International Journal of Communication 12(2018), 4292–4312 1932–8036/20180005

Mapping Communication Infrastructure Theory Onto Twitter: Network Integration and Neighborhood Storytelling

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Guided by communication infrastructure theory (CIT), this study examined residents' integration to the neighborhood storytelling network and its association with neighborhood storytelling. The ego networks of the local ties of 350 residents and their timelines were obtained from Twitter's search application programming interface (API). Residents' integration to the neighborhood storytelling network was operationalized as network size and network density. The results show that both network size and network density positively predicted neighborhood storytelling. When local ties were classified into types, residents who followed more geo-ethnic media accounts and other local residents participated more in neighborhood storytelling.

Keywords: *communication infrastructure theory, Twitter, neighborhood storytelling, network size, network density*

The U.S. population is becoming increasingly diverse (Cohn & Caumont, 2016). The demographic trends post challenges for civic engagement in diverse neighborhoods (Costa & Kahn, 2003). Communication infrastructure theory (CIT) makes inquiries about civic engagement from a communication infrastructure perspective, focusing on residents' integration to the neighborhood storytelling network (Ball-Rokeach, Kim, & Matei, 2001; Kim & Ball-Rokeach, 2006a). This network, consisting of multilevel storytellers, provides neighborhood discourses that foster civic participation, a sense of neighborhood belonging, and collective efficacy (Kim & Ball-Rokeach, 2006a).

Recent studies explore how digital technologies can be woven into the fabric of the neighborhood storytelling network (Ball-Rokeach, Gonzalez, Son, & Kligler-Vilenchik, 2012; Katz, Ang, & Suro, 2012; Wilkin, 2013; Wilkin & Ball-Rokeach, 2011). These studies conceptualize the Internet as a storyteller independent of other storytellers (i.e., geo-ethnic media, community organizations, and local residents). Social networking sites (SNSs) have been rapidly adopted by traditional neighborhood storytellers (Ellison,

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Date submitted: 2018–02–01

[1] The authors would like to thank the editor and two anonymous reviewers for their helpful feedback.

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Vitak, Gray, & Lampe, 2014; Lasorsa, Lewis, & Holton, 2012; Lovejoy & Saxton, 2012). The emerging media environment provides an opportunity to examine the digital layers of the neighborhood storytelling network.

This study takes a novel approach to testing ideas originating from CIT using a Twitter data set. We consider SNSs a platform that extends the presence of the neighborhood storytellers, who connect among themselves and form a neighborhood storytelling network on this particular platform. A linkage is established when one storyteller follows another. Knowledge derived from network analysis is used to understand the structural positions of residents and their integration into the neighborhood storytelling network. In this study, we use two network measures to operationalize residents' integration to the neighborhood storytelling network: network size and network density. Network size captures the scope of the connections, and network density reflects the integrated connectedness of the connections. We hypothesize that both network size and network density are linked to neighborhood storytelling. The findings have implications for measuring the potential for SNSs to connect local residents and promote neighborhood storytelling.

Communication Infrastructure Theory

A central piece of CIT is neighborhood storytelling, which is broadly defined as "any type of communicative action that addresses residents, their local communities, and their lives in those communities" (Kim & Ball-Rokeach, 2006b, p. 178). Neighborhood storytelling is embedded in daily communication practices, such as discussions about neighborhood redevelopments, home invasions, local holiday events, and after-school programs. A basic assumption of CIT is that community is built on shared discourses about the community and its residents. Neighborhood storytelling allows residents to actively construct a neighborhood identity, participate in civic activities, and cultivate intergroup relations (Ball-Rokeach et al., 2001; Kim & Ball-Rokeach, 2006a; Liu et al., 2018).

The neighborhood storytelling network consists of three key storytellers: geo-ethnic media, community organizations, and local residents (Kim & Ball-Rokeach, 2006a). *Geo-ethnic media* are the meso-level storytelling agents who primarily produce discourse concerning a particular residential area or a racial/ethnic group. Geo-ethnic media may supply news and information that is particularly useful in helping new immigrants acquire local resources, negotiate identity, adapt to a new place, and participate in the public sphere (Matsaganis, Katz, & Ball-Rokeach, 2010). *Community organizations* range from grassroots to formal nonprofit organizations. As meso-level storytellers, these organizations are located in the neighborhood and serve the needs of the residents. *Local residents* and their family members, friends, and neighbors constitute the interpersonal network, which is the micro-level of the storytelling system. Ideally, all levels of the storytelling system are mutually dependent on each other and form an integrated neighborhood storytelling network. Geo-ethnic media and community organizations may play linkage roles by producing stories that serve as catalysts for interpersonal discussion, or they may push certain local issues onto the agendas of the mainstream media and policy makers. The interplay among storytellers is theorized to facilitate civic engagement (Kim & Ball-Rokeach, 2006a).

Residents who are integrated into the storytelling network are connected to various communication resources to achieve their everyday goals (Kim & Ball-Rokeach, 2006b). The communication infrastructure

manifests itself when an unexpected event occurs. For example, in the event of a police helicopter chase in a residential neighborhood, residents increase their dependency on their neighborhood storytelling network to find out information about the chase and how they will be affected. If such a network does not exist or is fragmented, residents may experience a high level of uncertainty.

CIT and Social Networking Sites

Early research on the Internet and local communication infrastructure conceptualizes the Internet as a storyteller independent of geo-ethnic media, community organizations, and local residents (Katz et al., 2012; Wilkin & Ball-Rokeach, 2011). For example, the Internet was named among a list of communication resources such as healthcare providers, family/friends, mainstream TV, and ethnic radio for acquiring health information among African Americans and Latinos living in South Los Angeles (Wilkin, 2013). From a communication ecology point of view, the Internet is among the various communication options available for the residents to achieve their everyday goals, such as participating in civic life and solving health problems (Ball-Rokeach et al., 2012; Katz et al., 2012). These studies are among the first attempts to incorporate the Internet into the storytelling system. Conceptualizing the Internet as an independent storyteller is especially applicable to Internet-based sources of information, such as news aggregators (e.g., Yahoo! News and WebMD) and search engines (e.g., Google).

Recently, storytellers at the macro-, meso-, and micro-levels began to integrate themselves into the emerging communication spaces, such as social networking sites and other online venues. TV subscriptions and newspaper circulations have declined dramatically in the past decade (Barthel, 2017; Bond, 2017). Traditional media have been pushed to evolve and adapt to the fast-moving online world (Lasorsa et al., 2012). Many traditional media outlets have started to build and grow their social media presence in the past 10 years. For example, the *Los Angeles Times* created a Twitter account in 2008 and had more than 3 million followers as of December 2017. The *Pasadena Star News*, which covers local news for Pasadena and surrounding communities, has had a Twitter presence since 2009. Although there is no evidence to indicate that traditional media will eventually disappear, a number of social media features, such as immediacy and interactivity, make social media appealing for residents to obtain and share news, even for populations (e.g., older adults) who are traditionally thought to have high barriers to social media use (Madden, 2010). Research shows that traditional media outlets use Twitter not only to disseminate information, but also as a news source (Moon & Hadley, 2014).

Community organizations have also increased their SNS presence, which helps them achieve organizational goals. For example, Lovejoy and Saxton (2012) analyzed Twitter activities of the 73 largest nonprofit organizations. It was found that the nonprofits mainly used Twitter to disseminate information about the organization's activities, such as events, news, and reports. The nonprofits also use Twitter to initiate dialogue with stakeholders (e.g., giving thanks and acknowledgment of local events) and get their followers to take action (e.g., donating and volunteering). Obar, Zube, and Lampe (2012) surveyed 169 employees and volunteers from 53 advocacy groups and found that the majority of their participants used Twitter and other SNSs to inform the public about current events and issues relating to the organization. They also found that SNSs were especially useful in strengthening outreach efforts and providing advocacy groups with instant feedback loops.

SNSs usage at the micro-level takes various forms, such as cultivating social capital, acquiring and disseminating information, and expressing opinions. A line of social capital research makes inquiries about how people's use of SNSs is associated with social capital (Ellison et al., 2014). For example, Facebook users utilize a variety of strategies to cultivate social relationships, such as liking or commenting on Facebook friends' posts and sending birthday wishes (Ellison et al., 2014). Twitter users post daily routines and engage others in conversations using the @ symbol (Java, Song, Finin, & Tseng, 2007). These activities are linked to the feelings of social inclusion and more access to resources embedded in social relationships (Ellison, Steinfield, & Lampe, 2007). In addition, Twitter users are drivers of news. An early study on 1.3 million fetched tweets shows that many Twitter users shared information/URLs and reported news about current events (Java et al., 2007). A more recent study conducted by the Pew Research Center shows that more than half of their sampled Twitter users tweeted about news (Barthel & Shearer, 2015). Starbird and Palen (2010) studied retweeting activities during two natural hazards events. They found that local residents retweeted information highly specific about the emergency events, such as shelter information and first-person observations of the events. Finally, SNSs have been used extensively to express opinions about civic matters (Gordon, Baldwin-Philippi, & Balestra, 2013). For example, a survey shows that 34% of SNS users have commented on or posted their thoughts about political or social issues (Smith, 2013). Another study reveals that SNS users comment on information and policy content posted by local governments on SNS platforms (Mossberger, Wu, & Crawford, 2013).

SNSs are networked publics that serve the same social, cultural, and civic functions as other types of publics (boyd, 2010). SNSs such as Twitter and Facebook are not separate realms of neighborhood storytelling. The majority of SNS users who participate in political and civic activities on one social networking site are also active on other platforms (Smith, 2013). In the meantime, each SNS has distinct affordances that shape how users interact with each other. For example, Twitter affords hashtags, one-way follow networks, 280-character limit for tweets, and favoriting, retweeting, or replying to someone else's tweet. These affordances allow Twitter users to quickly disseminate real-time information. With its distinctive affordances and networked publics in mind, we view residents' Twitter use as one digital layer of connections within the much broader set of communicative links in the neighborhood storytelling network.

Twitter is more appealing to certain subsets of the population, including residents who are younger and have higher levels of education and income. According to Pew Research Center, 40% of U.S. adults aged 18–29 use Twitter. The number decreases as age increases and is reduced to 8% for residents older than 65 years (Smith & Anderson, 2018). The same report reveals that about 32% of college graduates use Twitter, compared with 18% of adults who have a high school diploma or less. About 32% of U.S. adults with an income higher than $75,000 use Twitter, compared with 20% of adults with an income lower than $30,000. Therefore, older residents and those who have lower levels of education or income are likely to be left out of local conversations on Twitter. In addition, an earlier study shows that 33% of American teens aged 13–17 use Twitter (Lenhart, 2015). Surveying youth with traditional survey methods is expensive and complicated. Twitter may expand its reach to youth populations noninvasively.

A Structural Approach to the Integration to the Neighborhood Storytelling Network

The increasing SNS presence of storytellers allows us to test CIT in the new media world (as opposed to conceptualizing SNSs as an independent storyteller). We conceptualize residents' connections to major neighborhood storytellers as their structural positions in the neighborhood storytelling network. The strategic locations within the network play an important role in accessing resources embedded in the network, which, in turn, affect civic engagement at the local level. This argument is built on recent developments in social capital research that separates structure from resource (Burt, 2004; Meng, Chung, & Cox, 2016; Shen, Monge, & Williams, 2014). Social capital shares some commonality with the idea of the neighborhood storytelling network, and it is viewed as "a source of society integration—integration that occurs at the system level via news media, at the community level via formal and informal social ties, and at the individual level via interpersonal discussion" (Rojas, Shah, & Friedland, 2011, p. 694). The following section discusses social capital research to exemplify relevant developments in its conceptualization and operationalization.

The work on social capital has been developed by a few theorists who conceptualize the term with different emphases. For example, Putnam (2001) viewed social capital as "connections among individuals—social networks and norms of reciprocity and trustworthiness that arise from them" (p. 19). Coleman (1988) defined social capital by its function, and its value lies in how it facilitates certain actions of individuals within the structure of relations. N. Lin (2002) viewed social capital as "resources embedded in a social structure that are accessed and/or mobilized in purposive action" (p. 29). Despite their differences, these definitions have two elements in common: the structure of relations, and resources/outcomes produced by the structure (Coleman, 1988). Resources take forms such as providing job references, lending money, introducing new people to talk to, and cultivating a sense of connectedness (Williams, 2006). The structural positions describe attributes of the network (e.g., centrality), such as actors located in the center of a network, managers at the top of the managerial hierarchy, and actors who link unconnected others (Burt, 2004; N. Lin, 2002; Rojas et al., 2011).

Rojas and colleagues (2011) examined the synergic relationship between structure and resources that flow in the structure. They argued that social capital is obtained when structural connections intersect with communication resources (e.g., political information). Thus, social capital is operationalized as the interaction terms between structural connections and communication resources. The interplay of structure and resource has been found to foster civic engagement. Recent studies build on the argument that individuals who occupy certain structural positions are at more of an advantage to acquire resources than others (Burt, 2004; N. Lin, 2002). These studies test the relationship between structural positions and resources obtained by the individuals, and they show that certain structural positions in online communities are linked to ego's received resources and associated outcomes, such as social support, task performance, and trust (Gil de Zúñiga & Valenzuela, 2011; Meng et al., 2016; Shen et al., 2014). For example, Gil de Zúñiga and Valenzuela (2011) found that as the online network size increased, participants increased their frequency of discussing public affairs with others.

CIT focuses on local residents' integration into the neighborhood storytelling network (Kim & Ball-Rokeach, 2006a). The neighborhood storytelling network is viewed as "a certain kind of communication resource" (p. 432) that can be used for civic engagement. Following the same line of argument, there are also two elements of network integration: residents' structural connections to the neighborhood storytelling network, and communication resources generated from the network. In CIT studies, network integration has been operationalized as residents' connections to the major neighborhood storytellers (e.g., Ognyanova et al., 2013). A connection is established if a resident depends on a storyteller to stay on top of community happenings (dependency is operationally defined as perceived importance). This conceptualization shares some commonality with the structural approach to social capital. The difference is that this operationalization is grounded in the media dependency theory (Ball-Rokeach, 1998), which states that media effects increase when individuals increase their dependency on the media to achieve their goals. Therefore, the operationalization captures the most influential structural connections for the purpose of obtaining community news.

SNSs open new opportunities for the use of structural connections residents do not rely heavily on. These connections are conceptualized as weak ties in the social capital literature. Weak ties refer to social ties whom individuals do not know well, have infrequent contact with, and do not share emotional attachment with (Granovetter, 1973). The literature on weak ties has flourished since the rise of SNSs because SNSs lower the barriers to connect with acquaintances or new users (Ellison et al., 2014). A study conducted by the Pew Research Center shows that an average American has 838 ties on Twitter, and the vast majority are weak ties (Hampton, Goulet, Rainie, & Purcell, 2011). Weak ties facilitate the flow of novel information, which is otherwise not available in the immediate circle of discussants (Granovetter, 1973). A number of studies have shown that weak-tie discussion is linked to civic engagement (Gil de Zúñiga & Valenzuela, 2011; Yamamoto, 2018).

We expand the scope of connections and examine all linkages between individuals and their neighborhood storytellers on Twitter. A linkage is established if a focal person follows a local storyteller on Twitter. The following connection sets up a channel that allows the flow of information from the storyteller to the focal person. The connection is not necessarily reciprocal, that is, the storyteller may or may not follow back. One advantage of this directional relationship is that the focal person is able to have access to information from a source without personally knowing the source. Therefore, access to information is not confined by existing social ties; rather, it can be expanded by traversing connections of others (Ellison & boyd, 2013). In this study, we measure the network size of each resident's following network. *Network size* refers to the number of local storytellers the focal person follows on Twitter—the following network counts. This operationalization attempts to capture the scope of connections to neighborhood storytellers.

According to CIT, the integrated connectedness to the storytelling network (ICSN) is a theoretical tool that goes beyond the scope of connections and describes the dynamic and interactive relationships among multilevel storytellers (Kim & Ball-Rokeach, 2006a). In this study, we use two measures to operationalize ICSN. The first measure of ICSN has been used traditionally in CIT studies, which is the summation of the square roots of the interaction terms between the scope of connections to the local storytellers (Broad, Gonzalez, & Ball-Rokeach, 2014; Kim & Ball-Rokeach, 2006a). The

second measure of ICSN (denoted by ICSN2) is local network density. *Network density* refers to the proportion of connections that exist in a user's egocentric network to the total number of all possible connections. A dense egocentric network means that a lot of the ego's connections follow one another, suggesting an increased capacity to produce and disseminate neighborhood storytelling. A sparse egocentric network indicates that the ego's connections do not follow one another. For example, resident A follows B (local media) and C (community organization). A's network density increases when B follows C. When C releases a neighborhood narrative, A is able to see how B interprets or co-constructs the narrative. If B does not follow C, B might miss the opportunity to get the issues on the local agenda. Network density is an indicator of the overall connectedness or strength of the ego network.

Hypotheses

We use two novel measures from network analysis (i.e., network size and network density) to operationalize residents' integration into the neighborhood storytelling network. Drawing work from CIT, we test whether the scope and intensity of neighborhood connections are linked to residents' engagement with neighborhood storytelling. The hypotheses are listed next. The first three hypotheses examine the scope of the connection to each type of storyteller as outlined in CIT (i.e., geo-ethnic media, community organizations, and local residents; Kim & Ball-Rokeach, 2006b). The fourth hypothesis focuses on the overall connectedness to the neighborhood storytelling network.

H1: Connection to geo-ethnic media will positively predict neighborhood storytelling.

H2: Connection to community organizations will positively predict neighborhood storytelling.

H3: Connection to local residents will positively predict neighborhood storytelling.

H4: The integrated connectedness to neighborhood storytelling network will positively predict neighborhood storytelling.

Method

Research Context

The research site of this study is the city of Alhambra, which is located in the San Gabriel Valley in the Greater Los Angeles area. Alhambra has a population of 83,089 as of 2010, and the population is 52.9% Asian, 34.4% Latino, and 10% Anglo (U.S. Census Bureau, 2010). Past research shows that Alhambra is characterized as having insufficient coverage of local issues, limited levels of civic activity, and low levels of intergroup contact (Liu et al., 2018; Ognyanova et al., 2013).

Data Collection

Twitter data were collected using Python 2 in November 2017. First, a combination of methods was used to compile an initial list of Twitter users whose profile location or profile description contained

"Alhambra." The Twitter's search application programming interface (API) returns a collection of relevant Tweets, each of which contains the tweet object, user object, and other relevant objects. A search query ("Alhambra") to run against the user object was placed. Because the Twitter search API only returned a sample of tweets published in the past 7 days, additional methods were used to expand the size of the initial sample, including using Google proximity search ("twitter.com bio alhambra") and a commercial Twitter analytics website (followerwonk.com, search "Alhambra, CA" or "Alhambra, California" from user profiles). A total of 211 unique Twitter users were included in the initial sample.

Second, the friends and followers of each user in the initial sample were obtained. A sublist was compiled if the profile location or profile description of these friends and followers contained "Alhambra." This snowball sampling procedure was repeated until no new users were found. A manual check was performed to review users whose profile location was a city other than Alhambra (e.g., Los Angeles; Washington, DC; San Francisco; Martinez, CA; and Phoenix). Users who mentioned Alhambra as their clientele or business address in their profile description remained in the sample. Other users were removed from the sample. This selection process resulted in a sample of 1,013 Twitter users.

Third, tweets and retweets between January 1, 2017, and November 12, 2017, were obtained from each user's timeline. Because the user object only returns the user's most recent profile location and description at the time of retrieval, it is possible that some users did not live in Alhambra during the data collection period. According to the U.S. Census Bureau (2016), 91.8% of Alhambra residents lived in the same house as the previous year. About 7% moved to Alhambra from the same county. The statistics suggest that the vast majority of users in the sample might stay in Alhambra during the data collection period.

Users were removed from the sample if they were private accounts, suspended accounts, or inactive accounts (i.e., did not post any tweets during the data collection period). The final sample contained 462 Twitter users, 1,968 edges, and 185,549 tweets. In other words, this sample contained public Twitter users who indicated that they resided in the city of Alhambra and had some Twitter activity in 2017. Among these users, 460 self-declared that their user interface language as English, 1 as Spanish, and 1 as Chinese.

Measures

Neighborhood storytelling. Tweets that mentioned "Alhambra" or "San Gabriel Valley" were classified as local tweets (n = 1,406). Alhambra is one of the incorporated cities in San Gabriel Valley in Los Angeles County. "San Gabriel Valley" has been mentioned in 11.44% of the tweets posted by Alhambra Source, an online website dedicated to providing local news to the Alhambra residents. The vast majority of tweets were in English, and three tweets were in Spanish. The Chinese translation of Alhambra was also used to search local tweets, but the search yielded no results. Sample tweets include "City of Alhambra fireworks show starting soon" and "Alhambra Planning Commission approves Lowe's development in Fremont. People who came in protest aren't happy. Hearing talk of a lawsuit." Neighborhood storytelling was dichotomized, where users who posted at least one local tweet received a score of 1, and those who did not post any local tweets received a score of 0.

Connections to local storytellers. The type of local storytellers was coded based on the users' profile description (1 = geo-ethnic media, 2 = community organizations, and 3 = residents, and 9 = local businesses). When undecided, coders were instructed to explore the website linked to the user's profile and/or latest tweets. Two coders independently classified each Twitter user. Discrepancies were then discussed until consensus was reached. *Geo-ethnic media* (*n* = 5) were operationalized as media outlets targeting Alhambra: the official Twitter account of Alhambra Source (an independent local news outlet for Alhambra and gateway to the San Gabriel Valley), the editor of Alhambra Source, who predominantly promoted content from Alhambra Source, *West Valley Journal* (a community newspaper serving Alhambra, Rosemead, Monterey Park, and East Los Angeles), the *Mark Keppel Aztec* (an online publication of *The Aztec* of Mark Keppel High School located in Alhambra), and a weather channel that tweets Alhambra weather several times a day. *Community organizations* (*n* = 26) were operationalized as nonprofit organizations that were located in Alhambra or that served clientele in Alhambra, including Alhambra city officials, government departments, nonprofit organizations, churches, and public schools. A total of 21 users were coded as community organizations, such as Alhambra Chamber of Commerce, San Gabriel Valley Council of Governments, Alhambra Unified School District, Alhambra Police Department, Alhambra Teacher Association, and Southern California Resource Services (serving persons with disabilities in Los Angeles County). *Local businesses* (*n* = 81) were operationalized as users whose profile description contained a business mission statement and/or business address, such as restaurants (e.g., "We serve authentic Mexican cuisine with fresh ingredients prepared daily!"), shops (e.g., "Providing herbal healthy supplements and skin care products"), car dealers (e.g., "Volkswagen Dealer serving all of the Alhambra and greater Los Angeles area"), and private schools (e.g., "Private Montessori preschool and K–6 in Alhambra, CA"). Users who were not classified as geo-ethnic media, community organizations, or local businesses were coded as *local residents* (*n* = 350).

Connection to geo-ethnic media was operationalized as the number of geo-ethnic media accounts a user followed. Connection to community organizations was operationalized as the number of community organization accounts a user followed. Connection to local residents was operationalized as the number of local resident accounts a user followed. Connection to local businesses was operationalized as the number of local business accounts a user followed.

Integrated connectedness to neighborhood storytelling network. First, ICSN was calculated using the equation adapted from previous studies (Broad et al., 2014; Kim & Ball-Rokeach, 2006a). In the following equation, media is geo-ethnic media following count, org is community organizations following count, and resident is resident following count.

$$ICSN = \sqrt{Media \times Org} + \sqrt{Media \times Resident} + \sqrt{Org \times Resident}$$

Second, each user's egocentric network was extracted from the complete network by selecting the user and all of his or her follower and following connections. ICSN2 was operationalized as ego network density, which was calculated as the number of connections divided by the number of all possible connections.

Control variable. The total number of tweets (including retweets) posted by each user during the data collection window (i.e., January 1, 2017, to November 12, 2017) was controlled to rule out possible influences unrelated to the focal variables tested in this study.

Results

Descriptive Statistics

Data analysis was performed on 350 local residents, who posted, on average, 454.79 tweets (*SD* = 801.16) during the data collection period. A very small percentage of these tweets were local (0.16%). Ninety-three residents (27%) posted at least one local tweet. The means and standard deviations of their connections to storytellers were as follows: connection to geo-ethnic media (*M* = .14, *SD* = .40), connection to community organizations (*M* = .38, *SD* = .83), connection to other local residents (*M* = 3.50, *SD* = 5.00), and connection to local businesses (*M* = .24, *SD* = .92). The mean of the integrated connectedness to the storytelling network (ego network density) was .33 (*SD* = .26). Table 1 reports the correlations of the variables.

Table 1. Zero-Order Correlations Among Variables.

	1	2	3	4	5	6	7	8
1. Neighborhood storytelling	1							
2. Total tweets	.52***	1						
3. Connection to local businesses	.05	.01	1					
4. Connection to geo-ethnic media	.13*	.01	.41***	1				
5. Connection to community organizations	.04	-.06	.44	.49***	1			
6. Connection to local residents	.20***	.19***	-.07	-.12*	-.10^	1		
7. ICSN	.09^	.04	.43***	.60***	.77***	.08	1	
8. ICSN2	.13*	.04	.00	.10*	.10^	.19***	.11*	1

Note. ICSN stands for integrated connectedness to the storytelling network.
^$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Hypothesis Testing

A series of logistic regression analyses were performed to test the hypotheses using R 3.4.2. The dependent variable was neighborhood storytelling for all models. The first model contained two control variables: total number of tweets and connection to businesses. The second model examined the effects of the scope of connections to each neighborhood storyteller on neighborhood storytelling by adding three predictors: connection to geo-ethnic media, connection to community organizations, and connection to local residents. The

third model included an additional predictor, which was the integrated connectedness to the storytelling network. Regression coefficients of the second and third models were used for reporting the results of the hypothesis testing. Table 2 reports the standardized regression coefficients for each model.

Table 2. Regression Analysis Predicting Neighborhood Storytelling.

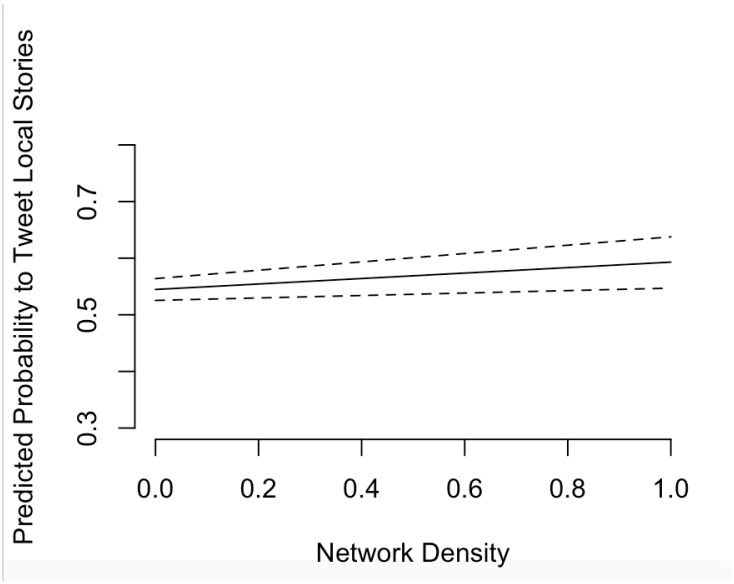
	Neighborhood storytelling (Local tweets)		
	Model 1	Model 2	Model 3
	Beta (*SE*)	Beta (*SE*)	Beta (*SE*)
Control			
Total tweets	1.32*** (.19)	1.29*** (.19)	1.31*** (.19)
Local businesses	.11 (.12)	-.03 (.14)	.00 (.14)
Connection to Storytellers			
Geo-ethnic media		.37* (.15)	.38* (.16)
Community organizations		.04 (.16)	.16 (.23)
Local residents		.35* (.14)	.35* (.15)
Integrated Connectedness			
ICSN			-.20 (.25)
ICSN2 (network density)			.27^ (.16)
Pseudo-R^2	.34	.37	.38
Residual deviance (*df*)	313.87 (347)	301.77 (344)	298.15 (342)

Note. ICSN stands for integrated connectedness to the storytelling network. Entries are standardized regression coefficients. Nagelkerke R^2 was reported as Pseudo-R^2. The null deviance was 405.26 (*df* = 349) for all models.
^*p* < .10. *p < .05. **p < .01. ***p < .001.

H1–H3 examined whether connection to geo-ethnic media (H1), connection to community organizations (H2), and connection to local residents (H3) positively predicted neighborhood storytelling. The second model was statistically significant, with $\lambda^2_{(5)} = 103.49$, $p < .001$. As shown in Table 2, connection to geo-ethnic media ($b = .92$, $p < .05$) and connection to local residents ($b = .07$, $p < .05$) positively predicted neighborhood storytelling. H1 and H3 were supported. Residents who followed 1 more geo-ethnic media account were 2.51 ($e^{0.92}$) times more likely to engage in neighborhood storytelling. Residents who followed 1 more local resident were 1.07 ($e^{0.07}$) times more likely to engage in neighborhood storytelling. Connection to community organizations ($b = .05$, p = n.s.) did not predict neighborhood storytelling. H2 was not supported.

H4 examined whether integrated connectedness to the storytelling network predicted neighborhood storytelling. The third model was statistically significant, with $\lambda^2_{(7)} = 107.11$, $p < .001$. As shown in Table 2, network density was marginally significant ($b = 1.02$, $p < .10$), holding other predictors constant. Residents were 2.77 ($e^{1.02}$) times more likely to engage in neighborhood storytelling with 1 unit increase in ICSN2 (network density). Figure 1 presents the predicted probabilities with 95% confidence intervals and network density. ICSN ($b = -.13$, p = n.s.) did not predict neighborhood storytelling. H4 was marginally supported. An additional model was conducted to check the robustness of this result. In this model, connections to each type of the storyteller were replaced by the total number of connections (regardless of user type). ICSN2 ($b = 1.16$, $p < .05$) positively

predicted neighborhood storytelling. Residents were .32 ($e^{1.16}/10$) times more likely to engage in neighborhood storytelling with 10% increase in ICSN2.



Note. Predictors, including total number of tweets, connection to business, connection to geo-ethnic media, connection to community organizations, connection to local residents, and ICSN, were held at mean.

Figure 1. Predicted probabilities to tweet local stories by network density.

Post Hoc Analysis

To explore the effects of connection to Alhambra Source on neighborhood storytelling, an additional model was estimated. Geo-ethnic media were broken down into two groups: Alhambra Source (and its editor) and other geo-ethnic media outlets. The dependent variable was neighborhood storytelling. After controlling for total tweets and other types of connections, the results indicate that residents who followed Alhambra Source and/or its editor (B = .30, p < .05) were more likely to engage in neighborhood storytelling. Connection to other geo-ethnic media outlets was marginally significant in predicting neighborhood storytelling (B = .27, p < .10).

Discussion

This study tested propositions derived from CIT using a Twitter data set. The following and follower networks of Twitter users who resided in the city of Alhambra were extracted. Residents' integration into the neighborhood storytelling network was operationalized as network size and network density, which were associated with neighborhood storytelling.

First, the results of this study show that connection to geo-ethnic media (as measured by geo-ethnic media following counts) positively predicted neighborhood storytelling. This finding supports CIT but is contrary to that reported in previous studies (Chen et al., 2013; Ognyanova et al., 2013). These studies surveyed Alhambra residents using random digit dialing and found that connection to geo-ethnic media played no role or even a negative role in predicting civic engagement. The unexpected findings were explained by the decline in small local venues that was due to funding struggles and shrinking markets. The inconsistent findings between this study and others might be related to the inclusion of Alhambra Source, which was the most followed account among the five geo-ethnic media accounts in this study. Alhambra Source was launched around the time the survey data were collected (Chen et al., 2013; Ognyanova et al., 2013). At that time, there was a dearth of local news in Alhambra. Alhambra Source was designed as an intervention to supply the Alhambra community with local news and promote immigrant integration and civic engagement (Alhambra Source, n.d.). Our data show that Alhambra Source was the third most active user that posted local tweets, after Alhambra Police and a local weather channel.

Second, connection to community organizations (as measured by community organization following counts) did not have an impact on neighborhood storytelling. A possible explanation is that community organizations do not actively produce neighborhood discourses even though they have a Twitter profile and a considerable follower network. This sample included 26 community organizations, with an average of 9.58 local followers and 9.08 local tweets, as compared with five geo-ethnic media users, with an average of 19.4 followers and 145 local tweets. Community organizations may provide more opportunities for community engagement by increasing their share of narrative construction.

Third, connection to residents (as measured by local resident following counts) positively predicted neighborhood storytelling. This finding is consistent with that from a survey study on the same research site (Ognyanova et al., 2013), highlighting the importance of connections to micro-level storytellers. This finding is also consistent with studies focusing on network size and civic engagement (Gil de Zúñiga & Valenzuela, 2011). A possible explanation is that when network size increases, the likelihood of interconnected ties decreases (Golbeck, 2013). Residents are connected to an increasing number of weak ties who spread novel ideas. These ideas can be used as resources for neighborhood storytelling.

Fourth, the integrated connectedness to the storytelling network (ICSN2, as measured by network density) was marginally associated with neighborhood storytelling. Studies show that dense networks spread redundant information (Harrigan, Achananuparp, & Lim, 2012). It is possible that redundant information makes certain issues prominent and sets the local agenda. Residents are likely to act on important issues and engage themselves in narrative construction. Furthermore, dense networks provide social reinforcement for behavioral adoption (Centola, 2010). The behavior in the context of this study is tweeting or retweeting local issues. When residents observe others engaging in neighborhood storytelling, they might be likely to perform similar behavior.

Fifth, this study included 26 community organizations, compared with more than 150 reported in resident surveys (Ognyanova et al., 2013). A comparison reveals that local government departments/agencies (e.g., Alhambra Police), regional organizations that have a wider clientele (e.g., Southern California Resource Services), school-affiliated organizations (e.g., Alhambra Teachers

Association), and some churches (e.g., Church in the Valley) have an active Twitter presence. Some community organizations were captured in this study but were excluded from data analysis because of their inactive participation on Twitter. For example, Alhambra Latino Association joined Twitter in January 2013, but its most recent tweet was posted in September 2015. It is possible that larger organizations have the capacity (e.g., personnel) to manage their social media accounts and achieve various public relations goals. Community organizations that were not captured in the Twitter data set but were mentioned in resident surveys tend to be support groups, after-school programs, educational classes, sports clubs, fitness groups, neighborhood watch programs, ethnic groups, and churches. It may be that these organizations/groups have a small-scale clientele and have not developed the needs and capacities to use social media for managing operations and public relations activities. In addition, the Twitter data set included connections with local politicians. This type of connection allows residents to directly interact with decision makers, which may empower residents to receive timely information and make informed decisions.

A different pattern was found in regard to geo-ethnic media. Our Twitter data set included a very small set of local media outlets that specifically target Alhambra residents. These local news outlets tend to be small scale and produce content specifically relevant to Alhambra. In addition to media outlets included in the Twitter data set, the resident surveys (Ognyanova et al., 2013) collected media outlets that tend to have a wider geographic scope (e.g., *Pasadena Star News,* the *World Journal*). The impact of connection to these media outlets is mixed. On one hand, these media outlets only have a small portion of news on local issues (W.-Y. Lin & Song, 2006), which may exert limited effects on neighborhood storytelling and local civic engagement (Chen et al., 2013). On the other hand, news stories that extend beyond the local level may have local implications, such as helping immigrants mobilize resources and develop a sense of belonging to their neighborhood (Matsaganis et al., 2010).

Implications for CIT

This study has important implications in advancing CIT research in the new media environment. The pervasive use of SNSs makes network data grow faster than ever before. A variety of network measures could be used to capture actors' specific structural positions and their functions. ICSN is theorized to be a useful tool in addressing "the quality of 'relationships' among communicative agents as a factor containing multiple dimensions such as access, scope, intensity, and centrality" (Kim & Ball-Rokeach, 2006b, p. 184). CIT research could be advanced by developing refined measures of ICSN that address specific dimensions (e.g., intensity and centrality) of this important theoretical concept. Theoretical advancements could be made by unveiling the processes through which structural positions produce different types of resources, which in turn are linked to different components of civic engagement (i.e., civic participation, community belonging, and collective efficacy). For example, it is speculated that residents who are connected to dense and close-knit networks are more likely to feel they belong to the community; on the other hand, residents with large but sparse networks are more likely to participate in civic activities.

Limitations and Future Research

This study has some limitations. First, neighborhood storytelling was coded as a binary variable for data analysis because the majority of residents did not post any tweets containing the name of the city of

residence. The small number of local tweets limits our ability to perform analyses (e.g., sentiment analysis and topic modeling) on the content of the tweets. Future studies could select research sites in which residents are active in producing shared narratives on Twitter and have high levels of civic engagement. Their tweets could be used to operationalize other measures of civic engagement, such as community belonging (measured by the sentiment of tweets). Theoretical advancement could be made by examining the nuanced pathways through which structural positions lead to civic engagement. For example, future studies could test whether the scope of connections to neighborhood storytellers is associated with the behavioral component of civic engagement and whether the density of these connections is associated with the affective component of civic engagement.

On a related note, we used an intuitive but simplistic approach to filter out nonlocal tweets. One advantage of using the names of the geographic areas as filters was that we focused on communicative acts highlighting the place-based identity. Tweets with geographical expression may have symbolic meanings, indicative of the process through which residents expressed and negotiated their place-based identity (Schwartz & Halegoua, 2015). In the meantime, it should be noted that the number of local tweets was a conservative estimate of neighborhood storytelling. It is possible that tweets about the neighborhood did not contain the keywords used in this study and thus were excluded from data analysis. Future research should use a more refined approach to identify local tweets.

Second, it is important to acknowledge some challenges about the sampling procedure. Twitter users whose profile description or location containing the word "Alhambra" were included in the sample. This sample excluded users who resided in Alhambra but either did not explicitly indicate their city of residence or used names associated with wider geographical areas, such as Los Angeles or California. We have considered and tried a few procedures to improve the sampling process, but have not been very successful. The city-level geolocation prediction algorithms based on tweet content and metadata can only achieve a 50% accuracy (e.g., Han, Cook, & Baldwin, 2013). In our sample, tweets were not geotagged, with only a few exceptions. Finding a solution that accurately locates Twitter users is beyond the scope of this study; therefore, we utilized users' declared residence location. It should be noted that we do not know the percentage of local friends/followers who declared Alhambra as their residence location, and that number could vary in different users. Research shows that social media users selectively and carefully present places to shape others' perceptions of who they are (Schwartz & Halegoua, 2015). Our sample could be considered a network of residents who would like to associate themselves with Alhambra. The connections among themselves reflect the projected common identity on the networked public space.

The sample may overrepresent English-speaking and younger members of the community. Alhambra has more than one third Chinese immigrants (U.S. Census Bureau, 2010). Many of them tend to use WeChat, a Chinese version of Twitter-like SNS (Ma, 2013). Future studies could select social networking sites mostly used by other demographic groups and test the robustness of the network effects. In the meantime, the use of different SNSs may pose challenges for research on intergroup connections and the use of these connections for constructing shared narratives.

In addition, demographic variables, including age, education, income, residential tenure, and racial/ethnic identity, have been found to influence local civic engagement in resident surveys (Kim & Ball-

Rokeach, 2006a; Ognyanova et al., 2013). However, information on user demographics was not available in this Twitter data set. It is possible that the correlation between connection to storytellers and neighborhood storytelling was due to confounding demographic variables. Future CIT research should find ways of controlling user demographics when using social media data sets.

Third, SNSs are blurring the boundaries among the neighborhood storytellers. Examples include political actors, journalists, celebrities, and other community influencers tweeting from personal accounts. This challenge has been reflected in the process through which we classified the storytellers. When we were uncertain about how to classify a user who was on the borderlines of two types, we checked the user's most recent tweets. It is unknown if the same results of this study would be obtained when different coding decisions were made.

Fourth, the pervasive use of SNSs opens up new possibilities for testing and developing CIT. This study focused on residents' integration into the neighborhood storytelling network at the individual level. Future research could examine network characteristics at the community level (e.g., global network density) and compare how community-level connectedness influences residents' neighborhood storytelling and civic engagement across communities. Furthermore, the use of neighborhood-based SNSs is expanding (Lunden, 2017). For example, Nextdoor is a private SNS for neighborhoods. Residents use their real name and verified home address to register on the site. They can only see the profiles of residents in their neighborhood but can read information posted by residents from nearby neighborhoods. Future research could examine the use of neighborhood-based SNSs and the effects on civic engagement at the local level. Finally, the rapid adoption of various SNSs poses challenges for incorporating SNSs into CIT. This study conceptualized the Twitter-based communication network as one digital layer of the neighborhood storytelling network. Future research should develop a more robust theorization to explain connections and processes occurring in the digital space.

Conclusion

This study contributes to CIT literature by testing residents' connections to storytellers and neighborhood storytelling in a digital environment. Residents who followed more geo-ethnic media outlets and other local residents were more likely to tweet local issues. Residents' embeddedness in the neighborhood storytelling network was marginally associated with Twitter activity relevant to local issues. Furthermore, this study captured a specific subset of community storytellers, who were active in participating in neighborhood storytelling on Twitter. They tend to be English-speaking residents, community organizations that have a wider geographic clientele, and media outlets that produce content specifically about the researched community. This study took a novel approach to operationalize connections to storytellers and provided some initial evidence for social networking sites to connect local residents and promote neighborhood storytelling.

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