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Volume 47 · Number 4 · June 20[]

Quality&
Quantity

International Journal of Methodology

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Bowling alone but tweeting together: the evolution of human interaction in the social networking era

Angelo Antoci · Fabio Sabatini · Mauro Sodini

Abstract The objective of this paper is to theoretically analyze how human interaction may evolve in a world characterized by the explosion of online networking and other Web-mediated ways of building and nurturing relationships. The analysis shows that online networking yields a storage mechanism through which any individual contribution—e.g. a blog post, a comment, or a photo—is stored within a particular network and ready for virtual access by each member who connects to the network. When someone provides feedback, for example by commenting on a note, or by replying to a message, the interaction is finalized. These interactions are asynchronous, i.e. they allow individuals to relate in different moments, whenever they have time to. When the social environment is poor of participation opportunities and/or the pressure on time increases (for example due to the need to increase the working time), the stock of information and ties stored in the Internet can help individuals to defend their sociability.

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1 Introduction

Were it not for the Internet, Barack Obama would not be president. Were it not for the Internet, Barack Obama would not have been the nominee, said Arianna Huffington, editor in chief and co-founder of *The Huffington Post*, the most popular American news website. Mr. Obama used the Internet to organize his supporters in a way that in the past would have required an army of activists and paid organizers on the ground. Through social networking sites (SNSs) such as Facebook, YouTube, and Twitter, he was able to mobilize thousands of people. The Obama campaign also caused a sea change in fact-checking, with citizens using the Internet to prove a politician wrong and then using SNSs to alert their fellow citizens. But SNSs have not changed only the political debate. In the last five years, they have literally revolutionized our lives. Social networking has made it simpler to interact with others without the limitations of geography and lack of time. In this paper, consistent with results from recent studies in the fields of applied psychology and communication science, we argue that Web-mediated interaction can play a major role in the preservation and development of interpersonal relations (Subrahmanyam et al. 2008; Park et al. 2009; Matzat 2010; Pénard and Poussing 2010; Bauernschuster et al. 2011; Gil de Zúñiga et al. 2012).

Participation through online networks can help individuals to maintain their social contacts from distant locations, for example after a transfer due to work commitments (Cummings et al. 2006; Ellison et al. 2007, 2011). Moreover, Web-mediated interaction is less sensitive to a reduction in leisure time caused by an intense pace of work. Facebook and Twitter allow users to stay in touch with their friends and acquaintances during coffee breaks or while waiting for the train. Online social participation favours asynchronous interactions which allow individuals to compensate for the lack of time: one can benefit from the others' participation, for example by reading a message or a note, even if the person who wrote it is currently offline. It is noteworthy that asynchronous interactions are not necessarily of inferior quality compared to simultaneous, face-to-face, interactions. Experiments found that the depth of a friendship can be significantly improved by computer-mediated communication. Apparently, by way of online relationships individuals become far better in expressing their true selves and feelings (Ellison et al. 2007; Park et al. 2009; Burke et al. 2011; Sheldon 2009; Burke and Settles 2011). Interactions through the Internet can foster the social inclusion of individuals suffering from social anxiety, i.e. anxiety about social situations, interactions with others, and being evaluated by others (Caplan 2007; Steinfield et al. 2008). Thanks to new tools such as Facebook messages and Flickr mails, many people have regained the habit of writing letters. Psychological studies claim this form of interaction can lead to an improvement in the quality of relationships. Letters have in fact been found to have the property of slowing the communication down, thus giving people more time and reasons to process their feelings, to put a greater effort into understanding others' expectations, and to think in depth before they respond (Kobayashi and Ikeda 2008; Miyata and Kobayashi 2008; Steinfield et al. 2008).

In addition to the preservation of existing ties, interaction through SNSs can foster the creation of new relations. Everyday life experience shows that a rising number of Internet users are forming closer relationships with individuals they first met online. Some SNSs serve the explicit purpose of favouring physical encounters between members. For example, Academia.edu was conceived to make authors meet and work together on new projects, LinkedIn aims to foster a better matching between workers and employers in the job market, and Meetic is now a reference point for individuals aiming to build a romantic relationship.

Last but not least, Web-mediated interaction contributes to the building of what has been called Internet social capital, i.e. the accumulation of a stock of knowledge, information and

trust within virtual networks (Gaudel and Peroni 2010; Vergeer and Pelzer 2009; Chaim and Gandal 2011; Matzat 2010; Antoci et al. 2012a).[1]

The phenomena briefly described above suggest that the Internet can help mitigate the decline in social participation which has been documented in a number of empirical studies (Paxton 1999; Putnam 2000; Robinson and Jackson 2001; Costa and Kahn 2003; Bartolini et al. 2013). From this point of view, social participation through the Internet could be considered as a defensive behaviour, which allows individuals to protect their relationships from the increasing pressure on time and from the possible decrease in the probability of in-person encounters offered by the social environment which physically surrounds the individual (Antoci et al. 2012b). The spread of this mode of participation can lead to second-best scenarios, in the case that face-to-face interaction is socially optimal. However, as shown in Antoci et al. (2012b), it may prevent the economy from falling into a social poverty trap.

The objective of this paper is to theoretically analyze how human interaction may evolve in a world characterized by the explosion of online networking and other Web-mediated ways of building and nurturing relationships.

To reach this goal, we build a theoretical framework where agents can develop their social interactions through two different strategies: (1) A social networking strategy (hereafter *SN*), within which social participation takes place both by means of online networking and face-to-face interaction. For example, when they are too busy to arrange physical encounters, individuals playing *SN* stay in touch with their relatives and friends through SNSs, but they meet them in person every time they can. (2) A face-to-face strategy (hereafter *FF*), which does not encompass social interaction through the Internet.

The analysis shows that Web-mediated interaction yields a storage mechanism through which any individual contribution—e.g. a blog post, a comment, or a photo—is stored within a particular network and virtually ready for use to each member who connects to the network. When someone provides feedback, for example by commenting on a note, or by replying to a message, the interaction is finalized. These interactions are asynchronous, i.e. they allow individuals to relate in different moments, whenever they have time to (e.g. in the night, just before going to sleep). When the social environment is poor in opportunities for participation and/or the pressure on time increases (for example due to the need to increase working hours, the social capital stored in the Internet can help individuals to defend their sociability. In other words, the relative performance of the two strategies of participation is influenced by the rise in the pressure on time. Social interaction through the Internet can thus help protect the relational sphere of individuals' lives from space and time constraints. Since the consumption of relational goods has been found to exert a significant influence on happiness (Gui and Sugden 2005; Becchetti et al. 2008; Bruni and Stanca 2008; Becchetti and Degli Antoni 2010), our results suggest that, under certain conditions, Internet usage can support well-being by counterbalancing the effects of time pressure on mental distress and the disruption of social ties. This result is consistent with recent empirical findings showing the existence of a significant and positive correlation between Internet usage and happiness (Pénard et al. 2011).

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[1] In addition to SNSs, the accumulation of information seems to be particularly evident in sites such as Tripadvisor and Zagat, where users review their experience with hotels, restaurants, airlines and travel agencies with no self-interested purposes may be able to nurture the diffusion of trust in strangers among travellers. However, it is noteworthy that the usefulness of online networks in the diffusion of information and trust has been questioned for groups where members are anonymous and their tastes are actually unknown (see for example Demange 2010). Pénard et al. (2011) finds that reputation feedback systems significantly improve the diffusion of trust in e-marketplaces, but are vulnerable to strategic ratings and reciprocation.

Our work has relevant theoretical and policy implications. First, we provide theoretical research with a logical framework for analyzing the relationship between web-mediated communication, the evolution of human interaction and the accumulation of social capital. Second, the analysis is also related to the literature on the digital divide (Goldfarb and Prince 2008; Agarwal et al. 2009; Drouard 2010). If the adoption of the SN strategy can support happiness through engagement in social activities, then Internet users could increase their subjective well-being compared to non-users, especially when the pressure on time increases. As recently remarked by Pénard et al. (2011) and Sabatini (2011), high income individuals tend to be happier and to use the Internet more than low income people. Thus, the digital divide may increase existing inequalities in subjective well-being. From the policy point of view, this suggests that the reduction in the digital divide could be an effective measure to contain inequalities in the distribution of well-being.

The remainder of the paper is as follows: in the next section we review the social science literature on the role of SNSs in the evolution of social interaction. In Sect. 3 we present our framework. Section 4 discusses the implications of this framework. The paper is closed by a few concluding remarks and considerations for further studies.

2 Related literature

Early sociological studies on computer-mediated communication shared the fear that the Internet would cause a progressive reduction in social interactions, just as the activity of watching TV does (Bruni and Stanca 2006, 2008; Frey et al. 2007). The main argument shared by Internet skeptics was based on the presumption that the more time people spend using the Internet during leisure time, the more time has to be detracted from social activities (Katz et al. 2001; Nie and Erbring 2000; Nie et al. 2002; Gershuny 2003; Robinson and Martin 2010).

Beyond a certain threshold, the development of human relationships by the exclusive means of online interactions may destroy social capital, thereby preventing users from enjoying those emotional benefits normally associated with face-to-face interactions. Drawing on the observation of the first two years online of 69 individuals from 93 households in Pittsburgh, Kraut et al. (1998) concluded that increased Internet usage was associated with a decline in interactions with family members within the household, a reduced social circle, and a rise in levels of loneliness and depression. Nie and Erbring (2000) used U.S. nationally representative survey data to show that Internet users reported spending less time with family and friends than non-users. It was found that for each minute participants reported spending on the Internet during the preceding 24 hours, there was a reduction of approximately one third of a minute spent with family members (Hamburger and Hayat 2011). Stepanikova et al. (2010) use panel time-diary data collected from adult U.S. residents in 2004 and 2005 to examine whether loneliness and life satisfaction are associated with time spent at home on various Internet activities. "Cross-sectional models reveal that time spent browsing the web is positively related to loneliness and negatively related to life satisfaction". However, not all of the relationships revealed by cross-sectional models persisted even when considering the same individuals over time in fixed-effects models accounting for time-invariant, individual-level characteristics. The authors' results "vary according to how the time use data were collected, indicating that survey design can have important consequences for research in this area" (p. 329).

As properly suggested by Hamburger and Ben-Artzi (2003), people who are already lonely may in fact be more inclined toward Internet use. This bias questions the causal

relationship between Internet usage and social interactions presented in previous studies on the topic. Drawing on data from a field study on Internet use and feelings of loneliness, extroversion and neuroticism conducted on 89 participants, the authors found that lonely people have a tendency to engage in greater Internet usage compared to non-lonely people. Analyzing responses from a survey of 277 undergraduate Internet users, Morahan-Martin and Schumacher (2003) show that "lonely individuals may be drawn online because of the increased potential for companionship, the changed social interaction patterns online, and as a way to modulate negative moods associated with loneliness" (p. 659). The insights proposed by Hamburger and Ben-Artzi (2003) and Morahan-Martin and Schumacher (2003) found important support in results from a 3-year follow-up of the respondents surveyed in the piooner study by Kraut et al. (1998). The same research team (Kraut et al. 2002) indeed found that the negative effect of Internet usage on sociability dissipated over time.

More in general, it is worth noting that studies emphasizing the negative correlation between Internet usage and sociability date back to just shortly before the explosion of online networking, and they could not differentiate between pure entertainment and social activities.[2] At that time, using the internet was predominantly an individual activity like watching TV or reading newspapers. Today, the use of the internet is strongly related to being connected to social networking sites, which in turn entails forms of engagement in social activities. According to data on the U.S. provided by the Internet & American Life Project carried out by the Pew Research Center (PRC), as of September 2009 nearly three quarters (73 %) of online teens (aged 12–17) and an equal number (72 %) of young adults (18–29) used social network sites. A recent survey conducted in the U.S. in May 2011 found that fully 65 % of online adults now use social networking sites. This figure marks a dramatic increase from the first time the Project surveyed usage of social networking sites in February of 2005. At that time just 8 % of internet users or 5 % of all adults said they used SNSs (Madden and Zickuhr 2011). In December 2010, U.S. Internet users were found to be more likely than others to be active in some kind of voluntary group or organization: 80 % of American Internet users participate in groups, compared with 56 % of non-Internet users. Moreover, social media users are even more likely to be active: 82 % of social network users and 85 % of Twitter users are group participants (Rainie et al. 2011). This evolution makes any comparison between the internet and TV anachronistic.

Pessimistic views on the social effects of Internet usage have already been challenged by results from pioneer studies specifically targeted at verifying the effects of online networking on communities living in a precise geographic location (e.g. a city area, a rural village, or a suburb). Drawing on survey and ethnographic data from a wired suburb of Toronto, Hampton and Wellman (2003) find that high-speed, always-on access to the Internet, coupled with a local online discussion group, transforms and enhances "neighbouring". In particular, the internet supports increased contacts with weaker ties, without causing any deterioration in strong ties. In the authors' words, "not only did the internet support neighbouring, it also facilitated discussion and mobilization around local issues" (Hampton and Wellman 2003, p. 277). Kavanaugh et al. (2005) find that computer-mediated interactions have positive effects on community cohesion, involvement, and social capital in the village of Blacksburg, Virginia. In one of the first economic studies on the topic, based on a longitudinal survey conducted in 1998 and 2001 among a random sample of Swiss citizens, Franzen (2003) finds that Internet use is not associated with a reduction in respondents' networks or in the time

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[2] Robinson and Martin (2009) use data from the 2006 wave of the General Social Survey, which were collected in 2005, just shortly before the explosion of online networking.

they spent socializing with friends. Instead, the time users devote to the Internet is taken away from the time spent on watching television.

2.1 Recent studies

Findings from the latest wave of studies (i.e. carried out between 2007 and 2011) on the relational effects of social networking further challenge the earlier concerns about the socially detrimental effects of the Internet. These studies almost unanimously converge on the claim that online networks support the consolidation and development of existing ties.[3] As emphasized in the review of the literature carried out by Antoci et al. (2012a), the main reason why these works appear to be more reliable than those that argue for a possibly negative relationship between computer-mediated interaction and social capital is that they were conducted *after* the explosion of online networking. Thus, they take into account the social implications of SNS usage. It is also remarkable that some studies on Facebook rely on server log data provided by the platform itself, which provides large samples, higher representativeness, objective information on what people really do on the platform, allowing for the distinction between social activities and individual pastimes like taking quizzes (see for example Burke et al. 2011; Burke and Settles 2011).

According to this strand of the literature, SNSs support the strengthening of bonding and bridging social capital (Steinfield et al. 2008; Park et al. 2009; Pénard and Poussing 2010; Bauernschuster et al. 2011), allow the crystallization of weak or latent ties that might otherwise remain ephemeral (Haythornthwaite 2005; Ellison et al. 2007, 2011; Miyata and Kobayashi 2008), facilitate the establishment of new collaborations in the academic community (Matzat 2004), support teenagers' self-esteem—encouraging them to relate to their peers (Ellison et al. 2007, 2011; Steinfield et al. 2008), stimulate social learning (Burke et al. 2011), enhance social trust (Matzat 2010), civic engagement (Stern and Adams 2010; Zhang et al. 2010) and political participation (Gil de Zúñiga et al. 2012), facilitate the creation of electronic networks of practice (Wasko and Faray 2009), and help the promotion of collective action (Landqvist and Teigland 2005).

Drawing on survey data from a random sample of 800 undergraduate students, Ellison et al. (2007) find that certain types of Facebook use can help individuals accumulate and maintain bridging social capital. The authors suspect that the social network helps students to overcome the barriers to participation so that individuals who might otherwise shy away from initiating communication with others are encouraged to do so through the Facebook infrastructure. In the authors' words, highly engaged users are using Facebook to "crystallize" relationships that might otherwise remain ephemeral (2007). Haythornthwaite (2005) argues that social media create latent tie connectivity among group members that provides the technical means for activating weak ties (p. 125). Latent ties are those social network ties that are technically possible but not activated socially (p. 137).[4]

Steinfield et al. (2008) analyzed panel data from two surveys on Facebook users conducted a year apart at a large U.S. university. Intensity of Facebook use in year one strongly predicted bridging social capital outcomes in year two, even after controlling for measures of self-esteem and satisfaction with life. The authors suggest that Facebook affordances help reduce

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[3] A reading list on the relationship between Internet usage and social interactions is available on the web site Social Capital Gateway at the url http://www.socialcapitalgateway.org/internet.

[4] According to Ellison et al. (2007), Facebook might make it easier to convert latent ties into weak ties, in that the site provides personal information about others, makes visible one's connections to a wide range of individuals, and enables students to identify those who might be useful in some capacity, thus providing the motivation to activate a latent tie.

barriers that students with lower self-esteem might experience in forming the kinds of large, heterogeneous networks that are sources of bridging social capital.

However, the growing literature on Facebook suggests that the social network—and, more generally, Internet-mediated communication—serves more the preservation of relations among offline contacts than the activation of latent ties or the creation of connections with strangers (Ellison et al. 2007; Steinfield et al. 2008). Most Facebook friend connections indeed represent in-person relationships (Ellison et al. 2011). In one of the rare economic studies on the topic, Pénard and Poussing draw on data from the 2002 wave of the European Social Survey (EVS) for Luxembourg to find that people who already have a large stock of social capital are more likely to use the Internet to take care of their social relationships. In a recent paper based on data drawn from the 2008 section of the German Socio-Economic Panel and confidential data provided by *Deutsche Telekom*, Bauernschuster et al. (2011) find that having broadband Internet access at home has positive effects on the frequency of visiting theatres, the opera, and exhibitions and on the frequency of visiting friends, even after controlling for endogeneity through instrumental variables estimates and by accounting for county fixed effects. Exploring a sub-sample of children aged 7–16 living in the sampled households, the authors further find evidence that having broadband Internet access at home increases the number of children's out-of-school social activities, such as doing sports or ballet, taking music or painting lessons, or joining a youth club.

Since engagement in relational activities and social capital are positively correlated with happiness (Becchetti et al. 2008; Bruni and Stanca 2008; Gui 2005; Bartolini et al. 2013), Internet usage could also have a positive effect on individual well-being. Using data from a random web survey of college students across Texas, Park et al. (2009) find a positive relationship between intensity of Facebook use and students' life satisfaction. Drawing on the Luxemburgish part of the EVS 2008 section, Pénard et al. (2011) find evidence that non Internet users are less satisfied with their life than users. The correlation between Internet use and reported happiness is stronger for low income and young individuals. Suggestive hints about the role that SNSs may play in reducing inequalities in well-being are proposed by Steinfield et al. (2008). The authors find that life-satisfaction and self-esteem serve to moderate the relationship between Facebook usage intensity and bridging social capital: those with lower self-esteem and who are less satisfied with their life gained more from their use of Facebook in terms of bridging social capital than participants with higher self-esteem.

Overall, the main claim emerging from the empirical studies briefly outlined above is that online networking is a means for nurturing and articulating existing ties, as well as a fertile ground for activating latent ties and, less often, for creating new connections with strangers. In the next section, we will integrate the assumption that online networking may contribute to the building and preservation of social capital into a theoretical framework aimed at better understanding the causal nexus between computer-mediated communication, social participation, and the evolution of social capital.

3 Analytical framework

We consider an economy composed by a continuum (of measure 1) of identical individuals. In each instant of time t, a share $p \in (0, 1)$ of the population is enjoying its leisure time, or, in other terms, is in the L mode. The remaining share of the population, $1 - p$, is currently working, or is in the W mode. In each instant of time t, an individual has a p likelihood of being in the L mode and a $1 - p$ likelihood of being in the W mode.

In this paper we assume that: (1) leisure time is entirely devoted to social participation. (2) The allocation of time between leisure and work is exogenously given. These assumptions allow us to focus on the agents' choice of how to allocate their leisure time—which coincides with social participation—between face-to-face encounters and Internet-mediated interaction. As already outlined in the Introduction, participation through the Internet can take place in any spare moment—such as during a coffee break or before going to bed at night—and between people in distant locations—e.g. not in the same town. Internet-mediated interaction can be viewed as a defensive choice protecting the individual's relational life from the possible poverty of the social environment where she lives—which may not offer adequate opportunities to meet friends—and/or from the possibility that, at the given instant of time t, the individual's social contacts may all be in the W mode, thus unable to interact with her. Through the SN strategy, L mode and W mode individuals can interact with each other at different times. The possible asynchronism of interaction is indeed a distinctive feature that differentiates social participation through social networking sites from other technology-intensive communication tools, such as Skype and mobile phones.

In each instant of time t, individuals can engage in two types of social participation: random pairwise face-to-face encounters, or Internet-mediated interaction. More specifically, they can adopt one of the following two strategies: (1) the social networking (SN) strategy, within which social participation takes place both by means of online networking and face-to-face interaction. Individuals playing the SN strategy thus interact both through in-person random pairwise encounters and through the Internet. (2) The face-to-face (FF) strategy, which entails only in-person random pairwise encounters and does not encompass Internet-mediated interaction.

Let $x(t) \in [0, 1]$ be the share of individuals adopting the SN strategy at the instant of time t. $1 - x(t)$ is the share of the population adopting the alternative strategy FF.

One of the main features of social networks is that they allow the storage of past online interactions inside the network. In other words, the past evolution of x influences the network's wealth of ties. The higher the number of agents who choose to join the network in the past, the more rewarding the choice to join the network will be. The growth of the quantity of agents playing SN will in fact entail an increase in the wealth of knowledge and information contained in online networks, and will contribute to the establishment of new online ties, probably directed at the strengthening and development of existing offline ties, as the literature suggests (Ellison et al. 2007; Steinfield et al. 2008; Pénard and Poussing 2010; Bauernschuster et al. 2011). In other words, an increase in the quantity of SN-type individuals is likely to imply an increase in the quality of online networks. From this point of view, the adoption of both strategies is path-dependent: the individual decision to develop her social interactions through the SN or the FF strategy is influenced by the number of individuals who choose the SN or the FF strategy in the past.

Let $K_N(t)$ be an index of quality of online networks. $K_N(t)$ can also be viewed as the stock of knowledge and information that has been added to online networks from time 0 to t. Every individual who joins online networks, i.e. who adopts the SN strategy, can enjoy the benefits of the stock $K_N(t)$. It is noteworthy that these benefits are extended to those individuals who, although being in the L mode, are matched with individuals who currently are in the W mode. The interaction between these individuals can in fact be asynchronous. By contrast, if two FF-playing individuals are randomly matched, they both need to be in the L mode to interact with each other. The stock $K_N(t)$ is a public good, in that it potentially benefits whoever connects to the Internet and adopts the SN strategy.

Assumption 1 We assume the payoff of the interaction through SNSs to be given by:

$$\alpha K_N(t)$$

where α is a strictly positive parameter. Since Internet-mediated interaction can also be asynchronous, this payoff is unrelated to the current behaviour of the individuals with whom players are matched, i.e. it does not depend on whether individuals are in the W or in the L mode, and on whether they play the SN or the FF strategy.

Assumption 2 We assume that the payoffs of the random matching-interaction between individuals who simultaneously are in the L mode are as follows:

$$
\begin{array}{cc}
 & \begin{array}{cc} SN & FF \end{array} \\
\begin{array}{c} SN \\ FF \end{array} & \begin{pmatrix} a & b \\ c & d \end{pmatrix}
\end{array}
\tag{1}
$$

Where $a > b$, $d > c$, that is each player gets a higher payoff if she is matched with someone who adopts the same strategy.

Assumption 3 We normalize the payoff of individuals in the W mode, independently of the behaviour of those other individuals with whom they are randomly matched. We assume this payoff to be equal to 1.

Assumption 4 We assume that when individuals who are in the L mode are matched with individuals in the W mode, they receive a payoff equal to 0 if they are playing the FF strategy and equal to $\alpha K_N(t)$ if they adopt the SN strategy. If an individual adopts the FF strategy, she cannot interact with people who are in the W mode, since an in-person encounter is impossible. The adoption of the SN strategy, instead, allows the individual to benefit from the stock of latent interactions stored within online networks through asynchronous communication.

First, we compute the expected payoff of the SN strategy. In each instant of time t, (1) a SN player has a $1 - p$ likelihood of being in the W mode. Thus, her payoff has a $1 - p$ likelihood of being equal to 1. (2) A SN player has a p likelihood of being in the L mode. Her payoff depends on the mode of the individual with whom she is randomly matched. If this individual is in the W mode, then the SN player's payoff is $\alpha K_N(t)$. Otherwise, the payoff also includes an additional reward depending on the strategy adopted by the other player, i.e. it is given by $\alpha K_N + ax + b(1 - x)$, where x and $1 - x$ are the likelihoods with which the SN and the FF strategy are respectively adopted by the other player.

The expected payoff Π_{SN} of the SN strategy is thus given by:

$$
\begin{aligned}
\Pi_{SN}(K_N, x) &= 1 - p + p\{(1 - p)\alpha K_N + p[\alpha K_N + ax + b(1 - x)]\} \\
&= 1 - p + p[\alpha K_N + pax + pb(1 - x)] \\
&= 1 - p + p[\alpha K_N + pb + p(a - b)x]
\end{aligned}
$$

In the same way, we can compute the payoff Π_{FF} of the FF strategy as:

$$
\begin{aligned}
\Pi_{FF}(K_N, x) &= 1 - p + p\{(1 - p) \cdot 0 + p[cx + d(1 - x)]\} \\
&= 1 - p + p^2[d + (c - d)x]
\end{aligned}
$$

The difference between the two payoffs is thus given by:

$$
\begin{aligned}
\Pi_{SN}(K_N, x) - \Pi_{FF}(K_N, x) &= p[\alpha K_N + pb + p(a - b)x - pd - p(c - d)x] \\
&= p[\alpha K_N + p(b - d) + p(a + d - b - c)x]
\end{aligned}
$$

Remark 1 $\Pi_{SN}(K_N, x)$ is increasing in x, i.e. the more the share x of the population participating in online networks grows, the higher the return of joining those networks will be.

Remark 2 $\Pi_{FF}(K_N, x)$ is decreasing in x, i.e. the payoff Π_{FF} decreases as the share of the population adopting the *SN* strategy grows.

Remark 3 The difference between the two payoffs, $\Pi_{SN}(K_N, x) - \Pi_{FF}(K_N, x)$, is an increasing function of x.

An increase in the share of the population adopting the *SN* strategy positively affects the payoff Π_{SN} and negatively affects the payoff Π_{FF}. In the case of Facebook, an increase in the number of subscribers will raise the individual's utility of joining the network. On the other hand, being outside of the network (i.e. continuing to play the *FF* strategy) implies an increasing relational cost. Think for example of an *FF*-playing teenager whose classmates join Facebook. Not following them into the network may lead to the cooling of some relationships as well as to the exclusion from new ones established through the activation of latent ties. There is a self-feeding process making the relative performance of the *SN* strategy grow with the increase in the share x of the population adopting this strategy.

We assume that the time evolution of K_N depends on the share x of the population adopting the *SN* strategy, on the number of people who are in the *L* mode, and on a positive depreciation rate γ:

$$\dot{K}_N(t) = \beta p x(t) - \gamma K_N(t)$$

The depreciation rate $\gamma > 0$ of K_N is introduced to account for the cooling of online relationships related to the lack of care (social ties developed online need care to be preserved just as traditional ties do) and for the obsolescence of the stock of information deposited in online networks. $\beta > 0$ is a parameter measuring the dependence of the time evolution of K_N on the share x of the population adopting the *SN* strategy.

Let us assume that the adoption process of the two strategies is given by the following replicator dynamics:

$$\begin{aligned}
\dot{x} &= x(1-x)\left[\Pi_{SN}(K_N, x) - \Pi_{FF}(K_N, x)\right] \\
&= px(1-x)\left[\alpha K_N + p(b-d) + p(a+d-b-c)x\right]
\end{aligned}$$

Combining the two equations above we have the following system:

$$\begin{aligned}
\dot{K}_N &= \beta p x - \gamma K_N \\
\dot{x} &= px(1-x)\left[\alpha K_N + p(b-d) + p(a+d-b-c)x\right]
\end{aligned}$$

which describes the time evolution of the share of the population interacting through online networks and of the wealth of ties and information contained in online networks.

4 Results

Along the line Γ_1:

$$x = \frac{\gamma}{p\beta} K_N$$

we have $\dot{K}_N = 0$. Γ_1 separates the left side of the plane (K_N, x), where $\dot{K}_N > 0$, from the right side, where $\dot{K}_N < 0$ holds.

It holds $\dot{x} = 0$ for $x = 0, 1$ and along the line Γ_2:

$$x = \frac{d - b}{a + d - b - c} - \frac{\alpha}{p(a + d - b - c)} K_N$$

On the left side of Γ_2 it holds $\dot{x} < 0$ and on the right side of Γ_2 it holds $\dot{x} > 0$. The slope of Γ_2 is strictly negative.

It is easy to check the following results. The system admits at most three stationary states:

$$K_N = 0, \quad x = 0$$

$$K_N = \frac{p\beta}{\gamma}, \quad x = 1$$

$$\overline{K}_N = \frac{p\beta(d - b)}{(a + d - b - c)\gamma + \alpha\beta}, \quad \overline{x} = \frac{\gamma(d - b)}{(a + d - b - c)\gamma + \alpha\beta}$$

The third stationary state, when it does exist, is always a saddle point. The state $(K_N, x) = (0, 0)$ is locally attractive if:

$$b - d < 0$$

and it is a saddle point if the condition $b - d \geq 0$ holds. Notice that the latter condition holds if and only if the strategy SN dominates the strategy FF in the payoff matrix (1) concerning the random matching-interactions between individuals who simultaneously are in the L mode; this implies that $\Pi_{SN}(K_N, x) - \Pi_{FF}(K_N, x) \geq 0$ always holds whatever the values of x and K_N are.
The state $(K_N, x) = (\frac{p\beta}{\gamma}, 1)$ is locally attractive if:

$$\alpha\frac{\beta}{\gamma} + a - c > 0 \tag{2}$$

and it is a saddle point if the condition $\alpha\frac{\beta}{\gamma} + a - c \leq 0$ holds. Condition (2) is always satisfied if the strategy FF does not dominate the strategy SN in the payoff matrix (1) (i.e. if $a \geq c$). When this is not the case, condition (2) holds if the payoff of the interaction through SNSs (measured by $\alpha\frac{\beta}{\gamma}$) is high enough.

The above basic results allow us to give a complete classification of replicator dynamics:

Case I: $b - d \geq 0$. In this context, the SN strategy always dominates FF for every values of x and K_N. It holds $\dot{x} > 0$ for every $x \in (0, 1)$ and the system converges to the stationary state $(K_N, x) = (\frac{p\beta}{\gamma}, 1)$ (see Fig. 1), where the wealth of information and ties of online networks reaches its highest possible level and everyone adopts the SN strategy, whatever the initial values of K_N and x are.

Case II: $\alpha\frac{\beta}{\gamma} + a - c \leq 0$. In this context, the FF strategy dominates the SN mode of participation. It holds $\dot{x} < 0$ for every $x \in (0, 1)$ and the system converges to the stationary state $(K_N, x) = (0, 0)$, where online networking disappears and everyone plays the FF strategy whatever the initial values of K_N and x are (see Fig. 2).

Case III: $b - d < 0$ and $\alpha\frac{\beta}{\gamma} + a - c > 0$. If both the conditions in Cases I and II are not satisfied, then a bi-stable dynamic regime occurs where both the stationary states
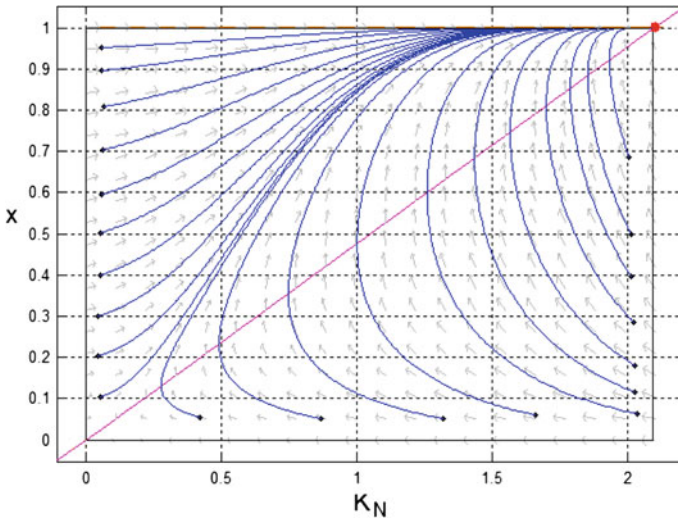
Fig. 1 Case $b - d \geq 0$; in this context, the SN strategy dominates FF and the dynamics converge to the stationary state $(K_N, x) = (\frac{p\beta}{\gamma}, 1)$, whatever the initial values of K_N and x are
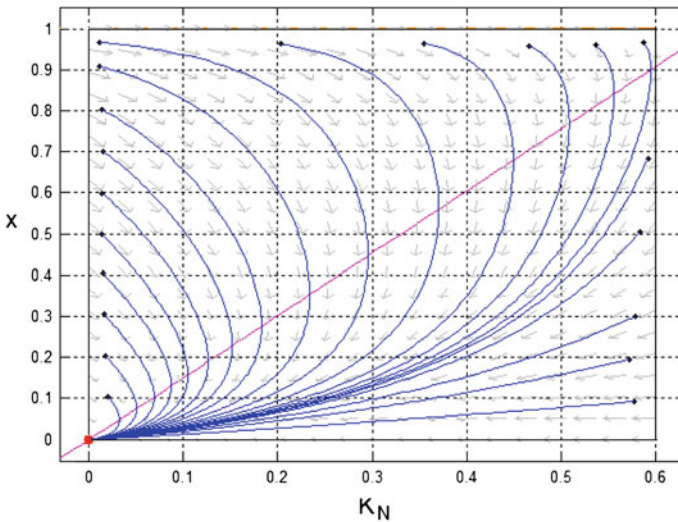

Fig. 2 Case $\alpha\frac{\beta}{\gamma} + a - c \leq 0$; in this context, the FF strategy dominates SN and the dynamics converge to the stationary state $(K_N, x) = (0, 0)$, whatever the initial values of K_N and x are

$(K_N, x) = (0, 0)$ and $(K_N, x) = (\frac{p\beta}{\gamma}, 1)$ are locally attractive and the interior stationary state $(\overline{K}_N, \overline{x})$ is a saddle point. The stable manifold of the stationary state separates the basins of attraction of the two attractive states $(K_N, x) = (0, 0)$ and $(K_N, x) = (\frac{p\beta}{\gamma}, 1)$ (see Fig. 3).

By following the same steps followed in Antoci et al. (2012a), it is easy to check that the basin of attraction of the stationary state $(\frac{p\beta}{\gamma}, 1)$, where all agents choose the SN strategy and the stock K_N representing the wealth of knowledge and ties of the Internet reaches its highest
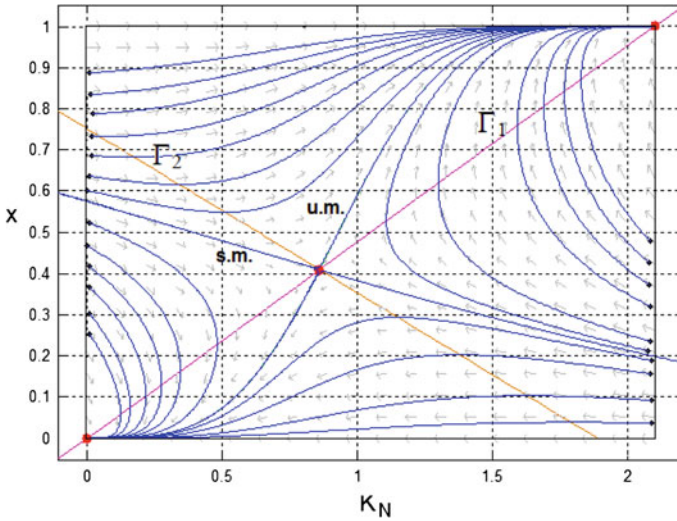
Fig. 3 Case $b - d < 0$ and $\alpha \frac{\beta}{\gamma} + a - c > 0$; in this context, a bi-stable dynamic regime is observed where both the stationary states $(K_N, x) = (0, 0)$ and $(K_N, x) = (\frac{p\beta}{\gamma}, 1)$ are locally attractive and the interior stationary state $(\bar{K}_N, \bar{x})$ is a saddle point

level, expands as the time p available for social participation decreases. Internet-mediated interaction can be seen as a tool allowing individuals to manage their social relationships despite increasing time pressures and possible distance constraints.

5 Welfare analysis

Let us now consider the welfare properties of the two attractive stationary states $(K_N, x) = (0, 0)$ and $(K_N, x) = (\frac{p\beta}{\gamma}, 1)$. Starting from the payoffs:

$$\Pi_{SN}(K_N, x) = 1 - p + p\left[\alpha K_N + pb + p(a - b)x\right]$$
$$\Pi_{FF}(K_N, x) = 1 - p + p^2\left[d + (c - d)x\right]$$

we see that, at the stationary state $(K_N, x) = (0, 0)$, every individual gets the payoff:

$$\Pi_{FF}(0, 0) = 1 - p + dp^2$$

while, at the stationary state $(K_N, x) = (\frac{p\beta}{\gamma}, 1)$, every individual gets the payoff:

$$\Pi_{SN}\left(\frac{p\beta}{\gamma}, 1\right) = 1 - p + p\left[\alpha \frac{p\beta}{\gamma} + pb + p(a - b)\right]$$

The payoff associated with the stationary state $(K_N, x) = (0, 0)$ where all agents adopt the *FF* strategy is higher than that associated with the stationary state $(K_N, x) = (\frac{p\beta}{\gamma}, 1)$ where everyone adopts the *SN* strategy, that is:

$$\Pi_{FF}(0, 0) > \Pi_{SN}\left(\frac{p\beta}{\gamma}, 1\right)$$

if and only if:

$$d > \alpha \frac{\beta}{\gamma} + a$$

Notice that this condition does not depend on the attractivity conditions of the two stationary states $(K_N, x) = (0, 0)$ and $(K_N, x) = (\frac{p\beta}{\gamma}, 1)$. Consequently, depending on the value of parameters, the stationary states where no one socially participates through online networking may dominate the state where everyone adopts the *SN* strategy, or vice versa. As in Antoci et al. (2012a), our model does not provide clear-cut welfare implications, and both the stationary states can be socially suboptimal destinations for the economy.

6 Conclusions

This paper develops an evolutionary framework to analyze how social relations may evolve as a consequence of Internet-mediated interaction and of the increasing pressure on the time available for social interaction. We assume that individuals can interact with each other through random pairwise face-to-face encounters and by connecting with their social contacts through online networks. Agents can choose between two possible strategies of social interactions: a face-to-face (*FF*) strategy, which is entirely developed through in-person encounters and entails no Internet-mediated interaction, and a social networking (*SN*) strategy, through which individuals maintain their interpersonal relationships in a mixed way, encompassing both physical encounters and involvement in online networks.

Our findings suggest that the explosion of social networking is likely to lead to a growing share of the population to embrace the *SN* strategy, especially in a scenario characterized by an increasing pressure on time. The process is path dependent: the increase in the share of the population adopting the *SN* strategy strengthens the wealth of knowledge, information and ties contained in online networks, making them more and more attractive for possible newcomers. The analysis of the model shows that, when physical interactions take place as random pairwise encounters, the economy may converge to a stationary state where all agents nurture social relations both through face-to-face interactions and online networking. Although our results suggest this is the more likely scenario, the welfare analysis does not allow us to discuss the social desirability of this evolution. Both the stationary state where all people choose to interact via a mix of in-person encounters and online networking ($x = 1$) and the other where all interactions are developed through physical encounters ($x = 0$) can in fact be socially suboptimal destinations for the economy. However, the finding that the basins of attraction of the stationary state where $x = 1$ expands as the time p available for social participation decreases suggests that Internet-mediated interaction is also used as a defensive tool allowing individuals to take care of their social relationships despite time and distance constraints. It thus seems reasonable to argue that Internet use can support well-being by counterbalancing some detrimental effects of the increasing pressure on time. From the policy point of view, this implies that the reduction in the digital divide could be an effective measure to contain inequalities in the distribution of well-being.

This paper represents the latest step in a research programme aimed at analyzing the evolution of social participation and the accumulation of social capital in relation to economic growth and technological progress. In previous works, we highlighted how the reduction in the time p available for social participation can trigger self-feeding processes leading to the progressive erosion of the stock of social capital (Antoci et al. 2012b, 2013). In these papers, we analyzed a scenario in which the time for social participation is an endogenous variable

(i.e. it depends on agents' allocation choices) and social relationships can be developed only by means of face-to-face interaction. In the present work, we address a scenario in which agents can interact with each other both through actual encounters and online networking, but p is exogenously given. The analysis suggests that, under certain conditions, the stock of information, knowledge, and social ties accumulated within online networks can create an infrastructure which helps individuals to develop their social participation despite space and time constraints. More specifically, the asynchronism that is a feature of online interactions can play an important role in reconciling working activities and pervasive busyness with the need to manage human relationships. Even if this result may look predictable, we are persuaded that this paper makes a contribution to the literature by being the first to provide a theoretical framework for analyzing the interdependence between increasing busyness, social participation and phenomena such as online networking and, in general, Internet-mediated communication, which are literally revolutionizing our lives. A straightforward implication for further researches is the need to analyze the agents' choice between the two possible strategies of social interaction within a framework where the time p for social participation is endogenously given.

References

Agarwal, R., Animesh, A., Prasad, K.: Social Interactions and the Digital Divide: Explaining Regional Variations in Internet Use. Information Systems Research. 20(2) (2009). doi:10.1287/isre.1080.0194

Antoci, A., Sabatini, F., Sodini, M.: See you on Facebook! A framework for analyzing the role of computer-mediated interaction in the evolution of social capital. Journal of Socio-Economics **41**, 541–547 (2012a)

Antoci, A., Sabatini, F., Sodini, M.: The Solaria Syndrome: Social Capital in a Growing Hyper-technological economy. Journal of Economic Behavior & Organization **81**(3), 802–814 (2012b)

Antoci, A., Sabatini, F., Sodini, M.: Economic growth, technological progress and social capital: the inverted U hypothesis. Metroeconomica, in press (2013). doi:10.1111/meca.12007

Bartolini, S., Bilancini, E., Pugno, M.: Did the decline in social capital decrease American happiness? A relational explanation of the happiness paradox. Social Indicators Research **110**(3), 1033–1059 (2013)

Bauernschuster, S., Falck, O., Woessmann, L.: Surfing Alone? The Internet and Social Capital: Evidence from an Unforeseeable Technological Mistake. SOEP WP. 392 (2011)

Becchetti, L., Degli Antoni, G.: The sources of happiness: Evidence from the investment game. Journal of Economic Psychology **31**(4), 498–509 (2010)

Becchetti, L., Pelloni, A., Rossetti, F.: Relational Goods, Sociability, and Happiness. Kyklos **61**(3), 343–363 (2008)

Bruni, L., Stanca, L.: Income Aspirations, Television and Happiness: Evidence from the World Values Survey. Kyklos **59**(2), 209–225 (2006)

Bruni, L., Stanca, L.: Watching alone: Relational goods, television and happiness. Journal of Economic Behavior & Organization **65**, 506–528 (2008)

Burke, M., Settles, B.: Plugged in to the community: Social motivators in online goal-setting groups. C&T 2011: Fifth International Conference on Communities and Technologies (2011)

Burke, M., Kraut, R., Marlow, C.: Social capital on Facebook: Differentiating uses and users. ACM CHI 2011: Conference on Human Factors in, Computing Systems (2011)

Caplan, S.: Relations among loneliness, social anxiety, and problematic Internet use. Cyberpsychology and Behavior **10**(2), 234–242 (2007)

Chaim, F., Gandal, N.: Direct and Indirect Knowledge Spillovers: The 'Social Network' of Open Source Projects. RAND Journal of Economics **42**(1), 70–91 (2011)

Costa, D.L., Kahn, M.E.: Understanding the decline in social capital, 1952–1998. Kyklos **56**, 17–46 (2003)

Cummings, Jonathon N., Lee, John B., Kraut, Robert: Communication Technology and Friendship during the Transition from High School to College. In: Kraut, R., Brynin, M., Kiesler, S. (eds.) Computers, Phones and the Internet: Domisticating Information Technology, pp. 265–278. Oxford University Press, New York (2006)

Demange, G.: Sharing information in Web communities. Games and Economic Behavior **68**(2), 580–601 (2010)

Drouard, J.: Computer Literacy, Online Experience or Socioeconomic Characteristics - What are the Main Determinants of Internet Adoption and Internet Usage? Communications & Strategies **80**(1), 83–104 (2010)

Ellison, N.B., Steinfield, C., Lampe, C.: The benefits of Facebook friends: Social capital and college students' use of online social network sites. Journal of Computer-Mediated Communication **12**, 1143–1168 (2007)

Ellison, N.B., Steinfield, C., Lampe, C.: Connection strategies: Social capital implications of Facebook-enabled communication practices. New Media & Society **13**(6), 873–892 (2011)

Franzen, A.: Social Capital and the Internet. Evidence from Swiss Panel Data. Kyklos **56**(3), 341–360 (2003)

Frey, B.S., Benesch, C., Stutzer, A.: Does watching TV make us happy? Journal of Economic Psychology **28**, 283–313 (2007)

Gaudel, A., Peroni, C.: Reciprocal attention and norm of reciprocity in blogging networks. Economics Bulletin **30**(3), 1–18 (2010)

Gershuny, J.: Web-use and net-nerds: A neo-functionalist analysis of the impact of information technology in the home. Social Forces **82**(1), 141–168 (2003)

Gil de Zúñiga, H., Jung, N., Valenzuela, S.: Social media use for news and individuals' social capital, civic engagement and political participation. Journal of Computer-Mediated Communication **17**(3), 319–336 (2012)

Goldfarb, A., Prince, J.T.: Internet Adoption and Usage Patterns are Different: Implications for the Digital Divide. Information Economics and Policy **20**(1), 2–15 (2008)

Gui, B.: From transactions to encounters: the joint generation of relational goods and conventional values. In: Gui, B., Sugden, R. (eds.) Economics and social interaction: Accounting for interpersonal relations, pp. 23–51. Cambridge University Press, Cambridge UK (2005)

Gui, B., Sugden, R.: Why Interpersonal Relations Matter for Economics. In: Gui, B., Sugden, R. (eds.) Economics and Social Interactions, Accounting for Interpersonal Relations, pp. 1–22. Cambridge University Press, Cambridge (Mass) (2005)

Hamburger, Y.A., Ben-Artzi, E.: Loneliness and Internet use. Computers in Human Behavior **19**, 71–80 (2003)

Hamburger, Y.A., Hayat, Z.: The impact of the Internet on the social lives of users: A representative sample from 13 countries. Computers in Human Behavior **27**, 585–589 (2011)

Hampton, K., Wellman, B.: Neighboring in Netville: How the Internet Supports Community and Social Capital in a Wired Suburb. City & Community **2**(4), 277–311 (2003)

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

Katz, J., Rice, R.E., Apsden, P.: The Internet, 1995–2000: Access, Civic Involvement and Social Interaction. American Behavioral Scientist **45**, 405–419 (2001)

Kavanaugh, A., Carroll, J. M., Rosson, M. B., Zin, T. T., Reese, D. D.: Community networks: Where offline communities meet online. Journal of Computer-Mediated Communication. 10(4) (2005). article 3

Kobayashi, T., Ikeda, K.: The effect of PC e-mail usage on social tolerance: Focusing on the mediating effect of communication with heterogeneous others. Research in Social Psychology **24**(2), 120–130 (2008)

Kraut, P, Patterson, M., Lundmark, V., Kiesler, S., Mukopadhyay, T., Scherlis, W.: Internet paradox: a social technology that reduces social involvement and psychological well-being? American Psychologist **53**, 65–77 (1998)

Kraut, R., Lundmark, V., Patterson, M., Kiesler, S., Mukopadhyay, T., McKenna, K.Y.A., et al.: Relationship formation on the internet: What's the big attraction? Journal of Social Issues **58**, 9–32 (2002)

Landqvist, F., Teigland, R.: Collective action in electronic networks of practice: An empirical study of three online social structures, Communities and technologies. In: Proceedings of the second communities and technologies conference Milano, Italy, 13–16 June, 2005

Madden, M., Zickuhr, K.: 65% of online adults use social networking sites. Pew Internet & American Life Project, http://pewinternet.org/Reports/2011/Social-Networking-Sites.aspx (2011). Accessed 19 January 2013

Matzat, U.: Academic communication and Internet Discussion Groups: transfer of information or creation of social contacts? Social Networks **26**(2004), 221–255 (2004)

Matzat, U.: Reducing problems of sociability in online communities: Integrating online communication with offline interaction. American Behavioral Scientist **53**(8), 1170–1193 (2010)

Miyata, K., Kobayashi, T.: Causal relationship between Internet use and social capital in Japan. Asian Journal of Social Psychology **11**, 42–52 (2008)

Morahan-Martin, J., Schumacher, P.: Loneliness and social uses of the Internet. Computers in Human Behavior **19**, 659–671 (2003)

Nie, N.H., Erbring, L.: Internet and society, a preliminary report, Stanford Institute for the Quantitative Study of Society, February 17, (2000)

Nie, N.H., Sunshine Hillygus, D., Erbring, L.: Internet Use, Interpersonal Relations and Sociability: A Time Diary Study. In: Wellman, B., Haythornthwaite, C. (eds.) The Internet in Everyday Life, pp. 215–243. Blackwell, Oxford (2002)

Park, N., Kee, K.F., Valenzuela, S.: Is There Social Capital in a Social Network Site?: Facebook Use and College Students' Life Satisfaction, Trust, and Participation. Journal of Computer-Mediated Communication **14**(4), 875–901 (2009)

Paxton, P.: Is Social Capital Declining in the United States? A Multiple Indicator Assessment. The American Journal of Sociology **105**(1), 88–127 (1999)

Pénard, T., Poussing, N.: Internet Use and Social Capital: The Strength of Virtual Ties. Journal of Economic Issues **44**(3), 569–595 (2010)

Pénard, T., Poussing, N., Suire, R.: Does the internet make people happier? CEPS/INSTEAD Working Paper 2011/41 (2011)

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

Rainie, L., Purcell, K., Smith, A.: The Social Side of the Internet. Pew Internet & American Life Research Center, http://www.pewinternet.org/Reports/2011/The-Social-Side-of-the-Internet.aspx (2011). Accessed January 19, 2013

Robinson, J.P., Martin, S.: IT and Activity Displacement: Behavioral Evidence from the U.S. General Social Survey (GSS). Social Indicators Research **91**, 115–139 (2009)

Robinson, J.P., Martin, S.: IT use and declining social capital?: More cold water from the general social survey (GSS) and the american time-use survey (ATUS). Social Science Computer Review **28**(1), 45–63 (2010)

Robinson, R.V., Jackson, E.F.: Is Trust in Others Declining in America? An Age-Period-Cohort Analysis. Social Science Research **30**, 117–145 (2001)

Sabatini, F.: Can a click buy a little happiness? The impact of business-to-consumer e-commerce on subjective well-being. Economic and Econometrics Reserch Institute Research Paper 2011_12, Brussels (2011)

Sheldon, P.: I'll poke you. You'll poke me! Self-disclosure, social attraction, predictability and trust as important predictors of Facebook relationships. Cyberpsychology: Journal of Psychosocial Research on Cyberspace. 3(2) (2009). article 1

Steinfield, C., Ellison, N.B., Lampe, C.: Social capital, self-esteem, and use of online social network sites: A longitudinal analysis. Journal of Applied Developmental Psychology **29**(6), 434–445 (2008)

Stepanikova, I., Nie, N., He, X.: Time on the Internet, Loneliness and Life Satisfaction: Evidence from Panel Time-Diary Data. Computers in Human Behavior **26**, 329–338 (2010)

Stern, M.J., Adams, A.: Do Rural Residents Really Use the Internet to Build Social Capital? An Empirical Investigation. American Behavioral Scientist **53**(9), 1389–1422 (2010)

Subrahmanyam, K., Reich, S.M., Waechter, N., Espinoza, G.: Online and offline social networks: Use of social networking sites by emerging adults. Journal of Applied Developmental Psychology **29**, 420–433 (2008)

Vergeer, M., Pelzer, B.: Consequences of media and Internet use for offline and online network capital and well-being. A causal model approach. Journal Of Computer-Mediated. Communication **15**(1), 189–210 (2009)

Wasko, M., Faray, S.: Why should i share? Examining social capital and knowledge contribution in electronic networks of practice. MIS Quarterly **29**(1), 35–57 (2009)

Zhang, W., Johnson, T.J., Seltzer, T., Bichard, S.L.: The Revolution Will be Networked. The Influence of Social Networking Sites on Political Attitudes and Behavior. Social Science Computer Review **28**(1), 75–92 (2010)