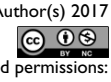
Article

new media & society
2018, Vol. 20(7) 2432–2449



DOI: 10.1177/1461444817724169
journals.sagepub.com/home/nms


Does the rise of the Internet bring erosion of strong ties? Analyses of social media use and changes in core discussion networks

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Abstract
We derive hypotheses from popular accounts of how use of social media affects our strong ties. Several authors have suggested that social media use erodes our strong ties by increasing the volume of social interactions and decreasing their depth. Using two-wave panel data representative of the Dutch population between 15 and 45 years, we examine changes in the core discussion networks (CDNs) of 5312 respondents (with 10,896 relations). Contradicting an erosion of strong ties, we found positive effects of social media use on CDN size, both cross-sectionally and longitudinally. Social media use was positively related to talking to CDN members in our cross-sectional model. Finally, we found that the CDNs of frequent social media users were more dynamic than those of less frequent users: they are more likely to both lose old and gain new ties. This suggests that Internet use is associated with more, and more dynamic, social interaction.

Keywords
Core discussion network, individualization, Internet, social media, strong ties

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Introduction

The Internet and its accompanying new channels of communication have often been associated with rising individualism and linked to negative consequences for social relationships. For instance, early Internet research found that time spent online displaced time spent with friends and family (Kraut et al., 1998), which gave rise to fears about negative consequences of Internet use. However, the host of studies that followed produced little evidence in support of these worries. Today, the general consensus seems more optimistic, at least in terms of overall social interaction or network size (Hampton, 2016). Many scholars are convinced that the Internet—and especially social media—extends and transforms the traditional (offline) community. It allows people to stay in touch with many more friends, family members, and acquaintances than would have been possible without it (Chen, 2013; Ellison and Vitak, 2015; Hampton et al., 2011b; Wang and Wellman, 2010).

This does not necessarily mean that all changes brought by the Internet are considered good news. Some scholars have argued that because of the abundance of social interactions on the Internet, our social relationships are becoming more superficial (Turkle, 2011). Others have suggested that frequent Internet use comes with the substitution of a larger set of weak ties for a small group of strong (local) ties (Chen, 2013; Mcpherson et al., 2006; Rainie and Wellman, 2014). In other words, fears of negative consequences of Internet use have largely moved away from negative effects on the total volume of social interaction to negative effects on the number of strong ties and quality of relationships.

In this study, we analyze longitudinal data from a large sample representative of the Netherlands to perform better tests of existing ideas about use of social media and strong ties and test new ideas about changes in core discussion networks (CDNs) as a result of social media use. We consider three types of outcomes. First, we perform a cross-sectional as well as a longitudinal test of the effect of social media use on the number of core discussants individuals report. Second, we perform a cross-sectional as well as a longitudinal test of the effect of social media use on frequency of talking with core discussants. Third, we analyze the dynamics of the CDN by looking at the effect of social media use on the number of stable ties (i.e. core discussants mentioned in both waves), the number of new ties, and the number of lost ties.

Our study contributes to the existing literature in several ways. First, there are very few longitudinal panel studies in this field (notable exceptions are Cornwell et al., 2014; Mollenhorst et al., 2014). In relation to social media use, most studies used cross-sectional data to test their hypotheses. Longitudinal analyses are preferable because there is a high risk of finding spurious effects. For instance, factors like personality, social skills, and mental health likely affect both Internet use and interactions with strong ties. Our analyses provide better controls for these (largely time-invariant) factors. Second, our analyses of (changes in) the frequency of talking prevent ecological fallacies, for they are conducted at the level of social relations rather than at the (aggregated) individual level used in most previous studies. For instance, when a person with a four-person core discussion network adds a fifth person with whom he or she talks very little, this will result in a decrease in average talking at the network level, whereas there may not be any change at the tie level. Finally, to the best of our knowledge, we are the first to study the

links between social media use and composition changes within the CDN. At the individual level, CDNs may look stable (e.g. a person mentions five discussants in both waves), but this may mask relevant changes at the relationship level (the five discussants could be the same persons but also five new ones).

Theory and previous research

Many factors drive changes in the organization of social relationships. Most notably, sociologists have often argued that—in Western countries—industrialization and urbanization caused weakening of community and family bonds (Parigi and Henson, 2014). For instance, Fischer (1982) found that personal networks in cities are less dense but not smaller compared to those in rural areas. New technologies can also change social relations. Several authors consider the arrival of the Internet, and especially social media, to be the most important driver of change in the organization of social interactions of our time (Ellison and Vitak, 2015; Rainie and Wellman, 2014). The Internet allows its users to keep in touch with a large group of friends, family members, and acquaintances, and substantially increases the number of people one actively communicates with (Hampton et al., 2011b). Social network sites (SNSs) in particular have altered relationship dynamics and added new ways of maintaining relationships (Wellman et al., 2003). For instance, by enabling both parties to regularly receive updates about the other's life, these sites allow friendships to be maintained with less effort (Burke and Kraut, 2014). Additionally, they offer several ways to communicate one to one.

Although the way in which online social networking has changed our social interactions remains poorly understood, there are three dominant theoretical ideas in the literature, resolving around arguments based on (1) displacement, (2) media richness, and (3) individualization. In the remainder of this section, we will discuss these ideas and derive hypotheses about how social media use affects strong ties.

Time displacement

The initial hypothesis that Internet use would increase social isolation as it presumably displaced time otherwise spent with family and friends (Kraut et al., 1998; Nie and Erbring, 2000; Putnam, 2000) has largely become obsolete since the rise of social media (Wang and Wellman, 2010). Nevertheless, scholars have come up with new arguments that still build on displacement mechanisms. For instance, some have suggested that strong ties are gradually replaced by weaker ones. If one accepts the idea that the more contacts one has, the less attention is given to each individual contact (Mayhew and Levinger, 1976; Parigi and Henson, 2014), then strong ties may suffer from the exponential growth of online social networks (Edunov et al., 2016; Ugander et al., 2011); their maintenance requires more time and energy compared to that of weak ties. One updated version of the displacement hypothesis thus states that Internet use does not necessarily increase social isolation, but substitutes weak for strong ties (Chen, 2013).

If strong ties are indeed replaced by weaker ties, the CDN should become smaller. Several studies have reported such a decrease (Brashears, 2011; Hampton et al., 2011b; Mcpherson et al., 2006, 2008), mainly based on US data. Some authors have suggested

that the Internet is one of the factors driving this change (Mcpherson et al., 2006; Putnam, 2000), although few studies directly test this relationship and the available empirical evidence is both contested (Fischer, 2009; Paik and Sanchagrin, 2013) and inconclusive (Chen, 2013; Hampton and Ling, 2013).

Media richness and media displacement

Another prominent theory is media richness theory (MRT). Its main idea is that there is large variation in the number (richness) of verbal and non-verbal cues transmitted by different types of media, which results in differences in how suitable they are for certain types of interpersonal communication (Daft and Lengel, 1986). Face-to-face communication is usually considered the richest medium, since it provides immediate feedback and a wealth of verbal and non-verbal information. Internet applications like e-mail, on the other hand, are considered poor, due to delayed response, a lack of non-verbal cues, and limited verbal cues. SNSs probably score somewhere in between, as they incorporate a large variety of communicative functions, including real-time chat and video calling.

According to MRT, more complex (uncertain, equivocal, sensitive) messages need richer media to be communicated. This is relevant for strong ties because intimate relationships involve more emotions and non-verbal cues play a major role in communicating these emotions (Laurenceau et al., 1998). From this perspective, social media and strong ties are not an ideal combination. Online conversation is generally brief and to the point, and due to the absence of non-verbal cues and physical proximity some argue it is more prone to misunderstanding and less suitable for the expression of complex ideas or deep feelings (Cummings et al., 2002; Stern, 2008).

Despite the general finding that individuals make use of different means of communication to keep in touch with their (strong) ties—a phenomenon referred to as *media multiplexity* (Haythornthwaite, 2002, 2005)—some scholars have argued that the Internet and smartphone direct attention away from, and make it less likely for individuals to engage in, face-to-face conversations and phone calls (Turkle, 2011). When combined with MRT, this would mean that poorer media partially displace, or crowd out, richer ones. Sometimes people even choose to communicate online in the presence of family and friends—especially via mobile phones (Pettegrew and Day, 2015). This phenomenon is also referred to as side-by-side communication (Turkle, 2011) and falls within the broader framework of bounded solidarity (Palackal et al., 2011; Shrum et al., 2011).

Results of previous tests of MRT are inconsistent and there is a general lack of representative, longitudinal studies in this literature (Brandtzaeg, 2012). Turkle (2011) presents evidence—based on qualitative interviews—that points at lower quality interactions; Pettegrew and Day (2015) report that young people who rely more on their mobile phone are less reliant on face-to-face interaction; and Stern (2008) finds a negative correlation between Internet use and face-to-face communication in a quantitative study of a rural area in the United States. On the other hand, Lu and Hampton (2016) find Facebook use and the amount of in-person contact to be positively related. Baym et al. (2004) find a mutually reinforcing relationship between online and face-to-face communication, which is especially pronounced among strong ties. Burke and Kraut (2014), likewise, observe an association between social media and relational closeness, as does Brandtzaeg

(2012) for SNS use and frequency of talking with close friends. The latter, however, finds no evidence of such a relationship in his longitudinal analyses.

Part of this inconsistency might arise because for some people scarcity of cues leads to more instead of less self-disclosure compared to face-to-face communication (Schouten et al., 2007). Especially in text-driven social media, anonymity may encourage disclosure of personal information (Suler, 2004), for instance when people use online support groups to confide to others who share similar experiences (Van Ingen and Wright, 2016). However, since most popular forms of social media are not anonymous we believe that this argument is less relevant here.

Individualization

According to some, the 20th century in Western societies is marked by a shift toward individualism, in which social relations moved from ascribed to achieved (Beck, 1999). Today, people are in charge of their own network. They constantly have to renew and revalue existing relationships (Wittel, 2001) because social relations devalue without ongoing investments (Lin, 2001). Furthermore, the geography of social relations has changed. Where people used to reside in small, local, and relatively bounded communities, they nowadays associate with more dispersed subgroups of people. As a result, networks are characterized by higher numbers of cross-links between and within subgroups of people (Hampton, 2016). Moreover, networks seem to consist of shifting sets of friends, resulting in more fluid and dynamic networks (Rainie and Wellman, 2014), and more "loose connections" (Van Ingen and Dekker, 2011; Wuthnow, 1998).

For individuals, this means their relationships become less stable, with less rigid boundaries between groups. They live more segmented lives in which they cycle among different social networks (Wellman, 2001). Close ties might be as significant as before, but the type of interaction becomes more specialized with each individual (Hampton et al., 2011b). As a result, who is considered a core network member is likely to shift depending on the social circles and situations individuals are involved in at a specific moment in time (Small et al., 2015). What might initially appear as increasing isolation is in fact a shift to more fluid and more dynamic core networks (Rainie and Wellman, 2014).

Social media can boost individualization processes, allowing more, and more diverse and specialized, social interactions. To illustrate, Damian and Van Ingen (2014) found SNS use to be associated with more outgroup ties among ethnic minorities. Additionally, Palackal et al., (2011) found Internet use in Kerala (a region in India) to be associated with increases in non-local ties. More generally, SNSs enable individuals to easily tap into different social circles and collect more personal information about network members. Users become more aware of the diversity within their social network (Hampton, 2016), resulting in some contacts being approached in one instance, some in another (Hampton et al., 2011b). Regardless of whether this means that the core network becomes smaller (when core ties are defined as suitable for any type of support) or larger (because one has access to a larger array of specialized core ties), we should observe the core networks of frequent social media users to be more dynamic, with strong ties more likely to leave and enter the core network over time—either because these friendships actually arise and decay, or because they are simply not salient at a certain moment in time.

Hypotheses

We derive four hypotheses from the literature discussed above. Time-displacement arguments suggest that the overall increase in connectedness and network size resulting from social media use puts pressure on (the maintenance of) strong ties, since time can only be spent once. There are (at least) two ways to respond to this. One may either cut back on the number of maintained strong ties, or on the time invested in contacting each tie. Similar predictions can be derived when the observation that online media (partially) displace other communication channels—especially phone calls and face-to-face conversation—is combined with MRT. Since online media are less rich, this leads to an erosion of the strength of one's ties, which should lead to fewer strong ties in the long run. Time-displacement and media richness theories thus use different mechanisms to explain the same outcomes, captured by our first two hypotheses:

H1: More frequent social media use is associated with smaller core networks.

H2: More frequent social media use is associated with lower frequency of talking to each core tie.

According to proponents of individualization theory, our personal networks have become dynamic; they are more loosely knit and open, and ties are more specialized and transitive. Although these changes already started before the introduction of the Internet, the Internet's social applications have further boosted this process. Different contacts are approached for different occasions, so we should observe:

H3: More frequent social media use is associated with fewer stable ties that remain part of the core network over time.

H4: More frequent social media use is associated with a greater likelihood of (1) new ties entering and (2) old ties leaving the core network.

Method

The hypotheses are tested using two waves of the Netherlands Life Course Survey (NELLS), a large-scale panel survey among the Dutch population aged 15 to 45. The panel members form a probability sample, apart from an oversample of Turkish and Moroccan immigrants (the two largest non-Western immigrant groups in the Netherlands). In Wave 1, conducted between 2008 and 2010, 5312 respondents (response rate 52%) participated in the survey, of which the first part was conducted via face-to-face interviews and the second part through self-completion questionnaires.

In 2013, 3769 respondents of the original sample were re-approached to participate in Wave 2, conducted through an online web survey. Interviewers visited those who had not participated after a certain period of time to conduct the survey face-to-face. Ultimately, 2829 respondents rejoined. Response rates among Moroccans, Turks, and other ethnic groups were relatively low compared to the response rate of native Dutch. Additionally, men, younger people, people from Southern and Western regions, and people from more

populated areas participated less often in Wave 2. These deviations are comparable to other panel studies in the Netherlands and do not harm the sample's representativeness (Tolsma et al., 2014).

We structured the data on the level of respondents and that of their core relationships, which were elicited using name-generator questions. We selected the 2491 respondents who replied to these questions in both waves and pooled the data from Waves 1 and 2 to match core discussants that were listed in both waves. Core discussants were matched (i.e. coded as being the same person) when their names were (nearly) identical and the alter and respondent-alter characteristics corresponded. Several similarity techniques were used for this purpose. Alter combinations for which these techniques proved unreliable were coded as matches or non-matches manually (Stata syntax available from the authors). This resulted in a total of 10,896 ego-alter relations of which 3284 were listed in both waves, 3421 only in Wave 1, and 4191 only in Wave 2.

Measures

Dependent variables. Information on the respondents' core networks was obtained via name-generator and name-interpreter questions. Name-generator questions identify the respondents' main alters and name interpreters obtain information on the elicited alters and ego-alter relationships (Burt, 1984). In the NELLS, respondents were asked about their strong ties by means of the widely used question "Most people discuss important personal matters with others. If you look back on the past six months, with whom did you discuss important matters?" This question was first used in the 1985 General Social Survey (GSS) and later appeared in several other studies (Marsden, 2005). The resulting network is known as the CDN (Marsden, 1987) and is considered a measure of (the most important) strong ties in a person's life (Mcpherson et al., 2006). Respondents were instructed to list at most five persons by reporting their first names and the first letter of their last name. They were told explicitly to list the names of people most important to them and that these could include family members as well.

We constructed five dependent variables based on these questions. First, *CDN size* counted all valid responses to the name-generator question. Second, we stored for each ego-alter relation an interpreter item recording how often the respondent *talked to the CDN member* listed. Answer categories were 0 "about once a month," 1 "a couple of times per month," 2 "one or several times a week," and 3 "(nearly) every day." Finally, we counted per respondent the number of core discussants named in both waves (*stable core discussants*), in Wave 1 but not in Wave 2 (*lost core discussants*), and in Wave 2 but not in Wave 1 (*new core discussants*).

Independent variable. Changes in these dependent variables were explained from differences in *social media use*, which was measured through the question "How much time do you spend chatting and being active on friend networks (msn, Skype, Hyves, CU2, Facebook, etc.)?" This measure captures all social applications of the Internet, although use of SNSs probably makes up a large proportion of the answer. Respondents could choose from seven answer categories: 0 "(almost) never," 1 "less often than once a month," 2 "once or several times a month," 3 "once or several times a

Table 1. Descriptive statistics of all dependent and independent variables.

	n	Mean	SD	Range
Respondent level				
CDN size Wave 1	2490	2.641	1.402	1–5
CDN size Wave 2	2490	2.954	1.449	1–5
Social media use Wave 1	2473	2.477	2.282	0–6
Social media use Wave 2	2473	2.919	2.367	0–6
# Stable core discussants	2490	1.303	1.016	0–5
# Lost core discussants	2490	1.651	1.322	0–5
# New core discussants	2490	1.339	1.277	0–5
Relationship level				
Contact Wave 1	9008	5.321	0.878	0–6
Contact Wave 2	9008	5.253	0.940	0–6

SD: standard deviation; CDN: core discussion network.

week," 4 "about 15 minutes a day," 5 "about half an hour a day," and 6 "one or several hours a day."

Table 1 displays the descriptive statistics for the dependent and independent variables.

Control variables. Gender (56% *females* and 44% males), *age* ($M = 31.8$, standard deviation [SD] = 9.14), ethnicity (16% *Moroccans*; 18% *Turks*; 4% *Non-Western* immigrants; 5% *Western* immigrants; and 57% *native Dutch*), education (30% *lower*; 41% *intermediate*; and 28% *higher* educated), and cohabitation status (58.4% lived with a *partner*, 41.6% did not) were included as control variables in all analyses. Analyses performed on the dyad level also controlled for relationship type, differentiating between *family* (41%), *partner* (26%), *friends* (28%), and *other* (6%). Finally, we controlled for *time differences* between Waves 1 and 2 ($M = 3.74$, $SD = .50$) and, as survey mode is commonly found to be an important determinant of CDN size (Vehovar et al., 2008), for whether the Wave 2 survey was conducted face-to-face (48.73%) or via a *web survey* (51.27%).

Analytical strategy

Separate models were estimated for each of the four hypotheses. A hybrid Poisson regression model estimated how social media use influenced CDN size. Hybrid models incorporate a fixed-effects estimator within a random-effects panel regression model. This has two advantages. First, it does not only produce a test for the time-varying variables but also estimates cross-sectional effects of the observed time-invariant factors. Second, it estimates the effect of the time-varying variables while controlling for all (observed and unobserved) time-invariant factors (Allison, 2009). To estimate the model, we structured the data in long format, with two observations (waves) per respondent. For each respondent, we calculated the cross-sectional (average social media use over both waves) and longitudinal effect (the difference between the observed score for each wave and the average score over both waves).

An ordinal hybrid regression model measured the effect of social media use on the frequency of contact. This analysis was conducted on the dyad level and, to measure change over time, only included stable ego-alter relations. The data structure thus encompassed waves nested in ties nested in respondents. We corrected the standard errors for clustering of the ties within respondents (Cameron et al., 2011; StataCorp, 2013). See Cameron and Miller (2010) for a discussion of different ways of dealing with clustered data.

Three negative binomial regressions estimated the dynamics of the CDN, using the number of stable core discussants, lost core discussants, and new core discussants as dependent variables. The negative binomial model corrects for the overdispersion of these variables stemming from the frequent occurrence of zero ties. For all analyses, results are reported in terms of odds ratios (ORs) or incidence rate ratios (IRRs). These signal the multiplicative effect on the response variable for each unit increase in the predictor variable.

Finally, as robustness checks, all models were tested using regular ordinary least squares (OLS) regressions; the analyses on size and the number of stable, new, and lost core discussants using both Poisson and negative binomial models; and the analysis of frequency of contact using an ordinal probit model. These different model specifications did not lead to different results for any of the hypotheses.

Results

The average CDN size slightly increased over the two waves, $t(5532) = -6.854$, $p < .001$, from 2.4 to 2.7. This CDN size is comparable to what has been found in some other countries. For instance, Boase and Ikeda (2012) found that in 2003 the average CDN size for the Japanese was 2.64, and in 2004 the average CDN size for Americans was 2.06. Hampton and Ling (2013) found in 2008 average CDN sizes of 1.93, 2.58, and 3.78 for citizens of the United States, Norway, and Ukraine, respectively.

In our data, the growth can mainly be attributed to an increase in the number of respondents reporting five core discussants, from 392 (14%) in Wave 1 to 588 (21%) in Wave 2. Additionally, CDN composition changed considerably. Only 800 respondents (32%) listed the same CDN in Waves 1 and 2. Contrarily, 544 respondents (21%) reported a completely new set of CDN members. All others (47%) reported a mix of stable, lost, and new contacts.

The frequency of contact with core discussants decreased marginally, $t(20{,}060) = 5.208$, $p < .001$. In Wave 1, respondents talked to 53.5% of their core discussants daily, and in Wave 2, to 52%. Likewise, 32% and 31% of the core discussants were spoken to once or several times a week in Waves 1 and 2, respectively. This difference results both from decreases in the frequency of talking to stable core discussants, $M = -.140$, $t(2783) = 12.86$, $p < .001$, and from differences in the frequency of talking to old and new core discussants, $M = -.100$, $t(6878) = 4.724$, $p < .001$.

Finally, we observe an increase in social media use. Whereas in Wave 1 1013 respondents (37%) indicated to never use any type of social media, in Wave 2, only 920 respondents (34%) did. The number of people who used social media at least daily increased from 977 (36%) in Wave 1 to 1365 (50%) in Wave 2.

Table 2. Hybrid Poisson regression model on the size of the core discussion network ($N = 2724$).

	IRR	*SE*
Average social media use	1.041***	.009
Change in social media use	1.012**	.005
Female	1.149***	.022
Age	0.997*	.001
Moroccan immigrant[a]	0.722***	.022
Turkish immigrant[a]	0.792***	.023
Non-Western immigrant[a]	0.866**	.045
Western immigrant[a]	0.956	.042
Intermediate education[b]	1.130***	.027
Higher education[b]	1.296***	.034
Partner	0.965	.024
Time point 2	1.073***	.019
Time between t1 and t2	1.003	.019
Web survey in w2	1.014	.019
Intercept	2.164***	.194

IRR: incidence rate ratio; SE: standard error.
*$p < .05$; **$p < .01$; ***$p < .001$.
[a]Ref.: Dutch natives.
[b]Ref.: Lower education.

In relation to our first hypothesis, Table 2 shows the estimated effects of social media use on CDN size. We found both average social media use (i.e. averaged across the two time points for each respondent) and changes in social media use to be positively related to CDN size. Respondents who used social media more often had larger CDNs compared to their counterparts, and those who increased their social media use also expanded their CDNs. More specifically, each unit increase in social media use corresponded with 4.1% larger CDNs, which means that we found people who spend at least an hour a day on social media to have 27.3% larger CDNs than those who never use any type of social media. The longitudinal effect was small: an increase in the frequency of social media use by one unit increased CDN size by 1.2%. Altogether, the results contradict our predictions: Hypothesis 1 is rejected.

With respect to Hypothesis 2, Table 3 reports the effects of social media use on differences in the frequency of talking to one's core discussants (analyzed on the dyad level). Social media use was only associated with the frequency of talking to core discussants when comparing between persons; the longitudinal (within-person) effect of (change in) social media use on (change in) talking to a core discussant was non-significant. In other words, those who regularly spend time on social media talked to their confidants more frequently than those who do so less regularly, but changes in social media use did not induce changes in the frequency of talking. Hypothesis 2 is not supported.

Finally, Table 4 shows the results of three negative binomial regressions on CDN dynamics estimating the effect of social media use on the number of stable core discussants (Model 1), new core discussants (Model 2), and lost core discussants (Model 3). In all models, both the frequency of social media use in Wave 1 and the change in social media

Table 3. Clustered hybrid ordinal regression model on frequency of talking to stable core discussants, dyad level ($N = 2775$).

	OR	*SE*
Average social media use	1.119**	.045
Change in social media use	1.033	.038
Female	1.369*	.190
Age	0.907***	.010
Moroccan immigrant[a]	2.545**	.756
Turkish immigrant[a]	3.104***	.834
Non-Western immigrant[a]	1.968	.941
Western immigrant[a]	0.938	.297
Intermediate education[b]	0.640**	.110
Higher education[b]	0.323***	.061
Partner	0.589**	.115
Core discussant is family[c]	0.001***	.000
Core discussant is friend[c]	0.000***	.000
Core discussant is other[c]	0.002***	.002
Time point 2	0.414***	.037
Time between t1 and t2	0.983	.130
Web survey in w2	0.845	.115

OR: odds ratio; SE: standard error.
*$p < .05$; **$p < .01$; ***$p < .001$.
[a]Ref.: Native Dutch.
[b]Ref.: Lower education.
[c]Ref.: Core discussant is partner.

use had a significant positive effect. Over the whole range, those who spend time on social media at least 1 hour a day have 23.6% more stable ties in their CDN than those who do not spend time on social media. Furthermore, respondents who increased their social media use by one unit had 2.3% more stable ties. Hypothesis 3 is not supported by our data.

We do find support for hypotheses 4a and 4b. The networks of more frequent social media users seem more dynamic, as social media use positively affected the number of new as well as lost core discussants. Both social media use in Wave 1 and the change in social media use are significant, suggesting that social media use serves as a predictor of change in the composition of one's CDN. More frequent social media users lose more core discussants over time, but also obtain more new ones.

Combined, the three models indicate that the networks of frequent social media users are both more dynamic and simultaneously consist of more stable ties. This might seem counterintuitive at first, but is possible because of the larger CDN size among frequent social media users (see Table 2).

Conclusion and discussion

We studied whether social media use is linked to erosion of strong ties. We picked up on concerns about decreases in the size of core networks (Brashears, 2011; Hampton et al.,

Table 4. Negative binomial regression on the number of stable, new, and lost core discussants ($N = 2478$).

	(1) # Stable core discussants		(2) # New core discussants		(3) # Lost core discussants	
	IRR	*SE*	*IRR*	*SE*	*IRR*	*SE*
Social media use w1	1.036**	.011	1.022*	0.010	1.031***	0.011
Difference social media use w1, w2	1.023**	.009	1.025**	0.008	1.024**	0.009
# Stable core discussants			0.779***	0.015	0.743***	0.016
# New core discussants	0.849***	.013			1.039**	0.015
# Lost core discussants	0.847***	.013	1.029*	0.013		
Female	1.187***	.044	1.092*	0.035	1.162***	0.042
Age	0.990**	.003	0.994*	0.002	0.996	0.003
Moroccan immigrant[a]	0.560***	.037	0.888*	0.044	0.804***	0.045
Turkish immigrant[a]	0.656***	.039	0.916	0.043	0.890*	0.046
Non-Western immigrant[a]	0.791*	.083	0.973	0.084	0.952	0.091
Western immigrant[a]	0.926	.075	0.988	0.073	0.939	0.079
Intermediate education[b]	1.211***	.055	1.078**	0.042	1.193***	0.053
Higher education[b]	1.387***	.070	1.172***	0.053	1.370***	0.069
Partner	1.081	.053	0.840***	0.035	0.799***	0.037
Time between t1 and t2	0.990	.036	1.019	0.032	1.086*	0.039
Web survey in w2	1.174***	.043	1.402***	0.046	0.847***	0.016
Intercept	1.956***	.331	1.868*	0.281	1.376	0.235

IRR: incidence rate ratio; SE: standard error.
*$p < .05$; **$p < .01$; ***$p < .001$.
[a]Ref.: Native Dutch.
[b]Ref.: Lower education.

2011b; Mcpherson et al., 2006, 2008) and worries about the quality of our relationships (Turkle, 2011) and investigated whether earlier studies were right to blame the Internet for these developments. In general, our results provide evidence against these ideas. Frequent social media use seems to be associated with larger and more dynamic strong-tie networks. We draw three main conclusions.

First, our analyses showed that frequent social media users have larger CDNs than their counterparts and that increases in social media use were accompanied by increases in CDN size. These results are in line with at least three other (cross-sectional) studies (Chen, 2013; Lu and Hampton, 2016; Wang and Wellman, 2010) and add to a growing literature that puts in doubt the findings of decreasing CDNs (Fischer, 2009; Paik and Sanchagrin, 2013). Moreover, they relate to a PEW Internet study that reported a significant increase in CDN size for the average American (1.93 in 2008 to 2.16 in 2010), with SNS users reporting the largest CDN (2.27 in 2010) (Hampton et al., 2011a). Our longitudinal effect of social media use is marginal though, and our analyses do not rule out the possibility of a counter-effect, where those who expand their CDNs have more need to expand their social media use. Moreover, our data were only representative of the population between 15 and 45 years. This means that the increase in CDN size could reflect a

life-course effect rather than a period effect. Old age is associated with a decrease in CDN size (Cornwell et al., 2008), but this group is not included in our data.

Second, we conclude that the results for talking to CDN members are ambiguous: Frequent social media use is positively associated with talking to CDN members, but changes in social media use did not induce changes in talking. A possible explanation for the second result could be that in our data, half of the core discussants were contacted at least daily. With such large contact frequencies, differences over time might have been too marginal for social media use to significantly contribute to it. However, the findings at least provide evidence against negative expectations of the relation between social media use and strong ties. Therefore, they contrast a recent study by Hampton et al. (2016), who found that social media use reduced political discussion offline. Although the content of these discussions will only overlap with talking about important matters in our CDNs to a small extent, this shows that we are only starting to understand the complexities of the interrelations between on- and offline communication.

Combined, the results suggest that the social consequences of the rise of social media may not be as drastic as sometimes assumed. The effects we found were positive but small, which may imply that SNSs merely form another means of communication, without drastically altering the structure or quality of our relationships (Wellman et al., 2003). They are also in line with the observation that especially communication with strong ties is characterized by the use of multiple channels (Haythornthwaite, 2002, 2005), and might even imply that constant connectedness and multiplex activation of strong ties further boost their strength (Licoppe, 2004; Licoppe and Smoreda, 2005; Pettegrew and Day, 2015).

Third and last, our results suggest that social media use may render CDNs more dynamic. Previous studies have already shown that CDNs are not as stable as sometimes assumed (Morgan et al., 1997; Wellman et al., 1997). Our results also indicate that nowadays some relations may (temporarily) be put on hold, whereas others are revived and strengthened. Who is best able to comfort us, listen to us, and help us when we need them seems to depend on the circumstances (Small, 2013; Small et al., 2015). To the best of our knowledge, these dynamics have never been linked to social media use. We find that increases in social media use are associated both with losing core discussants and with adding new core ties to the CDN, hinting at the possible role of social media in further boosting individualization processes. They allow users to gather more information about their strong ties (including information on any helpful resource they may possess), to connect to latent ties (Ellison and Vitak, 2015; Hampton, 2016), and to mobilize support in times of need (Van Ingen et al., 2017).

Some limitations in the study design should be taken into account when interpreting these results. Most importantly, our analyses of network dynamics were based solely on the CDN name-generator question. If we want to know whether personal networks indeed become more dynamic and specialized, we would ideally analyze several name-generator questions, asking about a range of social support functions. If the reasoning about more specialized relationships is correct, such data should show that frequent social media users have more connections across these different social support functions compared to infrequent or non-users (who have more multi-purpose relations).

Second, our measure of online communication was very generic, combining all social Internet applications, ranging from passive news consumption to active one-on-one communication. Earlier research has indicated that when a distinction is made between communicative functions, only active communication, such as IMing, contributes positively to core ties and friendship quality (Verduyn et al., 2017). Without specifically focusing on active communication tools, we might have underestimated its true capacity.

Third, although we are fairly confident that the CDNs in our data represent strong ties to a large extent, CDNs do not consist of strong ties exclusively (Bailey and Marsden, 1999; Bearman and Parigi, 2004; Small, 2013). Unfortunately, our data did not allow us to separate between strong-tie and weak-tie core discussants. Future research should use more precise measures of tie strength and preferably also multiple name generators (see first limitation), thereby enabling analyses of the relation between social media use and ties of different strength.

Fourth, although we provided a better test of causal effects, several issues remain, which warrant caution in drawing conclusions about causality. One issue is that selection on social media use and the outcome variable may still disturb the findings (Morgan and Winship, 2014), causing differences in the trajectories of change that are not due to the treatment. Unfortunately, with two-wave data, it is impossible to assess whether this is a problem. Furthermore, the two-wave data do not allow us to disentangle the direction of causality using a fixed-effects approach, so our findings do not exclude the possibility of an effect of our dependent variables on social media use. A cross-lagged model is an alternative, although we consider this model to be inferior in the current case because there are many potential factors that simultaneously affect both social media use and strong-tie interactions (time-invariant, unobserved heterogeneity). Auxiliary analyses using these cross-lagged models showed positive, significant effects in both directions, with standardized coefficients of similar size. Future research based on three or more waves of longitudinal data should try to estimate the effects of lagged changes (in both directions) using the advantages of a fixed-effects approach.

Fifth, we interpreted all changes in the CDNs of our respondents as true changes. Research has shown that other factors (e.g. forgetfulness, historical events) also cause changes in networks. Our data did not allow us to test to what extent the registered changes reflect true change. Fortunately, there are studies that suggest that the vast majority of changes in CDNs are true. For instance, Wright and Pescosolido (2002) found that—even among individuals suffering mental health problems—forgetfulness was not a major cause of change. Moreover, Brewer and Webster (1999), in a study of recall among dormitory residents, found that respondents were unlikely to forget strong ties: the respondents in their sample only forgot 3% of their best friends.

Altogether, we believe that our findings contribute to the existing literature in this field. The longitudinal analyses of representative panel data are a first step in enhancing our understanding of the causal impact of social media on our strong ties. As a result, we can conclude with more certainty that—rather than with erosion of strong ties—social media use is associated with more, and more, dynamic interaction with our strong ties. This should temper some of the worries about negative consequences of the Internet.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

Allison PD (2009) *Fixed Effects Regression Models*: 160. Thousand Oaks, CA: SAGE.

Bailey S and Marsden PV (1999) Interpretation and interview context: examining the general social survey name generator using cognitive methods. *Social Networks* 21(3): 287–309.

Baym NK, Zhang YB and Lin M-C (2004) Social interactions across media: interpersonal communication on the internet, telephone and face-to-face. *New Media & Society* 6(3): 299–318.

Bearman P and Parigi P (2004) Cloning headless frogs and other important matters: conversation topics and network structure. *Social Forces* 83(2): 535–557.

Beck U (1999) *Individualization*. London: SAGE.

Boase J and Ikeda KI (2012) Core discussion networks in Japan and America. *Human Communication Research* 38(1): 95–119.

Brandtzaeg PB (2012) Social networking sites: their users and social implications—a longitudinal study. *Journal of Computer-Mediated Communication* 17: 467–488.

Brashears ME (2011) Small networks and high isolation? A reexamination of American discussion networks. *Social Networks* 33(4): 331–341.

Brewer DD and Webster CM (1999) Forgetting of friends and its effects on measuring friendship networks. *Social Networks* 21: 361–373.

Burke M and Kraut R and (2014) Growing closer on Facebook: changes in tie strength through social network site use. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, Toronto, ON, Canada, 26 April–1 May.

Burt RS (1984) Network items and the general social survey. *Social Networks* 6: 293–339.

Cameron AC and Miller DL (2010) Robust inference with clustered data. Working paper series, Department of Economics, University of California, Davis, CA, 6 April.

Cameron AC, Gelbach JB and Miller DL (2011) Robust inference with multiway clustering. *Journal of Business & Economic Statistics* 29(2): 238–1249.

Chen W (2013) Internet use, online communication, and ties in Americans' networks. *Social Science Computer Review* 31(4): 404–423.

Cornwell B, Laumann EO and Schumm LP (2008) The social connectedness of older adults: a national profile. *American Sociological Review* 73(2): 185–203.

Cornwell B, Schumm LP, Laumann EO, et al. (2014) Assessment of social network change in a national longitudinal survey. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences* 69(8): S75–S82.

Cummings JN, Butler B and Kraut R (2002) The quality of online social relationships. *Communications of the ACM* 45(7): 103–108.

Daft RL and Lengel RH (1986) Organizational information requirements, media richness and structural design. *Management Science* 32(5): 554–571.

Damian E and Van Ingen E (2014) How does SNS usage affect the personal networks of migrants? *Societies* 4(4): 640–653.

Edunov S, Diuk C, Filiz IO, et al. (2016) Three and a half degrees of separation. Available at: https://research.facebook.com/blog/three-and-a-half-degrees-of-separation (accessed 7 March 2016).

Ellison NB and Vitak J (2015) Social network site affordances and their relationship to social capital processes. In: Sundar SS (ed.) *The Handbook of the Psychology of Communication Technology*, vol 33. Chichester: Wiley-Blackwell, pp. 205–227.

Fischer CS (1982) *To Dwell among Friends: Personal Networks in Town and City*. Chicago, IL: University of Chicago Press.

Fischer CS (2009) The 2004 GSS finding of shrunken social networks: an artifact? *American Sociological Review* 74: 657–669.

Hampton K (2016) Persistent and pervasive community: new communication technologies and the future of community. *American Behavioral Scientist* 60(1): 101–124.

Hampton K and Ling R (2013) Explaining communication displacement and large-scale social change in core networks: a cross-national comparison of why bigger is not better and less can mean more. *Information, Communication & Society* 16(4): 561–589.

Hampton K, Sessions Goulet L, Rainie L, et al. (2011a) Social networking sites and our lives. *Pew Research Center's Internet & American Life Project*, Pew Research Center, Washington, DC, 16 June.

Hampton KN, Sessions LF and Her EJ (2011b) Core networks, social isolation, and new media: how internet and mobile phone use is related to network size and diversity. *Information, Communication & Society* 14(1): 130–155.

Hampton KN, Shin I and Lu W (2016) Social media and political discussion: when online presence silences offline conversation. *Information, Communication & Society* 20: 1–18.

Haythornthwaite C (2002) Strong weak and latent ties and the impact of new media. *Information Society* 18(5): 385–401.

Haythornthwaite C (2005) Social networks and internet connectivity effects. *Information, Communication & Society* 8(2): 125–147.

Kraut R, Patterson M, Lundmark V, et al. (1998) Internet paradox: a social technology that reduces social involvement and psychological well-being? *American Psychologist* 53(9): 1017–1031.

Laurenceau JP, Barrett LF and Pietromonaco PR (1998) Intimacy as an interpersonal process: the importance of self-disclosure, partner disclosure, and perceived partner responsiveness in interpersonal exchanges. *Journal of Personality and Social Psychology* 74(5): 1238–1251.

Licoppe C (2004) "Connected" presence: the emergence of a new repertoire for managing social relationships in a changing communication technoscape. *Environment and Planning D: Society & Space* 22: 135–156.

Licoppe C and Smoreda Z (2005) Are social networks technologically embedded? How networks are changing today with changes in communication technology. *Social Networks* 27: 317–335.

Lin N (2001) *Social Capital: A Theory of Social Structure and Action*. Cambridge: Cambridge University Press.

Lu W and Hampton KN and (2016) Beyond the power of networks: differentiating network structure from social media affordances for perceived social support. *New Media & Society* 19: 861–879.

Mcpherson M, Smith-Lovin L and Brashears ME (2006) Social isolation in America: changes in core discussion networks over two decades. *American Sociological Review* 71(3): 353–375.

Mcpherson M, Smith-Lovin L and Brashears ME (2008) Errata: social isolation in America: changes in core discussion networks over two decades. *American Sociological Review* 73(3): 1022.

Marsden P (1987) Core discussion networks of Americans. *American Sociological Review* 52: 122–131.

Marsden PV (2005) Recent developments in network measurement. In: Carrington PJ, Scott J and Wasserman S (eds) *Models and Methods in Social Network Analysis*. Cambridge: Cambridge University Press, pp. 8–30.

Mayhew BH and Levinger RL (1976) Size and the density of interaction in human aggregates. *American Journal of Sociology* 82: 86–110.

Mollenhorst G, Volker B and Flap H (2014) Changes in personal relationships: how social contexts affect the emergence and discontinuation of relationships. *Social Networks* 37: 65–80.

Morgan DL, Neal MB and Carder P (1997) The stability of core and peripheral networks over time. *Social Networks* 19(1): 9–25.

Morgan SL and Winship C (2014) *Counterfactuals and Causal Inference*. Cambridge University Press.

Nie NH and Erbring L (2000) *Internet and Society: A Preliminary Report*. Stanford, CA: Stanford Institute for the Quantitative Study of Society.

Paik A and Sanchagrin K (2013) Social isolation in America: an artifact. *American Sociological Review* 78(3): 339–360.

Palackal A, Mbatia PN, Dzorgbo D-B, et al. (2011) Are mobile phones changing social networks? A longitudinal study of core networks in Kerala. *New Media & Society* 13(3): 391–410.

Parigi P and Henson W (2014) Social isolation in America. *Annual Review of Sociology* 40(1): 153–171.

Pettegrew LS and Day C (2015) Smart phones and mediated relationships: the changing face of relational communication. *Review of Communication* 15(2): 122–139.

Putnam RD (2000) *Bowling Alone: The Collapse and Revival of American Community*. New York: Simon & Schuster.

Rainie L and Wellman B (2014) *Networked: The New Social Operating System*. Cambridge, MA: The MIT Press.

Schouten AP, Valkenburg PM and Peter J (2007) Precursors and underlying processes of adolescents' online self-disclosure: developing and testing an "internet-attribute-perception" model. *Media Psychology* 10(2): 292–315.

Shrum WM, Mbatia PN, Palackal A, et al. (2011) Mobile phones and core network growth in Kenya: strengthening weak ties. *Social Science Research* 40(2): 614–625.

Small LM (2013) Weak ties and the core discussion network: why people regularly discuss important matters with unimportant alters. *Social Networks* 35(3): 470–483.

Small LM, Pamphile VD and Mcmahan P (2015) How stable is the core discussion network? *Social Networks* 40: 90–102.

StataCorp (2013) *Stata User's Guide: Release 13*. College Station, TX: Stata Press.

Stern MJ (2008) How locality, frequency of communication and internet usage affect modes of communication within core social networks. *Information, Communication & Society* 11(5): 591–616.

Suler J (2004) The online disinhibition effect. *Cyberpsychology & Behavior* 7(3): 321–325.

Tolsma J, Kraaykamp G, De Graaf PM, et al. (2014) *The Netherlands Longitudinal Lifecourse Study (NELLS, Panel) Wave 1 2009 and Wave 2 2013-versie 1.1*. The Netherlands: Radboud University Nijmegen, Tilburg University & University of Amsterdam.

Turkle S (2011) *Alone Together: Why We Expect More from Technology and Less from Each Other*. New York: Basic Books.

Ugander J, Karrer B, Backstrom L, et al. (2011) The anatomy of the Facebook social graph. Available at: http://arxiv.org/abs/1111.4503 (accessed 7 March 2011).

Van Ingen E and Dekker P (2011) Dissolution of associational life? Testing the individualization and informalization hypotheses on leisure activities in the Netherlands between 1975 and 2005. *Social Indicators Research* 100(2): 209–224.

Van Ingen E and Wright KB (2016) Predictors of mobilizing online coping versus offline coping resources after negative life events. *Computers in Human Behavior* 59: 431–439.

Van Ingen E, Rains SA and Wright KB (2017) Does social network site use buffer against well-being loss when older adults face reduced functional ability? *Computers in Human Behavior* 70: 168–177.

Vehovar V, Manfreda KL, Koren G, et al. (2008) Measuring ego-centered social networks on the web: questionnaire design issues. *Social Networks* 30(3): 213–222.
Verduyn P, Ybarra O, Résibois M, et al. (2017) Do social network sites enhance of undermine subjective well-being? A critical review. *Social Issues and Policy Review* 11(1): 274–302.
Wang H and Wellman B (2010) Social connectivity in America: changes in adult friendship network size from 2002 to 2007. *American Behavioral Scientist* 53(8): 1148–1169.
Wellman B (2001) Computer networks as social networks. *Science* 293(5537): 2031–2034.
Wellman B, Quan-Haase A, Boase J, et al. (2003) The social affordances of the internet for networked individualism. *Journal of Computer-Mediated Communication* 8(3). Available at: http://onlinelibrary.wiley.com/doi/10.1111/j.1083-6101.2003.tb00216.x/full
Wellman B, Wong RY-L, Tindall D, et al. (1997) A decade of network change: turnover, persistence and stability in personal communities. *Social Networks* 19(1): 27–50.
Wittel A (2001) Toward a network sociality. *Theory, Culture & Society* 18(6): 51–76.
Wright ER and Pescosolido BA (2002) "Sorry, I forgot": the role of recall error in longitudinal personal network studies. In: Levy JA and Pescosolido BA (eds) *Social Networks and Health*. Bingley: Emerald Group Publishing, pp. 113–129.
Wuthnow R (1998) *Loose Connections: Joining Together in America's Fragmented Communities*. Cambridge, MA: Harvard University Press.

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