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Gendered discourse patterns on online social networks: A social network analysis perspective

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ABSTRACT

The study examines the gendered discourse patterns on a popular online social network, TheMarker Café, using social network analysis. Overall, the findings strengthen previous analyses that report evidence of men's assertive and dominant discourse style and social role versus women's more cooperative and supportive discourse style. Men wrote more posts, while women commented on other people's posts more often. Women's posts received higher rankings than men's posts, strengthening the notion that women receive more affirmations on online social networks. The study also examined the interplay between the structure of the TheMarker Café network and gendered discourse patterns. Our findings also confirmed a link between activity network structure and women content popularity.

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1. Introduction

The role of gender in social conversations has attracted the interest of scholars for decades (Leaper & Ayres, 2007; Leaper, 2014; Maltz & Borker, 1982). A meta-analytic review of studies found strong evidence that men produce a more domineering and assertive discourse style in line with their perceived social status and competitive nature, while women's discourse style is more often characterized as affiliative and supportive (Leaper & Ayres, 2007). In light of the central role of online social networks in contemporary society, recent studies have moved to examine whether such traditional gendered discourse patterns persist in online social network environments or whether online social networks are a "game changer" (Brandtzaeg, 2015; Joiner et al., 2014, 2016).

This study aims to contribute to studies of gendered discourse on online social networks via a social network analysis of gendered discourse using *TheMarker*,¹ an online social networking site operated since 2007 by Haaretz, a prominent Israeli news outlet. While previous studies of online gendered discourse patterns

mostly used surveys (e.g., Joiner et al., 2014) or experiments to examine how men and women respond to messages (Joiner et al., 2016), the social network analysis method used in this study allows a deeper examination of the connections between members in a real social network environment and on a much larger scale than most alternative methods (Hayat & Lyons, 2010; Lesser, Hayat, & Elovici, 2016; Onnela et al., 2007; Szell & Thurner, 2013). Indeed, as noted below, the *TheMarker Café* community includes over 100,000 members, and over 1.7 million links, allowing a large scale and wide perspective on the issue.

The social network analysis method also makes it possible to identify the online network structure and thus illuminates not only the gendered discourse patterns but also the characteristic features of the network environment and their potential impact on community members' gendered discourse patterns. In contrast to previous studies of gendered discourse that did not address network structure, our analysis maps the link between network structure and the gendered discourse patterns within the network.

Traditionally, it has been argued that certain network positions within offline social networks are associated with increased influence, which may lead to advantageous benefits in offline social settings (Burt, 1992; Erickson, 1996). Recent evidence suggests that these arguments are also true for online environments (Szabo & Huberman, 2010). Typically, online sites facilitate various means of interactions between individuals, such as following or

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E-mail addresses: Tsahi.hayat@idc.ac.il (T. Hayat), lessero@post.bgu.ac.il (O. Lesser), tazran@idc.ac.il (T. Samuel-Azran).¹ <http://cafe.themarker.com>.

responding. These social and communication ties form a network which provides an opportunity for Online Social Network (OSN) members to increase their visibility and exposure, interact with others, and gain real advantage from their network position (Ellison, Vitak, Gray, & Lampe, 2014). However, researchers have not yet systematically investigated whether, and to what extent, online network structures affect OSN members' abilities to increase the popularity of their content. This article attempts to fill this gap. Building on prior research, we propose that online content's popularity is highly correlated with social network structures, and even more so with the communication interactions network. Our study identifies preferred network positioning that might enhance popularity among OSN users.

The understanding of how certain network structures – which are often associated with social capital – can be mobilized to gain benefits in online environments may assist individuals and organizations seeking to promote their messages. Furthermore, acknowledging gender-specific differences in OSN behavior can provide gender-targeted insights for OSN administrators and members aspiring for influence and leadership.

In line with all the above, and in order to contribute to the question of the social networks gendered discourse patterns, the analysis was specifically designed to examine the following research questions:

- RQ1 Which gender writes more posts?
- RQ2 Which gender comments on posts more often?
- RQ3 The posts of which gender are more popular?
- RQ4 Which type of social ties (friendship ties or activity ties) are more strongly correlated with content popularity?

To address these research questions, in January 2012, we collected all the historic data – including all the posts and comments – from *TheMarker Café* since its inception in 2007. A detailed description of the friendship network can be found in Lesser, Tenenboim-Chekina, Rokach, and Elovici (2013), and this portion of the dataset is also publicly available.² We collected the public portion of *TheMarker* dataset using a dedicated scraping tool, extracting information on two types of ties among its members – friendship and commenting – which were described by previous studies as the two main forms of communication between individuals on online social networking sites (Bohn, Buchta, Hornik, & Mair, 2014; Ghosh & Lerman, 2010). From the over 100,000 members of the network, 42% identified themselves as males, and 36% as females, and the remainder chose not to indicate their gender. As we also did not analyze dormant members, our analysis includes a total of 21,413 *TheMarker Café* members (52% males and 48% females) who disclosed their gender, had at least one friendship tie, and posted at least one comment during the period analyzed in this research.

Importantly, the question of whether traditional gendered discourse patterns persist in online social network environments is central not only for gender studies but also for information studies, which widely examine whether the web and social networks serve as “social equalizers.” This question arose in light of the notion that online interactions allegedly blur some of the external social boundaries that are emphasized in real-life situations, consequently weakening or erasing traditional “social roles.” Amichai-Hamburger, McKenna, and Samuel-Azran (2008), who analyzed the web's effect on social connections and on social power plays, argue that the web empowers socially disadvantaged individuals and thus the socially poor get richer. Indeed, studies found that

individuals who suffer from high levels of social anxiety benefit from interacting in small groups online because the factors that trigger their anxiety in face-to-face situations are absent in text-based Internet interactions (McKenna & Seidman, 2006; McKenna, Green, & Gleason, 2002). Other studies found that the greater sense of control and security in online interactions benefits introverts, neurotics (Amichai-Hamburger, 2005; Maldonado, Mora, Garcia, & Edipo, 2001), and people with physical disabilities (Raghavendra, Newman, Grace, & Wood, 2013).

In contrast to this optimistic notion, other studies show that the opposite effect occurs in many instances, as the socially rich accrue even greater social assets online. Thus, for example, studies show that attractiveness levels rise when Facebook members have good-looking friends (Walther, Van Der Heide, Kim, Westerman, & Tong, 2008), further compounding effects of the offline beauty bias (Rhode, 2010). Furthermore, in a gender studies context, a recent big data analysis (Brandtzaeg, 2015) that examined gender differences in civic engagement across countries found that traditional gendered discourse patterns persist in online social network environments, and concluded that Facebook is definitely not “the great equalizer.” Analyses by Joiner, Stewart, et al. (2014) and Joiner et al. (2016) also identified persistence of traditional women affiliative discourse versus males' dominant discourse on social networks online.

To contribute to the debate over the web's role as the great equalizer and an e-empowerment tool, the current study contributes to the ongoing mapping of the issue not only by continuing examining the interplay between gender and social media discourse but also by examining the interplay between social network structure, gendered discourse, and content popularity, thus addressing a lacuna in contemporary studies. To place the study's hypotheses in context, analyses of online and offline gendered discourse patterns are reviewed below.

2. Related work

2.1. Social network analysis

In recent years, the rise of the Internet has facilitated the emergence of an enormous volume of traceable communication on frameworks such as OSN, providing an opportunity to study social networks on a larger scale (Onnela et al., 2007; Szell & Thurner, 2013). Often these studies have been based on the social network analysis (SNA) methodology (Wasserman & Faust, 1994). A key element of social networks is the ability for individuals to simultaneously interact in multiple social contexts by maintaining different types of social ties such as friends, acquaintances, and correspondents. The overlay of several networks on the same set of nodes (individuals) is called a multiplex network (MPN). A MPN facilitates the description, quantification, and analysis of complex sets of relationships among individuals.

A large and growing body of literature has investigated gender differences in this area by studying the social networks of males and women (e.g. Brashears, Hoagland, & Quintane, 2016). These differences are manifest on several levels. Women's networks are often larger than men's networks (Moore, 1990), and they include a higher proportion of kin (Marsden, 1987). Furthermore, females often provide more interpersonal support in this setting than males (Wellman & Wortley, 1990). Gender-specific differences in managing the multiplex network ties were also demonstrated on a dataset of an online-gamers community (Szell & Thurner, 2013). Thus, it is clear that the networks of men and women – including OSNs with multiple types of social ties – differ on several levels.

OSNs typically include technical functionality that enables various types of communication (Amichai-Hamburger & Hayat,

² <http://proj.ise.bgu.ac.il/sns/themarker2.html>.

2017). Several examples of such OSN functionalities are: forming a friendship connection, posting content, commenting on others' posts, and rating these posts. A hypothetical example of an OSN operating as a multiplex network can be found in Fig. 1. The network illustrated includes four individuals who maintain three types of ties: friendship ties (the dotted lines), ties of communication via commenting (green lines), and favoring others' content (the blue lines). Hereinafter, we refer to the friendship ties network as a *friendship network* and to the commenting network as *activity network*.

Note that the social network analysis framework - and particularly the MPN literature - can only partially explain the interplay between the network structure of OSN users and the popularity of their content by capturing images of interactions among users, if such exist. Thus, along with the SNA framework, our work is built on an additional theoretical pillar, the social capital literature. Social network analysis, in conjunction with social capital can yield significant insight regarding the benefits associated with the positions individuals occupy in social networks (Lin, 2008, pp. 50–69).

2.2. The social capital account

Since there is no firm, commonly agreed upon, definition of 'social capital,' the specific definition adopted by a study depends upon the discipline and level of investigation. In its simplest form, 'social capital' can be defined as the social networks or connections through which one gains access to resources that include human and economic capital (Bourdieu, 1986). In his work, Bourdieu stated that social capital has two elements: (1) the actual social relationships that allow people to access resources possessed by others, and (2) the quantity and quality of these resources.

There are two main theoretical approaches to describing the process of how social capital is expected to produce returns: accessed and mobilized (Lin, 2008, pp. 50–69). In the *accessed* approach social capital is conceived of in terms of its capacity - the pool of resources embedded in one's social networks - with the expectation that the richer or greater the capacity, the better the returns. Thus, the description entails the linkage between *accessed social capital* and its expected return. In the *mobilized* approach, social capital is defined in terms of the actual use of this resource (one's social networks) with the expectation that the better the capital used, the better the returns. The social capital may have different benefits in different settings (e.g. in the workplace or in online environments settings). Our description focuses on *mobilized social capital*. While *accessed social capital* estimates the degree of access to social resources or the extent to which a potential pool of resources capable of generating returns is available to actors, *mobilized social capital* examines how the social capital is

utilized to gain greater returns.

In an online environment, resources - such as social capital - are often limited to those actually available online. For instance, in online social networks, information and knowledge are very important resources (Chang & Chuang, 2011). Furthermore, there are several objectives - benefits - that can actually be achieved online. One such objective might be to spread information in order to potentially gain a good reputation, and OSNs can be used as tools to create awareness and draw attention to one's opinions and views (Castells, 2013). In this context, mobilized social capital can be utilized to enhance the popularity of content published by OSN users.

2.3. Online discourse and posts writing

Our first research question is whether males or females upload more posts to social networking sites. Writing a post is, to some extent, similar to starting a conversation, a clear sign of dominance on online social networks. Dominance in social networks discourse has long been examined using diverse approaches in line with timely social perceptions. In his review of the history of the debate, Coates (2004) notes that early studies examined the issue via the dominance prism (Lakoff, 1975), which deems that men dominates conversations in line with their' superior role in men-dominated and sexist societies, relegating women to roles of compliance and support of men in conversations. In contrast, the more recent social constructivist prism deems that people act in accordance with their perceived assigned role in society, and that males dominate conversations to fulfill social expectations of them (Cameron, 2010). Other approaches include socialization theory, which explains males' dominance via the perceived impact of gender on socialization patterns. The theory suggest that participating in gender-segregated peer group activities affects discourse patterns; and as females participate in more cooperative activities and males in more competitive group activities, girls develop more supportive forms of talk while boys use more assertive language to establish their dominance (Sidanius & Pratto, 1999).

While the prisms through which the question was addressed were different, the studies' findings almost unanimously pointed to the same conclusion: males are more likely to use assertive language to gain dominance and achieve practical goals, and usually dominate conversations, whereas females are more likely to use affiliative language in order to connect with others. Indeed, a recent comprehensive study in the online social networks realm found that women tend to share more personal topics (e.g., family matters) using an affiliative mode of discourse, while men are more likely to discuss less personal issues such as politics and sports (Wang, Burke, & Kraut, 2013). Another recent study (Brandtzaeg, 2015) used a big data tool (Wisdom) to examine whether Facebook facilitates more equal civic engagement across genders and countries by analyzing expressions of civic engagement among 21,706,806 Facebook users in 10 countries across Asia, Africa, the Americas, and Europe. The study found that males are drawn more toward political and information-oriented subjects compared to females, who are more strongly attracted to private issues (Brandtzaeg, 2015). The researchers concluded that offline gender differences in civic engagement are reinforced by and reproduced on Facebook. In line with this empirical evidence of men dominance in both offline and online discourse, our first hypothesis is that males are more likely initiate conversations by posting on social networking sites:

H1. Men write more posts on social networking sites, when compared with women.

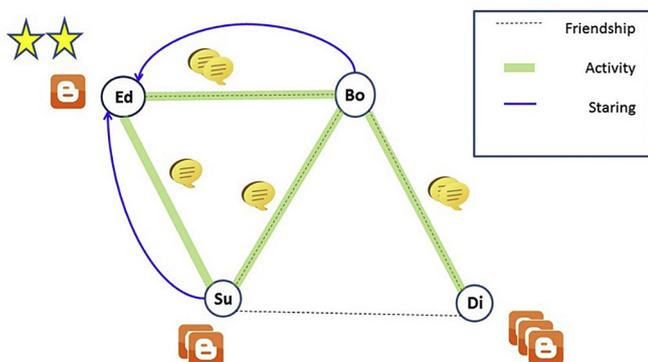


Fig. 1. An example of a MPN (adapted from Lesser et al., 2016).

2.4. Online discourse and comments

Our second hypothesis, which pertains to who comments more on the online social network *TheMarker Café*, in which comments constitute the main form of responding to others' posts, is based on analyses that identify females' tendency to be more supportive than males in online conversations (in a similar manner to the offline world). A recent study (Joiner et al., 2016) shows that women are more supportive than males and tend to respond to others' messages in social network settings. These findings are also supported by findings of another recent study (Joiner et al., 2014) that examined gender differences in language use on Facebook, surveying 600 undergraduate students (388 females and 207 males), and analyzing men and women responses to two Facebook status updates. The study found that females were significantly more likely to 'Like' a Facebook status update, post a public reply to a Facebook status update, and express stronger emotional support than males. Wang et al. (2013) similarly identifies that females post twice as many comments and updates on Facebook in comparison to men. Walton and Rice's analysis (2013) of nearly 4000 tweets also revealed females' tendency to be more positive and supportive on social media in comparison to men. Females were also found more supportive of others' posts on MySpace than men (e.g., Thelwall, Wilkinson, & Uppal, 2009). These findings are all consistent with the earlier meta-analysis conducted by Leaper and Ayres (2007), which confirmed females' tendency to use more supportive language in comparison to men. Accordingly, in line with the main trend revealed in former studies, our second hypothesis is.

H2. Men post fewer comments on social networking sites, compared with women.

2.5. Content popularity

Next, we seek to understand content popularity, examining the posts of which gender enjoy greater popularity on online social networking sites. On such sites, popularity of content and individuals is often measured by indices such as the number of views (eyeballs) or ratings. For example, YouTube displays the number of times a video has been viewed. Some sites also allow members to express their opinions of posted content by marking a post as preferred, with a thumbs-up sign (on YouTube) or favoring (faving) a photo (on Flickr).

Popularity of content (using measures such as content ratings or exposure) is one way of assessing leadership and influence in online social networking sites (e.g., Szabo & Huberman, 2010). Preece and Shneiderman (2009) identified the various roles of users who produce, consume, and interact with online social networking site's content, dividing these roles into four categories: readers, contributors, collaborators, and leaders. While most users participate in online social networking sites simply as readers who do not create any content, leaders may invest some, or even significant, time and energy in writing and posting on online social networking sites.

Previous studies of offline networks have shown that popularity of concepts and products is often associated with, and influenced by, members' social ties and network structure (Rogers, 2010). Furthermore, certain network structures may increase the accessibility of content (Burt, 1992; Lin, 2008, pp. 50–69). Building on these findings, a large and growing body of literature has investigated the relationship between network structure and online content popularity (e.g., Weng, Flammini, Vespignani, & Menczer, 2012), yet very few analyses have explored the interplay between gender and online social network popularity.

One of the few to address this topic was an analysis (Wang et al., 2013) that used the Latent Dirichlet Allocation (LDA) analysis method to identify topics from more than half a million Facebook status updates, which revealed that women generally receive more feedback than men (although the analysis did not identify the tone of the comments). Joiner et al. (2016; and Joiner et al., 2014), analyze the tone of comments and showed that females messages tend to receive stronger emotional support than men messages. Accordingly, our study's third hypothesis is:

H3. Men's posts on social networking sites receive lower rankings when compared with women's posts.

Our fourth hypothesis relates to the interplay between the types of ties individuals have, and the popularity of their content. There is a large and growing body of literature on the relations between network structure and content popularity in a variety of online social networks environments including Twitter (Weng et al., 2012), Digg (Lerman & Hogg, 2010), and YouTube (Szabo & Huberman, 2010), yet few examined gender effects. The content popularity prediction models developed in these studies typically included two types of ties: The first type is *friendship social ties* that, once created, remain intact, such as the ties between various account followers on Instagram or Pinterest. The second type of network structure is the *activity network structure* which refers to high and dynamic communication activity within an online social network, such as re-tweets on Twitter or 'likes', 'share' and 'comments' on Facebook. While friendship ties indicate the potential for information exchange, activity ties serve as stronger evidence that information exchange has actually occurred.

Social capital is a concept closely related to information exchange in social networks (Hayat & Mo, 2015), and may explain further the relationships between individuals' social ties and popularity (Kawachi & Berkman, 2000; Putnam, 1995, 2000). There is no firm, commonly agreed-upon definition of "social capital" and the particular definition adopted by any given study is dependent on the discipline and level of analysis. In its simplest form, "social capital" can be defined as the social networks or connections through which one gains access to resources (Bourdieu, 1986). Coleman defines "social capital" as a function of social structure producing advantage (1988), and Bourdieu further defines "social capital" as "the aggregate of the actual or potential resources that are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition" (Bourdieu, 1986, p. 248).

Others view social capital as a process. For example, Newton (1997) noted that social capital is essentially cyclical. He suggests it is comprised of norms, networks, and resulting outcomes, which can then feed back into further norms and networks. Similarly, Resnick (2001) has noted that such cyclical patterns carried out through communications technology comprise "sociotechnical capital" (p. 2). These cyclical approaches are theoretically important but methodologically difficult to capture. Blurring the differences between the social networks and their subsequent effects (which then create further networks) creates an endogeneity problem for measurement (Williams, 2006).

Although social capital is a contentious and slippery term, all these definitions emphasize the notion that social capital resides not within the individual but rather in the relationships that an individual or group maintains with others. For the purpose of this study, social capital is defined as the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual; social capital comprises both the network and the assets (including information) that may be mobilized through this network (Nahapiet & Ghoshal, 1998). Social capital can influence and facilitate the flow

of information (Lin, 2001).

Within the context of content popularity, recent studies highlight that activity network measures may be a better indication of individuals' social capital (compared to friendship networks), and as result, better predictors of the popularity of their content (Lerman & Hogg, 2010; Szabo & Huberman, 2010). This view is supported findings of a Facebook based study by Ellison et al. (2014), which suggest that social capital is not generated simply by the existence of friendship connections, but rather is developed through relationship maintenance behaviors such as responding to questions and maintaining active communication with others. The evidence that social capital increases with the number of outgoing communication ties is further supported by Bohn et al. (2014). These findings highlight the importance of managing social ties actively through communication.

Communication activity among online social network members – such as commenting – signals interest and information transfer among these members. Such interest has been shown to lead to increased number of readers of one's content (Brooks, Hogan, Ellison, Lampe, & Vitak, 2014); which consequently may increase the popularity of the content posted by members who communicate frequently. In other words, the activity network – the network comprising comments to others' posts – may be a better indicator and predictor of content popularity than the friendship social network.

H4. Content popularity is more strongly correlated with activity network structure measures in online social networks than with friendship measures.

To conclude, through the examination of the four hypotheses discussed above, this study aim is to examine the gendered discourse patterns on a popular online social network, TheMarker Café, using social network analysis. Specifically the study will explore the nature of the activity of men and women within TheMarker Café; look at the popularity of men and women's content, as well as at the interplay between the network structure of men and women who are active users of TheMarker Café, and the popularity of their content.

3. Method

The current study uses the social network analysis method, grounded in the premise that social life is created primarily and most importantly by relations and the patterns formed by these relations. Social networks are formally defined as a set of nodes (representing network members) connected by one or several types of relations (Wasserman & Faust, 1994). Because network analysts view networks as the primary building blocks of the social world, they not only collect unique types of data, but also begin their analyses from a fundamentally different perspective than the approach used by individualist or attribute-based social scientists.

A network's topology is characterized by the structural properties of the node and edges comprising it. Following is a formal definition of the measures we chose for our analysis. We represent the OSN as a multiplex network $G = (V, E, C)$, where V is a set of n nodes (OSN members), E is a set of edges representing the friendship links, and C is a set of edges representing the activity links. The graph edge $e_{ij} \in E$ represents a friendship link between node v_i and node v_j . Similarly, the graph edge $c_{ij} \in C$ represents an activity link between node v_i and node v_j . All of these links are defined as undirected. Consequently, $G^S = (V, E)$ and $G^A = (V, C)$ represent the friendship and activity networks, respectively. For each node in G , we calculate the following variables: number of posts, number of comments, total number of views v 's posts attracted, and total number of stars v 's posts were awarded. For each node on both

networks (friendship and activity), we also computed the degree centrality.

3.1. Data collection

We collected our data from *TheMarker Café*, an online social networking site in operation since 2007. Members of *TheMarker Café* may establish mutual friendship connections with each other, post content on personal blogs or community pages, comment on other members' published content, and mark favorable content with stars.

The site maintains a relaxed privacy policy: The default privacy setting of a newly created *TheMarker Café* account is such that the profile information is publicly visible. Consequently, the majority of the information on the networking site is accessible without the need for any credentials. In January 2012, we collected the public portion of *TheMarker Café* dataset using a dedicated scraping tool, extracting information on two types of network ties: friendship and comments. Friendship ties are bidirectional links between network members, representing the mutual confirmation of both connected individuals. Commenting ties are represented by the written responses that a *TheMarker Café* member affixes to an existing post. Since these comments are effectively a form of communication between individuals, we represent them as a distinct type of network tie that represents network activity. We captured a snapshot of the friendship network, and all the historical posts and comments related to the activity network. Below we refer to the *friendship* and *activity* networks as the networks constituted by each type of tie.

Additionally, for each member, we extracted demographic information from his or her public profile and compiled a list of all posts. For each post, we also recorded the number of views and star ratings it attracted. We further collected the seniority of members by relying on chronologically ordered members' IDs. Members who register with the site may opt to disclose their gender. Out of the over 100,000 members of *TheMarker Café*, 43,489 users (42%) self-identified as males, and 37,276 users (36%) as females, and the remainder chose not to indicate their genders. Following the approach adopted in recent studies (e.g., Joiner et al, 2014, 2016), the disclosed gender of these users was used to recode the users' gender. The average age of the men users is 40.3 (SD 7.8), and the average age of the women users is 38.9 (SD 8.3).

Studies have revealed that people typically start using online social networks (OSNs) out of curiosity, by joining a discussion group, connecting to others, or reading a blog. However, while many decide that one look is enough to satisfy their interest, a few return to the site a second or third time (Preece & Shneiderman, 2009). As our study examines behavioral trends, we focused only on *TheMarker Café* members who remain involved for the longer term. To ensure a minimum activity level, we considered for our analysis only individuals who disclosed their gender, had at least one friendship connection, and posted at least one comment. Our final sample comprised 21,413 members (52% males and 48% females).

3.2. Data analysis

We employed the Mann-Whitney U test to test whether significant gender differences exist for a given set of variables: number of posts written (H1), number of comments written (H2), and posts rankings (H3). Given our large sample size, we further calculated the Cohen's effect size for each of the conducted Mann-Whitney U tests. Unlike significance tests, these indices are independent of sample size (Cohen, 1988, pp. 20–26).

We then employed two linear regression models to study the

interplay between content popularity; and social and activity degree measures. The first regression model, assessed the effect of Friendship degree on content popularity. Our second regression model, assessed the effect of activity degree on content popularity. For both regression models the Durbin-Watson statistic was used to investigate the assumption of independence. Normal probability (P-P) plots were used to investigate the normality of error terms and homoscedasticity was tested by observing the scatter plot of the residuals and the predicted value. These checks identified no violations of multiple regression assumptions. All statistical tests were one-tailed and a significance level of $p < 0.001$ was set for all analyses. To calculate the statistical power of this study to reject false null hypotheses, we conducted a post-hoc statistical power test (Faul, Erdfelder, Buchner, & Lang, 2009). With 11 predictors in the regression analysis, an observed R^2 of 0.77 (see Table 2), a sample size of 21,413 and $\alpha = 0.05$, the test results indicated an observed power of 1.0. Next, we conducted multi-group analysis (Jaccard & Wan, 1996) to test whether the differences between these two regression models are significant.

4. Results

Previous online social network studies have shown that information diffusion and the popularity of posts show heavy-tailed distributions (Cha, Mislove, & Gummadi, 2009). Thus, we used the Mann-Whitney U test to test whether significant gender differences exist for a given set of variables. Table 1 presents the average numbers of posts, comments, views, and stars for females and males respectively, as well as information on friendship degree (i.e., number of friendship ties an individual has – with both men and women) and activity degree (i.e., number of activity ties an individual has – where activity tie means that the individual made at least one comment on any of the posts written by other).

All the gender differences were found significant. Men tend to post more original posts than do women ($U = 2825$, $p < .01$). Given our large sample size, we further calculated the Cohen's effect size. Unlike significance tests, these indices are independent of sample size. Cohen's effect size value ($d = 1.41$) suggested high practical significance, thus supporting H1. However women tend to communicate by commenting more on others' posts than men ($U = 2689$, $p < .01$)/Cohen's effect size value ($d = 1.26$) suggested high practical significance, thus supporting H2. Women and men differ not only in their activity patterns, but also in the attention their posts garner: While men's posts attract more eyeballs (total views of all posts) on average, women's posts in total received more stars ($U = 2769$, $p < .01$). Cohen's effect size value ($d = 1.37$) suggested high practical significance, thus supporting H3.

Our analysis indicates that the number of posts, number of comments, total number of views, total number of stars, friendship network degree, and activity network degree are skewed: While a small number of users have high values in each of these variables, the majority have lower values. We therefore conducted a log transformation for the value of these variables (Tabachnick & Fidell,

Table 1
Variables extracted from *TheMarker* network.

	Mean		Median	
	Men	Women	Men	Women
Number of posts	19	16	2	2
Number of comments	126	167	9	10
Total number of views	14,269	10,292	1002	795
Total number of stars	75	99	0	1
Friendship network degree	97	96	19	31
Activity network degree	49	52	9	10

Table 2
Hypotheses testing: Linear regression models regressing total star awards.

	Model 1			Model 2		
	β	S.E	t	β	S.E	t
Views (lg)	.663**	.002	151.888	.574**	.002	127.423
Seniority	.044**	.000	10.554	.040**	.000	10.312
Age (years)	.002**	.000	7.566	-.004	.000	-1.035
Gender (men = 1)	-.044**	.006	-10.705	-.044**	.006	-11.539
Education	-.001	.004	-.239	.001	.004	-.038
Posts # (lg)	.167**	.000	38.614	.147**	.000	36.179
Friendship Degree (lg)	.037	.031	1.443			
Activity Degree (lg)				.744**	.038	23.780
Adjusted R^2	.749			.766		

Note. $N = 21,413$; (lg) indicates that the variable undergone log transformation; * $p < .05$. ** $p < .01$.

2013). The skewed measures of these variables now approach normal distribution (i.e., skewness is less than 0.5). Preliminary analyses were also conducted to ensure no violation of the linear regression assumptions of normality, linearity, multicollinearity, and homoscedasticity.

We used two linear regression models to study star award patterns within the OSN (Table 2). We examined whether total stars are more strongly correlated with activity network measures or with friendship network measures in the OSN (Models 1 and 2, respectively). Both models regress the number of total stars as the dependent variable. Model 1's independent variables were friendship degree centrality. Model 2's independent variable was activity network degree centrality. Control variables for both models were gender, age, education, network seniority, and number of posts (which can potentially affect the number of total stars).

To test Models 1 and 2's appropriateness, we used an F test to assess Model 2's R^2 increase relative to that of Model 1. Model 2, which consisted of activity network measure, accounted for significantly more variance in total stars ($R^2 = 0.766$), $F(2, 14973) = 6201.392$, $p < .01$; when compared to Model 1 which consisted of friendship network measures ($R^2 = 0.749$, $F(2, 14979) = 5192.969$, $p < .01$). F test results indicate that Model 2 is more appropriate and should be retained, supporting H4. Furthermore, a multi-group analysis was conducted (using AMOS Version 18) to examine the comparability of the proposed model. A chi-square (χ^2) difference test was computed between the two model 1 and model 2 (Bryne, 2013). P -values less than 0.05 indicate that Model 2 is more appropriate and should be retained. According to H4, activity network measures are more strongly correlated with content popularity than are friendship measures. Furthermore, this finding offers an explanation for the higher popularity of women's posts, as depicted in Table 1: Women have a higher activity degree and, as our regression models indicate, activity degree is a stronger indicator of post popularity.

5. Discussion and conclusions

The current study examines the gendered discourse patterns on *TheMarker Café*, a popular online social network, using the social network analysis method. Overall, the findings clearly strengthen former analyses that presented evidence of men's assertive and dominant discourse style and social role versus women's more cooperative and supportive role. In line with our first hypothesis, men wrote more posts, thus initiated and introduced more topics to *TheMarker Café* community, while women more often commented on other peoples' posts. The study also reveals the females' posts received higher ranking than males, possibly due to the fact that females' messages tend to attract more support on online social

networks, as identified by several recent analyses (Joiner et al., 2014, 2016).

In addition, our study sought to examine the interplay between the structure of the *TheMarker Café* network and its gendered discourse patterns. Our findings support the hypothesis that activity ties are stronger predictors of content popularity than friendship ties. The fact that women are maintaining more active networks ties (through writing more comments) may explain why women's post are more popular than men's posts. Our findings suggest that social networks largely conform to traditional norms and the web does not serve as the great equalizer, in the sense that men write more posts and females most often commented more. Nonetheless, women do attract more popularity than men, specifically due to their activity within the social network environment.

Our findings contribute to the literature on gender and networks in several ways. While there is much research on differences regarding mobilized social capital among men and women, research on potential mechanisms that can reduce these differences is limited and underdeveloped. By focusing purely on content popularity, this article significantly adds to this body of research by uncovering the existing gender differences in mobilized social capital within OSNs. The understanding of these conditions can potentially contribute to diminishing (or even eliminating) these differences. Our study highlights the role of communication activity as a popularity predictor and suggest that activity network measures may be better indicators of content popularity than friendship connections. Communication activity between OSN members, such as commenting or favoring, signals interest and information transfer among the members. Such communication may enhance the ability of members to nurture their social ties, and thus increase their mobilized social capital. Consequently, the social capital may be utilized to gain more popularity for their content. Relatively few studies have addressed this issue within the context of OSNs. Studies that did use the SNA framework have mainly focused on the network's structure or relational information, and include measures of network size and density, while not differentiating between activity and friendship networks (e.g., Szell & Thurner, 2013). In this paper, we move beyond this analysis to find support for the interplay between more complex network structures. While activity networks have been found to be correlated with mobilized social capital in offline interactions (Burt, 1992; Lin, 2008, pp. 50–69), we offer validation for these findings in the online environment.

Our findings are hampered by three major limitations. First, the design of the study precludes causal conclusions and allows us to draw conclusions regarding only correlated relationships. For example, we can assume only that activity network centrality interplay with content popularity, not that it affects it. Second, we did not ask the users regarding their gender, but rather we have identified their gender from their online profile. Furthermore, our sample does not include users who did not indicated their gender in their profile. While this is a common practice when collecting gender data regarding OSNs users (e.g., Hayat, Samuel-Azran & Galily, 2016; Szell & Thurner, 2013; Lou et al., 2013), there are some issues concerning the representativeness and reliability of this kind of aggregated sample data (Panger, 2016), hence we should be aware that our gender data might be biased. We suggest that future studies should also examine the interplay between activity network structure and network popularity using other methods such as interviews and surveys, in order to validate our gender related findings.

Finally, in this study, we did not look at the specific features of individuals' social ties (e.g., strength and diversity of social ties) and how such features might affect content popularity. More

specifically, no attention has been directed to an exploration of the types of social ties (e.g., strong vs. weak ties) that are more effective in enhancing content popularity. Given the documented importance of interpersonal ties for enhancing mobilized social capital (Burt, 1992; Lin, 2008, pp. 50–69), we suggest that future studies should address this theoretical and empirical gap.

Finally, future studies should also compare friendship and activity networks and gendered discourse patterns to further examine the effect of network structure on content popularity and gendered discourse patterns, with the aim of validating or weakening our finding regarding activity networks' potential to enhance the popularity of women network members' content.

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