate more in terms of number of messages though the p-value for "Msgs" is fairly large. Interestingly, when it comes to initiating conversations, men seem to be more active as indicated by the "InitMsgs" metric. This phenomenon requires more in-depth analysis.

Table 2: Evaluated Metrics

		Individual User based			ESN Groups based		
Metric Category	Metric	Mean Female	Mean Male	p-value	Mean Female	Mean Male	p-value
Platform Features	HashTags	0.0681	0.0503	0.001	0.0567	0.0529	0.58
	UserTags	0.164	0.137	<0.001	0.149	0.143	0.42
Network	Closeness Centrality	0.246	0.242	<0.001	0.382	0.381	0.71
	Degree Centrality	0.00214	0.00194	0.04	0.119	0.115	0.49
Linguistic	Politeness	0.197	0.164	<0.001	0.138	0.131	0.27
	Optimism	0.062	0.0547	0.01	0.0258	0.0264	0.54
Interaction	Msgs	29.4	26.7	0.2	5.64	5.55	0.79
	InitMsgs	0.426	0.438	0.28	0.412	0.446	0.02
	SameSexReplied Msgs	0.0473	0.174	<0.001	0.151	0.386	<0.001

For activity and adoption of platform features, we have weak evidence stemming only from two features. Further analysis is needed. But we observe homophily in communication, i.e. we can accept H2A-H2C at a significance level of less than 0.001 as our "SameSexRepliedMsgs" metric shows. For larger optimism in female communication (H3a) we find strong support when measuring across all individuals but not as much on a group level. For assessing team-orientedness (H3b) in the future, we intend to investigate on the usage of pronouns (e.g. "I" vs "we"), but the politeness metric could also be used as a related first weak indicator, which is in support of the hypothesis. With respect to network structure, i.e. H4a, our degree centrality measure for individuals indicates that women have overall more ties than men. For H4b we lack the computation of betweenness centrality but closeness centrality states that women seem to be more in the interior of the network. For all current and future results, we will analyze the development over time (H5a-H5d) to assess, if ESN helps to overcome gender-related boundaries.

Expected Contributions and Limitations

Several contributions can be expected for practitioners as well as academics. Based on data from two large corporations, we will show how offline gender differences may transfer to ESN and how ESN help to overcome corresponding boundaries over time. In consequence, our study will show, if and how information flow and the establishment of social capital between genders can be supported through the introduction of an ESN in the organization over time. As of now, a limitation of our study is the limited number of groups that does not yet yield sufficient evidence in some cases. Our final study covering two large companies will be one of the largest with respect to the amount of used data in the field of ESN providing valuable empirical facts and insights. Still, as an inherent limitation of case study research remains the generalizability of results. On the methodological side, we propose novel metrics in the context of ESN. We propose and analyze graphs with groups as nodes as depicted in Figure 2. Such a graph allows, e.g. to investigate the impact of size of groups and topics on gender behavior that are likely to be directly translated into recommendations for management. A variety of conceptual contributions, such as defining connectivity and metrics for such graphs might foster further research.

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