Modelling Digital Habitus: The relationship between the internet and the density and duration of friendship ties

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Abstract

This paper reports the use of agent-based modelling to explore the impact of the internet on the density and duration of friendship. It uses data from the pre-internet era to validate a model that is then used to compare the dynamic process of friendship with and without the internet. It concludes that the internet is likely to increase the stability of social ties. The paper also affirms the importance of examining the dynamics of social processes, and the usefulness of agent-based modelling as a technique for investigating processual phenomena.

Keywords: agent-based modelling, dynamics, duration of friendship, internet, social networks

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Introduction

Friendship has always been a central theme of sociology. Webs of connection made around friendship were said by Simmel (1922/1955), for example, to be both the consequence of institutional and professional bonds and the source of those bonds. In his view, work affiliation could lead to intimacy, and intimacy could be the motivation to join professional and organisational groupings. Given this, the term *friendship* is at once a label that distinguishes those who are friends from those who are not and a label for a connection that leads to action. Pahl and Pevalin (2005) use longitudinal data to affirm that this is a better way of thinking about friendship; they explain that friendship is both a categorization of a relation in time and something that evolves *through* time. While Simmel was interested in the move from friendship to institutional relationship, and in how webs of sociality lead to webs of economy (and thus ultimately with the formal properties of social relations), Pahl and Pevalin focus on emotional connections, not economic ones. Moreover they are interested in both the making and the breaking of relationships: how individuals start as acquaintances, and then gradually, with the passing of time, become friends; and how friendships can weaken with the passing of time and the shock of life events.

Friendships can also be viewed in another way: the relations can be thought of as a social network that is "fluid, shifting" (Boissevain, 1974: 48). Confirming this, Grossetti (2005) demonstrates that there is "a constant turnover" in personal relationships, developing from family at birth through to friends at school, and then changing as co-workers and neighbours come and go in adulthood. In this respect, social networks are affected by social mobility, not in the sense of movement in economic class, but insofar as people experience changes in their social context and geographic location. Key life stage events, such as marriage, cause perturbations affecting both the size and structure of the network (see for example Kalmijn, 2003; Wellman et al., 1997). However, kin relationships are more likely to persist over time than relationships with non-kin, even if contact is infrequent.

People have few friends compared to the number of people around them; that is, social networks are of low density, despite the fact that most modern life is spent in urban settings where people are in constant close proximity. Many studies show that physical proximity increases the likelihood of social closeness, especially with non-kin (Heider, 1958: 188-189; Fischer, 1982; Cummings et al, 2006; Mok et al., 2007). In 2000 just over half of British adults had close relatives living nearby and three quarters had nearby close friends. Many of these were seen daily, suggesting that geographical nearness was a property of the relations in question, for otherwise this frequency of contact would not have been possible (Coulthard et al., 2002: 54). Being together is what friends do, it would appear, even if the social geography in which these friendships occur is one that is populated by many strangers, that is, in Simmel's anonymous modernity.

Communications technology and human connection

The way these physically close connections with friends and kin are maintained is less well understood. What is sure is that the frequency of face-to-face meetings falls dramatically with increasing distance (Smoreda and Thomas, 2001; Quan-Haase and Wellman, 2002: 305; Licoppe and Smoreda, 2005; Larsen et al., 2006: 112; Frei and Axhausen, 2009). Nevertheless, it would seem obvious that technologies that enable some amelioration of the effect of distance will affect social networks – even if how they actually do that is manifold, and even sometimes opaque.

New transport and communications technologies have enabled people to interact over increasing distance. But, those interactions are diverse and subtle. Roads not only allow more frequent visits but also allow speedier sending of the gifts of friendship; postal systems deliver content but also help create a cultural sensibility to make social bonds through the written word (Henkin, 2007). Telephones do not just allow voice to be conveyed over distance, but foster the desire to chit-chat and thus make friendship in new ways (Fischer, 1992). Research on the impact of communication technologies shows that they can increase the strength of friendship connections in rather particular ways (Schiano et al., 2002; Boase, 2008). The frequency of phone calls, fixed or mobile,

becomes less frequent as distance increases, though they are of longer duration; but phones are important in maintaining friendships, especially strong ones, regardless of the frequency or ease with which face-to-face meetings can occur (Wellman, 1996; Wellman et al., 1997; Cummings et al., 2002; Quan-Haase and Wellman, 2002: 305; Coulthard et al., 2002; Licoppe and Smoreda, 2005; Larsen et al., 2006: 112). And Carrasco et al. (2008) note the importance of email in maintaining contact in a way not facilitated by phones.

The internet is the most recent technology to affect the process of friendship. Early studies, in the 1990s, used rather simple measures that suggested that the more time people spent on the internet, the fewer friendships they had, because spending time on the internet was treated as an alternative to investing time in friendships. This led to the formulation of the so-called 'internet paradox', the inverse relationship between time spent on the internet and friendship (Kraut et al., 1998). However, social networking technologies were then less advanced and less widely used than they are today, and internet behaviour often entailed playing very crude online games where little communication with other players was possible. It is hardly surprising therefore that the internet paradox was refuted by the same researchers a few years later (Kraut et al., 2002) when new social networking applications began to appear. By this time motives for using the web had altered too. The later research suggested that internet interaction helped foster friendships across the board.

Another set of researchers drew a distinction between types of experience people have with one another and the friendships that resulted. Friendships deepen and sustain themselves when 'quality time' is invested in them, these researchers asserted (Nie et al., 2000). In this view, good friendships exist when people spend time together. Other forms of connection, in which the parties are physically apart, were less rich and hence less consequential. Accordingly, use of internet-enabled techniques to communicate across distance could undermine friendship if that were the primary mode of contact, especially if it led people to spend less 'quality time' with each other. This research showed some concern with the patterns of friendship and friendship networks through time, although

this was implied rather than researched. A greater concern was revisiting the internet paradox argument.

However, a growing body of literature has emerged that suggests that the impact of the internet on friendship is related to social type: people who are more sociable online are more sociable offline too (Di Gennaro and Dutton, 2007; Wang and Wellman, 2010). Those who do not make use of connections online are also more likely to have few friends offline (Dutton et al., 2009: 5). This research suggests some of the reasons why friendship networks vary in size and in density, with some people having consistently more friends on the internet through time than others: it is because they would have more friends whatever the technological infrastructure at hand. This infrastructure eases the work of 'keeping in touch', allowing those who have a propensity to leverage such opportunities to do so, while leaving those with less inclination to do otherwise. Claims about the internet paradox have come to be seen as somewhat orthogonal to these (and indeed other) sorts of questions.

Investigating the impact of the internet

One such question is the topic of this paper: how has the duration of friendship ties been affected by the coming of the internet? Answering this question poses some difficulty, however. Despite the increasing sophistication of these debates it is becoming apparent that the standard sociological data typically evoked to explain social action – gender, age, income, education – when combined with such things as internet access times and site usage, are not sufficient to analyse the ways that friendship is being shaped by this technology. Nor are these data rich enough to explore how the technology in turn is being shaped by friendship (Di Gennero and Dutton, 2007). Other factors need to be uncovered.

Solutions to these concerns may be at hand, however. New kinds of data are being made available by the internet beyond the enervating counts of access volumes and duration that have been hitherto relied upon. As Savage & Burrows (2007) note, social network data can provide opportunities not just for researching the scale of friendship but for a whole host of sociological topics including 'points of view' within capitalist society

(2007: 891). While agreeing, we would add that the kinds of evidence that are being garnered through analysis of social connections made through services like *Facebook* does not suggest that the essential material of sociological inquiry is altering as much as might have been hoped. For example, Ellison et al. (2007) note that there is a strong link between the extant social capital that people bring to bear when they engage with others through social networking sites (SNS) and the duration of that social capital. SNS increase the lifecycle of human connection. On the other hand, Henson et al.'s research (2010) is uncovering new forms of sociality and social identity, and they bring to bear huge aggregates of data to support their analysis. These data say little about the experience or process of friendship however, being more allied to the question of civic role in the age of networked technical support.

Discerning new characteristics in internet-mediated human friendship is not easy. As yet, no clear and comprehensive patterning governing how friendships are made, sustained, or come to wither on SNS and other forms of mediated connection has been found. The relation between modes of contact and the processual character of friendship has also not been completely researched. It is easy to point out that more new connections are made via SNS than via other more traditional modes (Di Gennero and Dutton, 2007), but what happens thereafter is less well understood. Although some years ago Urry (2003) implied that there might be a natural prosody to how often people would need to meet face-to-face in order to sustain close connection, more recent research shows that no such clear cut distinctions can be made (Harper, 2010). Different modalities of communication afford different opportunities and constraints and people appropriate these in various ways, sometimes resisting and altering those affordances to use the technology in new ways (Papacharissi, 2011: 304-318). As Sosik et al. (2011) illustrate: although *Facebook* only affords asynchronous and primarily textual modalities of expression, these limitations do not weaken friendships. Users put effort into making their acts of communication within *Facebook* more adroit and powerful because of these limits. There is still much to learn about how different sorts of communication media affect the process of friendship.

This brings us back to Savage and Burrows. They propose that sociology should invite new methodologies and tools. In our view, concerns deriving from apparently premature judgements about internet-mediated changes on social connection, common agreement about the limitation of current data taxonomies, and deficiencies in understanding the relation between the internet and other technologies, lead us to suggest that one new method is especially worthy of investigation. Though it does not transform the source of sociological data (something that drew the attention of Savage and Burrows) this method uses computational techniques to treat data in novel ways. This technique is computational agent-based modelling.

Agent-based Modelling

This kind of modelling is not an alternative to the traditional sociological methods of observation, interview and survey, nor of those new sources of data that Savage and Burrows propose. Indeed, without such data collection, modelling of any kind would be impossible. Agent-based modelling is rather a way of consolidating the data that are available, and can bring together the qualitative and the quantitative in ways that were not possible before.

A major limitation of the 'traditional' qualitative and quantitative sociological studies is that they generate data that represent essentially static moments in social processes: they show a snapshot at one point in time. Longitudinal studies lasting over several years are rare, but again offer links between what are essentially static points. Agent-based modelling, meanwhile, not only captures the outcomes of process, but presents those processes as inspectable phenomena, insofar as investigators can alter the variables so as to test the adequacy of the model against various known or certain data samples.

Relatedly, the act of building an agent model itself can help investigators think about a problem and clarify their own hypothesis or motivating questions. Adjusting the model can expose implicit assumptions that might not otherwise have been appreciated, can identify variables that had not been considered, and can even raise questions of definition

about the form or dynamics of relationships. All of this can help investigators better assess the relative importance of various factors suggested by more traditional forms of data gathering and theory. Furthermore, modelling can be used to test theories about dynamic social processes by facilitating experimentation that for practical or ethical reasons is impossible to conduct in any other way. Modelling permits researchers to address 'what if' questions that simply cannot be addressed by any other means.

To sum up, following Epstein (2008), there are four key reasons to model:

- to test theories of explanation;
- to explore dynamics;
- to formulate questions (and thereby guide data collection);
- to examine possible outcomes.

There are of course many different types of modelling. However, the newly emerging computational agent-based modelling has two characteristics that seem especially useful in relation to the impact of the internet on the duration of friendships. First, it is good at tracing out the dynamics of social relations such as the processual concerns in relation to friendship, for example.

Second, agent-based modelling facilitates experimentation, allowing tests of the importance of different factors. As mentioned above, recent research about the internet has shown that an increasing number of diverse factors are important. Understanding of the relations of these data is often inadequate. Agent-based modelling can help test which factors would seem to be most likely to explain the emerging evidence about internet use and its relation to friendship, and it can do so with the limited data that is available. As a case in point, Casilli and Tubaro (2010) combine ethnographic data about friendship enabled through *Facebook* with agent-based modelling to explore how different types of individual action can affect the overall macro structure of a social network.

What are agent-based models?

Agent-based modelling is very different to more traditional methods such as factor analysis. (See for example, Gilbert and Troitzsch, 2005 and Gilbert (2007).) An agent-based model is a computer program that creates an artificial world of heterogeneous agents and enables investigation into how interactions between these agents, and between agents and other factors like time and space, add up to form the patterns seen in the real world (Gilbert and Troitzsch, 2005: 11-12). The program creates agents with different characteristics and tells them what they can do under different circumstances. Some of these instructions incorporate a degree of randomness. For example, if the mortality rate is set at 10 per cent a year, the program will ask one in 10 agents to die each year: but agents are selected randomly to die. Thus each time the model is run different agents, with different characteristics, will die and these differences will affect the overall patterns observed. There are many such rules in an agent-based model and because of this randomness, each run will produce a different result even though the rules – such as the mortality rate – have not changed. Thus it is not sufficient to undertake one run for any given set of assumptions. A normal rule of thumb holds that 30 is sufficient to provide reasonably robust results for various statistical purposes; similarly in agent-based modelling. For each set of assumptions, the model is run 30 times: the set of results presented are the average of these 30 runs.

A simple model

This section presents a simple model to facilitate the discussion of the social dynamics of connection and the way that they might be captured in a model. It starts by setting out a method of modelling social networks that reflects the key known attributes of ego-centric and social networks. It then explores how these factors can be seen to interact through time and thus analysed through the modelling technique.

Among the properties of ego-centric networks are that they:

- vary in size between individuals;
- are limited in size;
- display high clustering i.e. friends tend to know one another;

- can change over time.

The properties of the social networks constituted by the sum of the ego-centric networks are that they:

- have low whole network density i.e. few of the total possible links actually exist;
- are positively assortative by degree of connectivity i.e. well-connected people tend to be connected to other well-connected people;
- have communities i.e. there are groups and these have only a few links to other groups;
- can have short path lengths i.e. others in the network can be reached via a few steps.

(For more details, see Hamill and Gilbert (2009), Hamill and Gilbert (2010) and Hamill (2010: 92-105).)

However, ego-centric networks can be defined in various ways, from a small group comprising closest relatives and friends to those people who are encountered in everyday life but whose names might not even be known (1974: 47-8; Hamill (2010: 106-133)). In this paper, we focus on the closest relatives and friends, those with the strongest links, which we refer to as the core network.

In the model, a thousand agents, representing individuals, are randomly distributed over a space in which the distance between agents represents social distance. Ego-centric networks can be generated by using the concept of social circles. A circle is drawn round each agent. Varying the radius of this circle, we call the social reach, produces ego-centric networks of different sizes. A small reach produces a core network, averaging 5, but with 90 per cent of agents having between 2 and 8 (as shown in Figure 1).

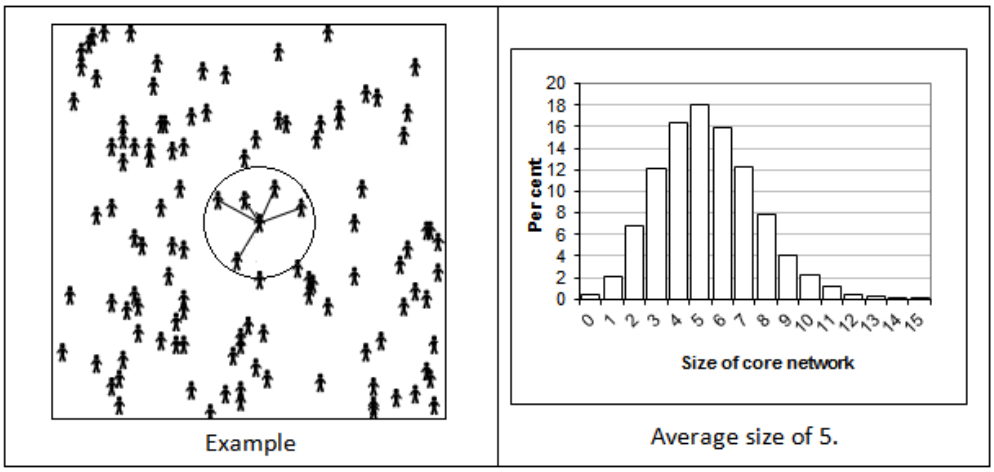


Figure 1: Simple model results: core networks.

To assess the possible impact of the internet on the duration of friendship through the use of modelling requires some evidence of the pattern in pre-internet days. Wellman et al. (1997) conducted a study from 1968 to 1978, well before the arrival of the internet. They found that after 10 years 'only 27%' of 'intimate' ties outside the respondents' homes (i.e. excluding co-habiting spouses and partners) persisted. Three dynamic processes underlie these changes: mortality, geographical mobility and social mobility (in the sense discussed earlier in this paper). We now look at each in turn.

In Wellman et al.'s (1997) study only 5 per cent of ties were lost due to death in 10 years. (This low mortality rate appears to be due to the exclusion of older people from this study: none of the respondents were aged over 66 by the end of the study.) In a model, this can be replicated by assuming a mortality rate of ½ per cent a year, so that each year 5 of our 1,000 agents die, so 950 will survive 10 years. Thus if mortality were the only cause of change, 95 per cent of core ties would persist for 10 years or, we say, the *persistence rate* is 95 per cent (the persistence rate is defined as the percentage of ties that remain after ten years). This implies that geographical and social mobility account for most of the changes.

Any geographical move is likely to disrupt personal networks to some extent, for instance by changing neighbours. Wellman et al. (1997) argued that geographical moves did not have much effect on core ties because of the availability of 'low-cost, efficient transportation and communication facilities'. But it may be that those who were highly geographically mobile were in effect excluded from the sample because they were not available for re-interviewing a decade later. The UK's Office for National Statistics' (ONS) *Social Capital Survey* in 2000 found that almost a quarter had lived in their area, defined as a '15-20 minute walk or 5-10 minute drive from your home', for less than five years. This implies that 4 to 5 per cent a year had moved into the area each year (Coulthard et al., 2002).

People move geographically for many reasons: young people going to university and later moving into work is a major cause (ONS, 2009: 52). But people will also move due to changes in employment and household status: getting a new job, co-habiting or marrying, divorcing or becoming bereaved. It is well established that major life events such as marriage and divorce cause large disruptions to ego-centric networks, and that ties with kin are more likely to persist than other ties. In Wellman et al.'s (1997) study for example, 44 per cent of 'intimate kin' ties lasted the decade compared to 19 per cent of ties with friends.

In a simple model that represents the above evidence, it is not possible to take into account each of these effects individually. Instead these effects have to be implicitly represented, drawing on the geometry of circles (Hamill, 2010: 112), as follows.

- Those who move geographically, but suffer little disruption, are represented by agents moving a distance equal to half the core social reach. On average this will produce a persistence rate of 70 per cent, but the rate will vary from zero to 100 per cent depending on the positioning of the agents and the direction of the move.
- Those who move geographically due to major life changes suffer moderate to total disruption of their networks. Moderate disruption is represented by agents moving a distance equal to the core reach, producing an average persistence rate

of 40 per cent, but again varying between zero and 100. Total disruption is represented by agents moving a distance of twice their reach and their persistence rate will be zero, with no variation.

These three possibilities are illustrated in Figure 2.

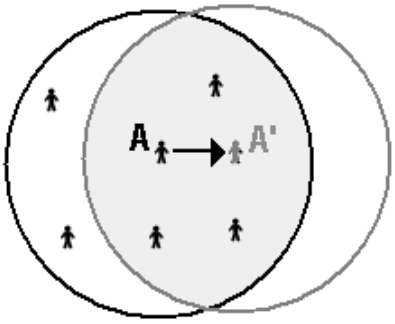
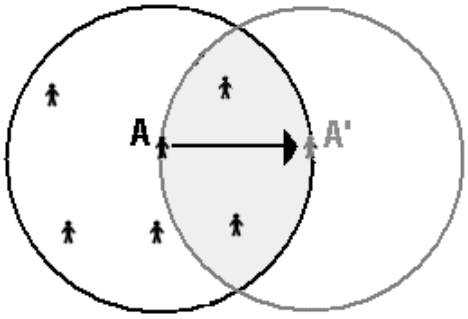
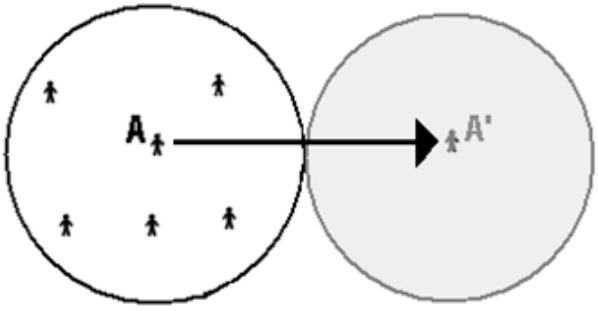
Little disruption On average if an agent moves half its reach, it will keep 70 per cent of its ties. In this example Agent A moves to A' and its new core ties are defined by the grey shading. It loses two of its five core ties; so its *persistence rate* is 60 per cent.	
Moderate disruption If Agent A moves by a distance equal to the core social reach, then on average only 40 per cent of its core links will be maintained, those in the grey shading, as in this example.	
Total disruption If Agent A moves twice its social reach then none of its original core ties would remain i.e. the *persistence rate* is zero.	

Figure 2: Disruption to networks.

Social distance also changes as relationships wax and wane; over time, some become closer and some move apart. This can be called 'social shifting'. Each time period a selected proportion move slightly: when social shifting is 100 per cent, all agents move in this way.

Findings from the simple model: persistence rates

The model allows us to test the impact of different assumptions about geographical mobility and social shifting on persistence rates. Figure 3 is based on 12 different sets of assumptions about geographical and social mobility and shows that:

- If there were no geographical mobility or social shifting, the persistence rate is 95 per cent due to mortality (as previously explained): point **P** in Figure 3.
- If there were no geographical moves, but 100 per cent social shifting, the persistence rate would fall to 40 per cent (point **Q**).
- If 5 per cent moved with maximum disruption (as defined in Figure 2) and there were no social shifting, the persistence rate would be 35 per cent (point **R**): with 100 per cent social shifting, the persistence rate falls to only 15 per cent (point **S**).

In Wellman et al.'s (1997) sample the average persistence rate was 27 per cent. As illustrated in Figure 3, neither 100 per cent social shifting alone (point **Q**) nor 5 per cent moving with maximum disruption alone (point **R**) can produce such a low persistence rate; some combination of the two effects is needed. Line **AB** shows the combinations that would produce a persistence rate of 30 per cent: at one extreme (point **A**) some 3 per cent move with 1 per cent experiencing each of the three types of disruption and there is 100 per cent social shifting each year; while at the other extreme (point **B**) just under 5 per cent move with maximum disruption and about 25 per cent social shifting.

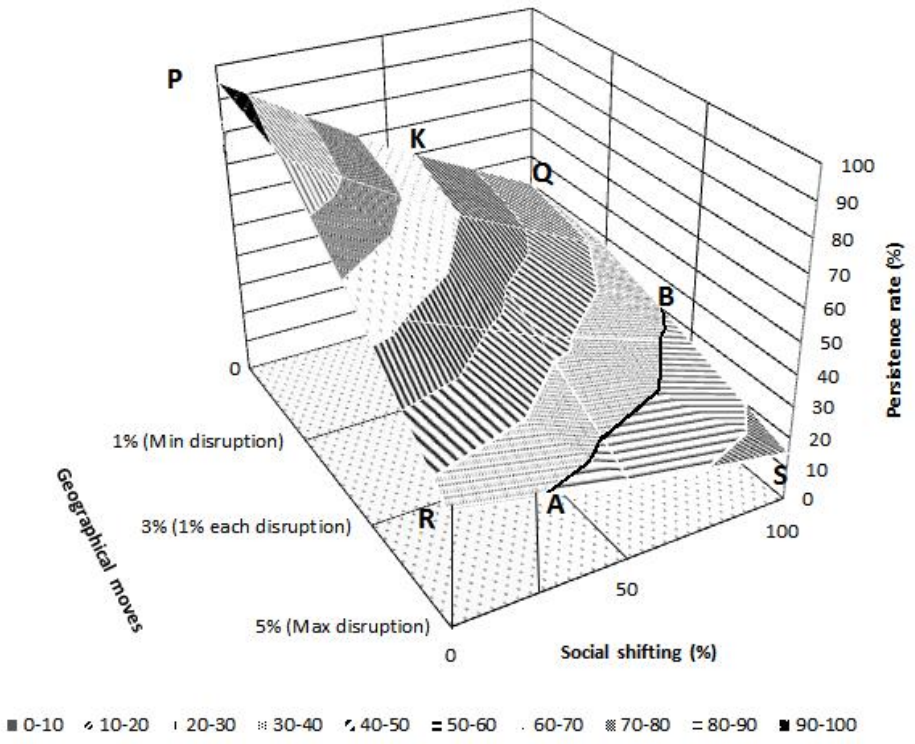


Figure 3: Model results: variation of 10 year persistence rates by assumptions.

Clearly it would not be right to assume that all geographical moves cause the same level of disruption; and intuitively, a high level of social shifting would seem desirable. In order to replicate Wellman et al.'s average persistence rate of 27 per cent, it is therefore assumed that 3 per cent move each year: 1 per cent each experiencing minimal, moderate and maximum disruption respectively. Social shifting is assumed to be 100 per cent. This produces an average of persistence rate of 26 per cent. Furthermore, this assumption reproduces Wellman et al.'s distribution of persistence rates, as shown in Figure 4.

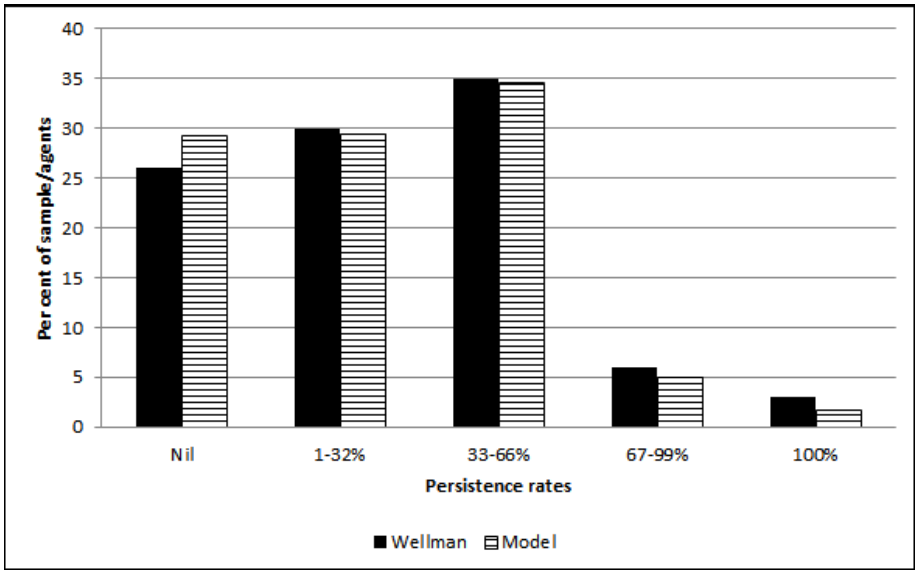


Figure 4: Distribution of persistence rates: model results compared with Wellman et al. (1997).

Augmenting a simple model: the impact of the internet

When the data is modelled thus, it highlights certain assumptions and draws attention to assumptions whose absence deserves remedy. For example, it seems clear that increasingly sophisticated communications technologies will have probably weakened the relationship between strength of tie and geographical distance. But there are still major social discontinuities in people's lives, such as divorce. These discontinuities will have some kind of relationship to the effects of distance. The simple model does not include that possibility. However, one can take from economists' idea that there is a 'production possibility frontier', which entails bringing together feasible combinations of different types of inputs. Thus, Figure 5 introduces the 'social possibility frontier', which shows the feasible combinations of social and geographical distance. (For simplicity, the boundaries are drawn as straight lines.) In this component of the model, new communications technologies push that frontier down so that it is increasingly possible to maintain relationships at a distance. This could have two basic effects.

- It could reduce the impact of geographical moves on ego-centric networks and reduce the extent of social shifting, making it easier to maintain ties that would otherwise have been lost and thus increase the persistence rate.

- It is unlikely to increase the number of core ties very much, as even today the number of one's friends must be limited because the maintenance of social networks is not costless; it could, however, have a larger impact on the number of less strong ties.

For instance if in a completely online society, geographical moves had no effect on core networks – truly the 'death of distance' – the 10 year persistence rate might rise to 40 per cent (as shown by point **Q** in Figure 3). And if social shifting also fell, then the persistence rate would rise further: for instance, if social shifting fell to 50 per cent, then the persistence rate would rise to 64 per cent (point **K**).

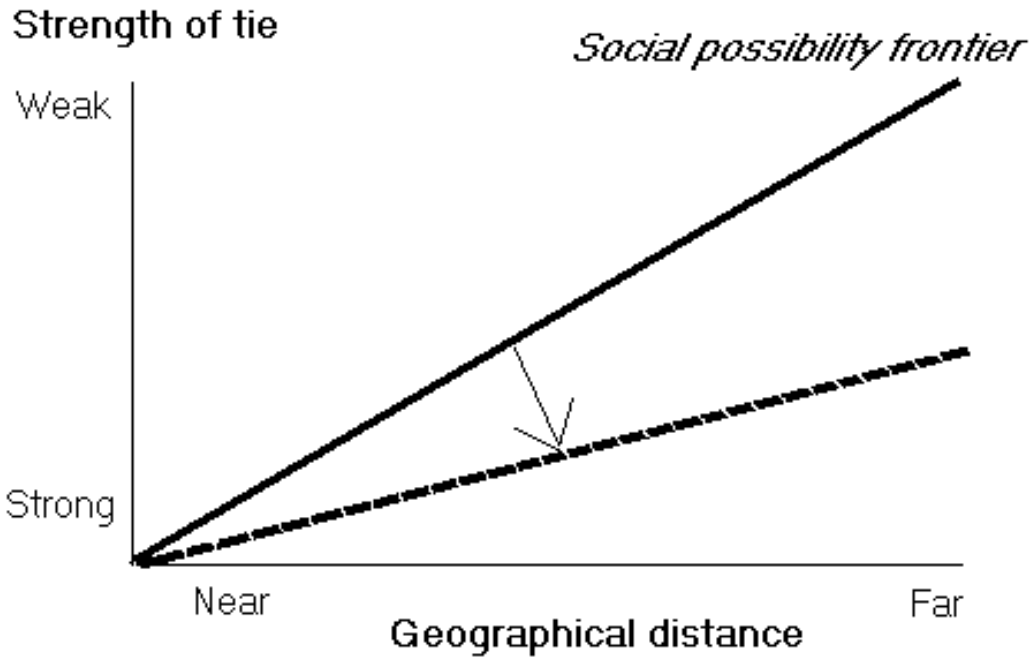


Figure 5: 'Social possibility frontier'

A More Realistic Model

Having presented then, how agent-based modelling works, we now present a more complex model that we propose offers analytic insights into the issues at hand.

This model, developed from Hamill (2010: 264-323), reproduces key features of the spread of the internet to households in the UK from 1998 up to 2009. The same social space and the same method of generating personal networks are used as in the simple model. But whereas mortality and social and geographical movement were all random, in this more realistic model these dynamics are based on demographic and socio-economic characteristics.

Each agent has following attributes:

- age, ranging from 10 to 105; 10 was taken as the lower age boundary because by 2008, 80 per cent of children over 11 had access to the internet (Ofcom, 2008b: 294, 345);
- Socio-economic class: a quarter are ABs, half are Cs and the remaining quarter DEs, reflecting the overall structure in the UK in 2001 (ONS, 2001).
- household income, distributed to produce an overall Gini coefficient of about one third (in line with Barnard, 2009).
- an initial digital literacy score, based on class and age, with youngsters of class AB having the highest scores on average and old people in class DE having the lowest on average.

As with the simple model, the same three basic dynamics are included: mortality, geographical movement and social shifting. But these are made more subtle and in addition, skills and economic variables are included:

- Mortality. Agents aged 45 and over have an increasing probability of dying, reflecting current mortality rates. Those who die are replaced with those aged 10 so that the total number of agents is unchanged.

- Geographical movement is the same as in the simple model: 3 per cent of agents move each year, divided equally between the three types of moves set out in Figure 2. But geographical moves are confined to those aged 18 to 44 as such moves are concentrated in this age group (ONS, 2009: 52).
- Social shifting is as in the simple model.
- Incomes increase, as measured by the growth in real disposable income (i.e. after adjusting for inflation), and the price of going online falls, as measured by the Consumer Price Index for information processing equipment.
- An agent's digital literacy rises in line with both the proportion of adopters in its core network (to reflect the direct influence of close friends and family), and the overall proportion in society (to reflect general economic and social pressures). Once an agent's digital literacy score exceeds a threshold, it obtains a home computer if it can afford to do so i.e. if its income exceeds a threshold. Once the agent has a computer, its skills continue to rise over time and once it goes online, its skills rise still faster. Also, over time, the digital literacy scores of the population as a whole rise as older, less digitally literate agents are replaced by those who are younger and more digitally literate.

Thus adoption is driven by both economic factors and a social positive feedback loop: as more agents adopt, more will adopt.

To validate the adoption section of the model, its results are compared to the pattern of households' take-up of the internet from 1998 to 2009 (in particular from the ONS's *Family Spending* report (2010) and earlier editions). Figure 6 shows that the model tracks the overall rise in internet adoption from 10 per cent in 1998-9 to 71 per cent in 2009. It also broadly tracks the rise in take-up by the richest and the poorest households, and broadly reproduces the age and class distributions of internet users in 2007 (the only year for which these data are available).

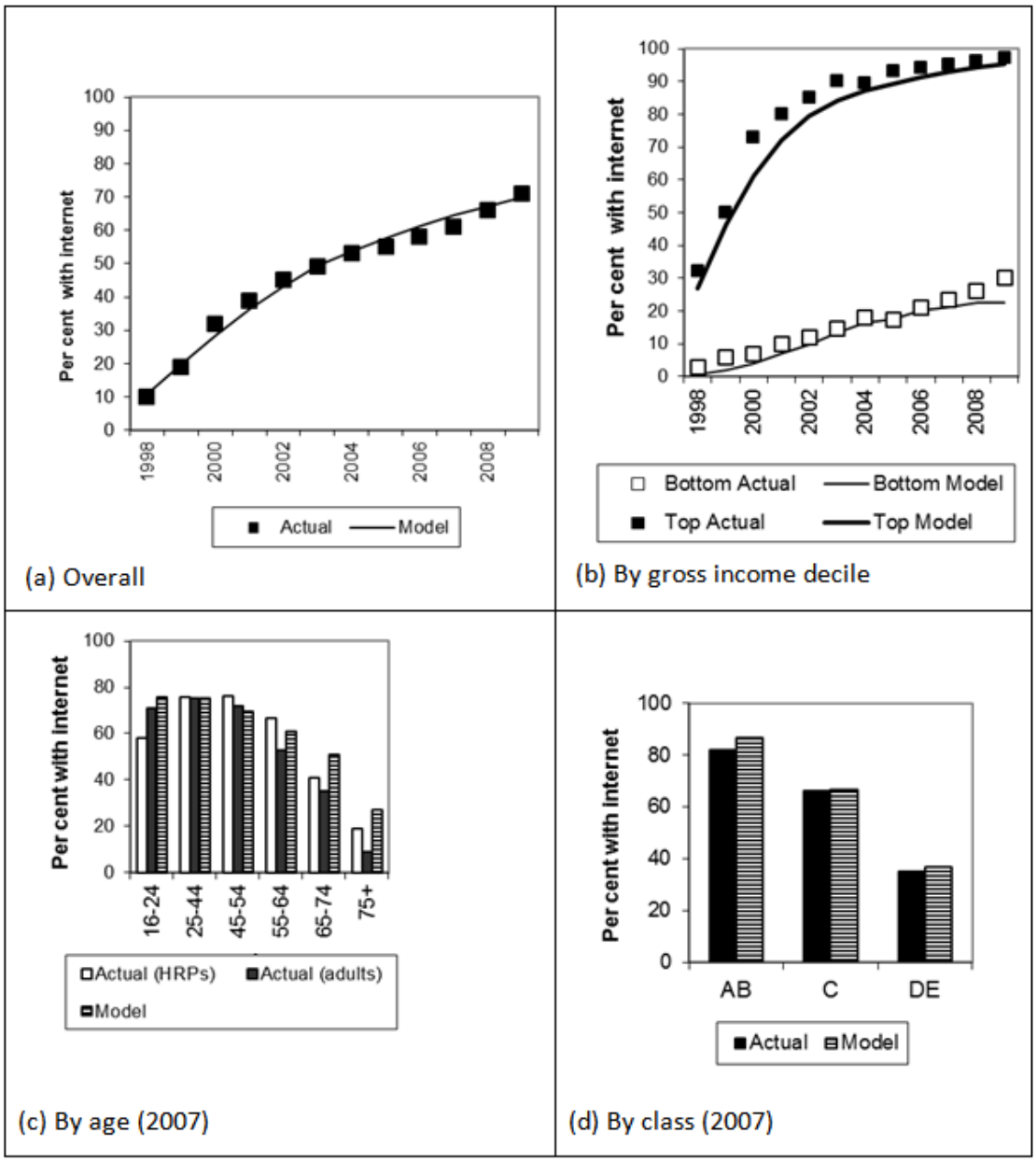


Figure 6: Model v actual: (a) overall (b) bottom and top gross income deciles (c) class (2007) (d) age (2007).

Sources for 'actual' data: (a) and (b) various ONS *Family Spending* reports; (c) and (d) Ofcom (2008a). In (c), HRPs = household reference persons, a concept which has replaced 'head of household'.

Having ensured that the model does broadly reflect what is currently known about the adoption of the internet, it can be used to investigate the impact this might have had on friendship. However, being online is not in itself sufficient to influence friendship

networks: people must also use the internet to communicate. Surveys found that 9 out of 10 internet users in Britain in 2008 used email (Helsper 2008: 11; Dutton et al. 2009: 21-22, 28). In this more realistic model, agents become email users as their digital literacy levels pass certain thresholds and the model implies that by 2008, 95 per cent were internet users.

Modelling the possible impact of the internet on core networks

By definition, the size of core networks is limited: they are those with whom an individual will have the strongest ties. Thus in the model, agents are permitted to keep in touch by email with core friends up to 15 per cent beyond their usual core social reach.

On this basis, the modelling suggests that the average number of core friends people had by 2009 had increased from 5.4 to 5.6; and that the average persistence rate for the core networks of those who survived the full time period was 23 per cent for both those online and those offline. This is lower than Wellman et al.'s (1997) result of 27 per cent for at least three reasons:

- The mortality rate is higher because the model includes older people: Wellman et al.'s sample did not include anyone over 66.
- The model includes those who moved out of contact, which by definition Wellman et al.'s sample did not because they could not be tracked.
- It covers a slightly longer time period.

So simply comparing the 23 per cent produced by the model for both 'onliners' and 'offliners' with Wellman's 27 per cent does not tell us anything very useful about the impact of the internet on the duration of friendships. What we need to do is to use the model to assess what might have happened to the onliners had there been no internet.

Figure 7 shows the results of doing that: had there been no internet, the persistence rate for those survivors who were online by 2009 would have been only 20 per cent instead of

23 per cent with the internet. Furthermore these onliners were more likely to maintain at least one core member over the period: without the internet, 40 per cent would have had a persistence rate of zero while with the internet, it fell to 36 per cent. In addition, although the averages suggest little overall change, some have been affected significantly. By 2009, almost 1 in 5 had at least one agent in their core network who would not have been there had there been no internet effect: 1 in 25 had more than one such friend.

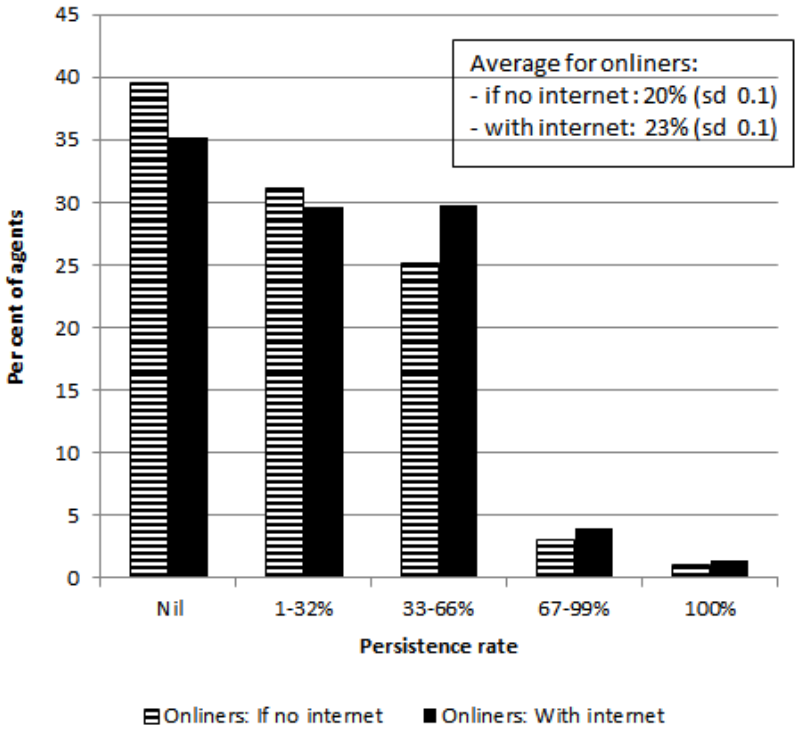


Figure 7: Model result: persistence rates for core networks of survivors online by 2009, with and without internet effect.

Conclusion

Friendship is one of the most profoundly subjective of experiences. But friendship also has what Simmel called 'formal properties': patterned dimensions manifest at an objective level. This paper has investigated one of these properties: namely the duration of friendship. In particular, it has addressed the question: how has the duration of friendship ties been affected by the coming of the internet? Because of the problems of using traditional sociological techniques to answer this question, this paper has used agent-based modelling. This modelling provides a quantitative assessment based on a set of plausible, consistent assumptions that can be varied thus permitting experimentation. It provides both a framework for answering some questions and a method to investigate concerns that cannot be addressed by more conventional means.

On the basis of the assumptions we made, this model suggests that the internet is unlikely to increase the number of core friends, but it may make these relationships more stable. The model indicates that:

- Between 1998 and 2009, the average number of core friends had increased from 5.4 to 5.6. Although these averages suggest little overall change, some individuals have been affected significantly. By 2009, almost 1 in 5 had at least one friend in their core network who would not have been had there been no internet effect: 1 in 25 had more than one such friend.
- Onliners were more likely to maintain at least one core member over the 11 years. Without the internet, 40 per cent would have had a persistence rate of zero i.e. none of the members of their original core network would have still been there at the end of the period; while with the internet, this fell to 36 per cent. Although the internet has had little effect on the average persistence rate of core ties so far, in the longer term it could affect it significantly, even raising it to as much as two thirds.

The modelling suggests that the number of friends that people might call close, or intimate, will likely remain fairly similar with the internet. This may seem surprising, given the hyperbole that often goes with discussion of the internet suggestive that social ties are weakening, that historical stability is being replaced by social fluidity (See for example Bauman 2005). What the internet appears to do is slow the pace of change, so friendships last longer. The oft-heard idea that the internet is creating change would seem to be egregious if by that is meant change in sociality. Our modelling suggests the reverse: the internet creates more stability through time. If this is so, such stability may help to assuage the loneliness of modernity that Simmel describes. One may also reflect on Giddens' explorations of the reflexivity of identity, and his view that people have to negotiate who they are through the myriad relations they form with others (1991). Our model suggests that this might not be such a burden as Giddens implies.

Relatedly, the modelling suggests that the importance of geography is reducing with the internet, but again, not greatly. Certainly one might say that friendships sustain themselves longer when geographical distance is increased. This is evidenced by Dutton and Blank's (2011: 38) finding that the internet has increased contact with friends and family who live further away. But being near still counts. Again, how does this relate to the claims about the move away from the door-to-door society? Cairncross's book (2001), *The Death of Distance* is evidently offering an erroneous but commonplace view.

And this in turn suggests that the internet is not simply a means of making, keeping and moving on from contacts. It, rather, affords particular forms of sociality. This sheds a different light on the arguments about the internet paradox. These suggested that there is a difference between the kind of relation enabled by face-to-face and by internet-mediated connections. It was proposed that there is a contrast between the 'quality time' delivered by bodies being co-proximate as against the weak and anodyne bonds made through the keyboard. What our modelling suggests, in contrast, is that the links made possible through the internet are as vital as any other, but that they may be of another kind. And what we are thinking of here is not a distinction between, say, the virtual and the real. We need to distinguish those who can foster human connection, whether it is

mediated or not, and those who do not or cannot foster such mediated connection. It is Bourdieau's habitus that is evoked, not arguments about space, time or volume of connection (see Mistzal, 1996: especially 102-156). This term is now somewhat old, but perhaps it could be brought up to date with the protocols of the internet social network site as its *mis en scène*. It is De Certeau's 'practice of everyday life' (1984) when that entails routine use of *Facebook*. What is required is a move from observing behaviours in Paris to observing them on the world wide web of activity, the *habitus* enabled by Palo Alto.

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