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► **To cite this version:**

Guillaume Favre, Julien Figeac, Michel Grossetti, Benoît Tudoux. Social distance in France: Evolution of homogeneity within personal networks from 2001 to 2017. *Social Networks*, 2022, 68, pp.70-83. <10.1016/j.socnet.2021.05.001>. <halshs-03227130>

HAL Id: halshs-03227130

<https://shs.hal.science/halshs-03227130v1>

Submitted on 2 Dec 2021

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HAL Authorization

**Social distance in France: Evolution of homogeneity within personal networks from
2001 to 2017**

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Reference:

Guillaume Favre, Julien Figeac, Michel Grossetti, Benoît Tudoux. Social distance in France: Evolution of homogeneity within personal networks from 2001 to 2017. *Social Networks*, Elsevier, 2022, 68, pp.70-83. (10.1 016/j.socnet.2021.05.001).

Abstract

This article explores the evolution of homogeneity within personal networks in France over time and across several relational contexts, using two cross-sectional surveys conducted in 2001 (n=399) and 2017 (n=663). Personal networks have changed relatively little overall, but with a tendency toward more homogeneity among the most educated, 26-45 and 61-75 year-olds, singles, and childless individuals. Differences in rates of personal network homogeneity are only partly explained by demographic shifts in French society. These findings are mostly consistent with those of other studies in Hungary and the USA. We argue that the effects of rising education levels, the segmentation of social contexts in terms of age, and the transformation of family models – which can be observed in most western countries – reinforce relational spheres characterized by relatively similar lifestyles.

Keywords

Personal networks, homogeneity, homophily, segregation, name generators

Introduction

While modernization, urbanization and the development of communication technologies contribute to the diversification of relational contexts – presumably making it possible to establish and maintain relationships with a wide variety of people (Rainie and Wellman, 2014) – it is nonetheless surprising to see how people actually interact with others who are similar to themselves. Indeed, homogeneity within personal networks – the proportion of alters within an ego’s personal network who are similar to him or herself – is one of the most established social phenomena (McPherson et al., 2001). Such tendency can be observed in very different cultural contexts, and across several dimensions: gender, education, religion, age, etc. This is certainly the case in France (Grossetti, 2007), Spain (Lozares et al., 2014), the USA (Marsden, 1987), the Netherlands (Mollenhorst et al., 2008) and Saudi Arabia (van Tubergen et al., 2016).

Similarities in personal relationships are partly explained by structural constraints. People can create and maintain relationships only with the pool of others available to them : the relative proportions of various groups within a population – when a characteristic is rare, all other things being equal, the probability of a relationship occurring between people who have that characteristic is lower – (Blau, 1994, 1977) as well as social contexts and circles in which people meet each other (Feld, 1982; Mollenhorst et al., 2008). Nonetheless, people tend to be more comfortable with, and to choose to interact with, others who are similar to themselves and who share their own views and values. The term “homophily,” as it was introduced into the sociological literature by Lazarsfeld and Merton (1954), refers to people’s tendency to associate with others similar to themselves. Homophily has been analyzed as a productive factor regarding ‘soft segregation’ (Bidart et al., 2020), so named because such behavior results not from legal or material arrangements but rather emerges from practices of sociability and affinity between individuals. A tendency toward homophily with respect to a specific personal attribute can be seen as an indicator that such attribute is a salient dimension in the social structure of a given society (Blau, 1977; Laumann, 1966), and one by which we can infer social distance between groups (Bogardus, 1933; DiPrete et al., 2011). Homophily also plays a key role in the reproduction of inequalities (Bidart et al., 2020; DiMaggio and Garip, 2011), as well as cultural tastes and attitudes (Noah, 1998). We choose here to refer to *homogeneity* within personal networks, and to *similarity* in personal relationships, for the purposes of considering these two mechanisms together.

We have limited knowledge regarding the evolution of homogeneity within personal networks over long periods of time. Western societies, and France particularly, have changed over the past 30 years (from socio-demographic, economic and technological points of view) and it is worth questioning how these changes may have affected the homogeneity of personal

networks. If certain dimensions of social life are salient at a given moment – for example, similarity according to race is one of the most predicative factors of relationships in the USA, followed by gender and age (Marsden, 1987) – nothing tells us that they cannot be lessened or, on the contrary, reinforced over time. To our knowledge, only two papers have addressed this question – one in the USA (Smith et al., 2014) and another in Hungary (Kmetty et al., 2017) – using nationally representative samples and focusing on close, confidant relationships. Personal network homogeneity has broad societal implications, especially with regard to social integration in large and diverse societies like France. Studying its evolutions makes it possible to analyze societal segregation and social distance between various groups, and to better understand changes in social cohesion within contemporary societies.

In this article, we study the evolution of homogeneity within non-kin personal networks using two surveys conducted in the Toulouse, France region in 2001 (n=399) and 2017 (n=663). This article contributes to the study of homogeneity within personal networks in three ways: First, we study the evolution of homogeneity beyond core networks (those composed of confidants) by extending our focus to other relational contexts (people with whom individuals socialize, discuss leisure activities, exchange services, etc.) which together give a better view of changes in sociability over time. Secondly, we study homogeneity with respect to different attributes – age, education, and family status – characterizing respondents' lifestyles. Homogeneity according to family status was not studied in the research previously mentioned, though it reflects the organization and rhythm of everyday life. During the last few decades, family models have changed rapidly in western societies, potentially having a strong effect on sociabilities. Finally, we aim to use our study of homogeneity in personal networks in France for the purpose of highlighting the phenomenon at an international scale, comparing and augmenting our results with those obtained in the USA and Hungary.

We show that personal networks are relatively stable over time. They mostly change in line with shifting demographics, but we highlight an increase of homogeneity among the personal networks of the most educated, 26-45 and 61-75 year-olds, singles, and childless individuals beyond what we would expect according to the evolution of the population structure. This trend leads us to identify a slight reinforcement of elective sociabilities, and contributes to fragmentation in relational spheres among those with relatively similar lifestyles.

1. The dynamic of homogeneity within personal networks

1.1. Studying evolutions of homogeneity within personal networks

Several efforts have been made at using cross sectional surveys to compare personal networks over time. These studies involve comparisons of basic network attributes: social isolation and network size (Hampton et al., 2011; Hua Wang and Wellman, 2010; Ishiguro, 2018; McPherson et al., 2006), face-to-face interactions (Patulny and Seaman, 2017), geographical distance (Mok et al., 2010) and other basic relational indicators (Fischer, 2011). Other studies also use longitudinal design in order to study how relationships develop or disappear over a lifespan (for example Fischer and Offer, 2020; Mollenhorst et al., 2014). To our knowledge, only two surveys have studied network homogeneity over time. In the USA, Smith et al. (2014) found that rates of network homogeneity – after controlling for demographic shifts – had decreased from 1985 to 2004 in terms of gender, but were stable with respect to race; the evidence also suggested an increase in rates of similarity by education level, age and religion. Kmetty et al. (2017) show that, in Hungary from 1987 to 2008, personal networks tended to be more homogeneous in terms of gender, age and education, a pattern only partly explained by demographic changes. For the most part, these two studies show a trend toward stability, sometimes indicating an increase in the homogeneity of relations across certain dimensions. However, they both focus on confidant ties, referred to as core networks. Very little information is presented about larger networks or broader relational contexts (for example acquaintances, colleagues, or neighbors). While regarding core networks makes it possible to understand an individual's immediate environment, it does not necessarily reflect the various social circles in which he or she interacts (McCallister and Fischer, 1978). In France, the available findings relate to homogamy, i.e. similarity between married people. Drawing on major national surveys, Bouchet-Valat (2014) shows that homogamy of education and social class decreased significantly between 1969 and 2011, with the exception of a small fringe of the most highly educated population, highlighting the reproduction of an elite class. He links this phenomenon to changes in class consciousness, spatial segregation, and increased economic inequality.

In this article, we study the homogeneity of personal networks by focusing on three factors with respect to which French society has undergone marked changes in recent decades, and which characterize broad differences in lifestyle: education, family status and age. Since the 1960s and 1970s, sociologists (in particular Bourdieu et al., 1977) have shown that the French school system tends to favor the success of students from the middle and upper social classes, and that an individual's level of education is strongly correlated with occupational achievement. More recent work has confirmed this (Peugny, 2013). Even though the average education level of the general population has risen sharply, inequalities have also increased. In most empirical studies conducted in France, educational level appears to be the most reliable indicator of social hierarchy. Family status is also an

important indicator of differentiation in terms of sociability and lifestyle. Family-related events – for example the birth of a child, a new partnership, or a divorce – significantly influence personal networks (Aeby et al., 2019; Bidart and Lavenue, 2005; Terhell et al., 2007). Family structures have changed considerably in France over the last several decades, and the traditional family model – married couple, with children – has been challenged (for an overview of trends in French family structures, see De Singly, 2010; Segalen, 2010). Family status is correlated with age, which itself is a strongly individuating factor with respect to various lifestyles and types of sociability. For example, in France, neighborhood relations are more prevalent among older people and personal networks are more age-homogeneous among younger people (Bidart et al., 2020). Moreover, in France, as in other European countries, the population as a whole tends to age over the long term, as a result of increased life expectancy. This, combined with the mutual evolution of both the education system and the structure of employment, has revealed social inequalities between generations, with young age groups appearing to be less favored than older ones (Chauvel and Schröder, 2014). We have chosen in this article not to deal with gender inequalities, which have also undergone major changes and which deserve a more full-fledged analysis, in order to focus on three factors that are partly linked in the characterization of the overall cohesion of French society. Taking gender into account does not alter the results that we present here.

1.2. Potential changes in homogeneity of personal networks

What might effect changes in the homogeneity of personal networks between 2001 and 2017? We distinguish here four potential influences: changes in social structure, changes in the contexts of encounters, technological changes and changes in the social selection process. We start with the most specific and easily testable assumptions, and finish with more general ones.

Structural changes

The first source of change relates to social structure and the relative sizes of groups within a society. Indeed, if groups become larger over time, then the rate of in-group relationships can be bolstered by a simple mechanical effect, and *vice versa* if groups become smaller (Blau, 1994; 1977).

Between 1999 and 2015, levels of education increased considerably in France (see table 3 in section 2.1 for precise rates). In the Toulouse urban area, the proportion of highly educated people (4 years or more after high school) rose from 16.7% to 26.2%, while the proportion of

people without a high school diploma fell from 52.9% to 25.6%. It can therefore be expected that rates of homogeneity within personal networks, in terms of education, have increased for the most highly educated and decreased for the least educated (Hypothesis 1.1).

The composition of families has also significantly changed over this period. In the Toulouse urban area, the proportion of single adults (with and without children, in all categories of age) grew steadily from 30.6% in 1999 to 37.2% in 2015. Single individuals are therefore more likely to have relationships with similar others in 2017 than they were in 2001, and people living as part of a couple should have, conversely, more heterogeneous networks (H1.2). The number of people living with children significantly decreased among the entire French population during this period, from 41.1% to 35.8%, but did less so in the Toulouse urban area (from 52.6% to 51.9%). Nevertheless, since some of the relationships are outside the urban area, it can be hypothesized that the personal networks of people living with children will be slightly less homogeneous than those of others, whereas the networks of childless people will be more so (H1.3).

The French population has seen a slight increase in the proportion of its older people. However, younger people tend to be increasingly concentrated in large cities, which means that the age structure of the Toulouse conurbation has not changed much. But the link between urbanization and age homogeneity has been clearly established. Age similarity in personal relationships is much higher in dense and urban areas than in rural areas as well as for singles' personal networks homogeneity (Beggs et al., 1996; Fischer, 1982). Urbanization reduces the constraints on the formation of relationships, simply because more people of the same age coexist in proximity to one another, which leaves more room for social selection. The Toulouse urban area grew considerably between 1999 and 2016, from 964,914 inhabitants to 1,345,492. The increase in the city's population could therefore lead to a mechanical reduction in constraints on individual choice of alters while producing more age homogeneity in personal networks (H1.4) and in singles' networks (H1.5).

Changes in the context of encounters

A second cause for change in personal network homogeneity may be found in the evolution of encounter contexts and social settings (Feld, 1982; Grossetti, 2005). Mollenhorst et al. (2008) show that encounters during advanced schooling are conducive to age and educational homogeneity within personal networks. As the education level has increased overall, we can expect more relationships created in this context and therefore more similar relationships in terms of education and age – for the younger generation – beyond what would be expected according to the evolution of the relative sizes of the groups (H2.1).

As space is socially structured and neighborhoods are often homogeneous, relationships within neighborhoods are likely to be between similar people (see for example Hipp and Perrin, 2009 and Tulin et al., 2019). Even if the neighborhood is not one of the main predictors of personal network homogeneity compared to other contexts (Mollenhorst et al., 2008), some research has shown that urban segregation is increasing, in terms of occupation, for the most skilled populations in French metropolitan areas and especially in the Paris urban area. (Préteceille, 2006). The mechanism is linked both to residential choices (particularly related to children's schools) and to the constraints, such as real estate prices, that weigh on these choices. Therefore, we can expect that neighborhood-based relationships will be more similar, in terms of education, for the most educated people, beyond what would be expected according to the evolution of the relative sizes of the groups (H2.2).

Technological changes

Another important development since 2001 has been the democratization of information and communication technologies (ICTs), especially the use of mobile phones and social media. Some researchers have emphasized the transformations that ICTs are bringing to personal networks, particularly the individualization of relationships (Rainie and Wellman, 2014). For now, we know that text messaging is more frequent among people of the same age and gender (Ling et al., 2012), and that internet use tends to be associated with higher rates of in-person contact among the socioeconomically advantaged, and lower ones among the disadvantaged (Hampton and Ling, 2013). Other research compares online and offline relational contexts. They reveal how online dating produces as much homogamy as other dating contexts, though not as much as the workplace, which remains the most favorable context for homogamy of education or social origin (Bergström, 2016; Potarca, 2017). Such dynamics apply to more than only romantic relationships. For example, a survey of teenagers by Mesch and Talmud (2007) shows that face-to-face relationships are more homogeneous than online ones. These findings do not allow us to define a clear hypothesis because they describe the effects of ICTs without explaining whether they reinforce or reduce homogeneity within networks over time.

However, we know that ICTs have influenced the sociability of minority groups, especially gays and lesbians (Rosenfeld and Thomas, 2012). For many of those in minority groups, social media and dating services provide an easy way of connecting with people with similar interests and backgrounds. As the internet allows individuals to build social affinities, it can therefore promote similar relationships within minority groups. This phenomena seems consistent with that observed by Fischer (1982), who showed that population concentration

in cities favors homogeneity in singles' networks (the minority group) and heterogeneity in networks of married people (the majority group). ICT and urbanism lower the constraints and costs of communications, helping to maintain relationships, not limited to the romantic, among friends and acquaintances (Licoppe and Smoreda, 2005). Even if the effect of the internet on social relations is extremely difficult to assess at the level of a population as a whole, this social process leads us to expect that ICTs promote homogeneity within singles' networks (the minority group; H3.1) and heterogeneity within networks of people living in a couple (the majority group; H3.2), beyond what we would expect according to the evolutions of the relative sizes of the groups.

Changes in social selection

In addition to these structural changes, it is possible that changes in the homogeneity of personal social networks may occur because of evolving social behaviors. Some individual characteristics may become more salient in terms of individual network choices (for example, if individuals increasingly tend to prefer relationships among those of their own age). These changes may be due to several factors: cognitive processes, selective tie dissolution (McPherson et al., 2001), social influence or social selection (Steglich et al., 2010). A strengthening of these processes would therefore indicate an increased tendency to seek to establish relationships with similar others, or to seek more – in a more or less conscious way – the comfort of homogeneous social groups.

Some scholars argue that ICTs have had an influence on the way social relations are managed, and that their use has facilitated a process of social selection, understood here in the sense of strategic relationship management, with the choice to favor some relationships and to defer others (for an overview see Stafford and Hillyer, 2012). By objectifying personal networks, individuals will have presumably developed a reflexivity and a rationality with respect to relationship management, which might have increased the homogeneity of their networks. However, while such behaviors could be studied through qualitative approaches, it seems difficult to associate an increase in the homogeneity of personal networks with this trend toward increasingly reflexive relational behavior.

Another factor could lie in the evolution of social structure with regard to the relative size of groups. As we have seen, social structure can constrain homogeneity in personal networks, but it can also stimulate such homogeneity beyond the normal rate of change by affecting social norms of interaction. Blau underlines this when he links exogamy rules in social

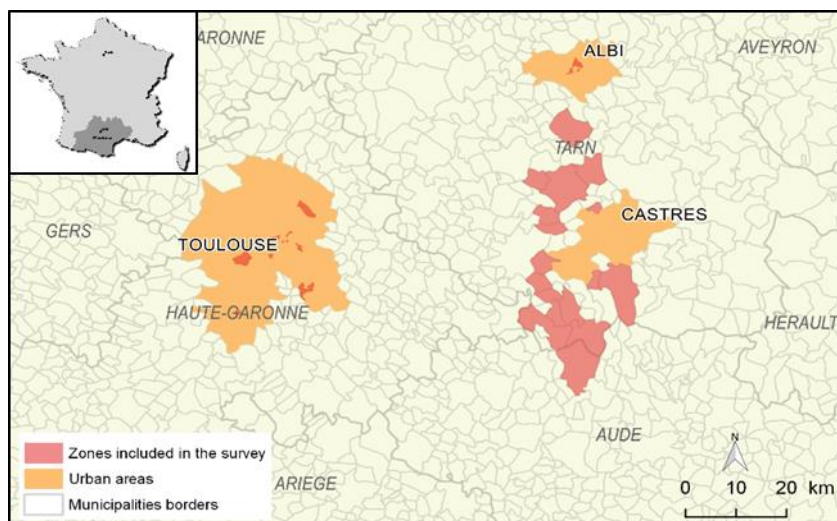
groups to group sizes: “*Even basic cultural norms and practices, like exogamy, develop and become modified in response to existing and changing structural conditions, inasmuch as the size of kin groups is not constant but changes owing to exogenous circumstances, such as droughts and epidemics.*” (1977, p.25). We can extend this idea to the influence of social structure on behavior. When a sub-population increases, it mechanically increases the rate of intra-group relationships within that sub-population, but at the same time individuals endogenize these structures, and produce new patterns of relationships in doing so. In other words, a strong increase in personal network homogeneity related to the evolution of the relative size of the group would favor a process of social selection. For example, with respect to education, one is more likely to observe relationships among highly educated people since they have become more numerous, and at the same time, contact with other graduates – when one is oneself highly educated – has grown more common and normal. These structural effects can develop into patterns of interaction, increase the social salience of specific individual characteristics, and reinforce barriers between social groups. From this perspective, members of groups that significantly grew in population between 2001 and 2017 could see their network homogeneity increase beyond the raw structural effect: namely, singles and the most educated (H4).

2. Methodology

2.1. Survey procedure

In order to evaluate the evolution of personal network homogeneity, we replicated a survey in 2017 originally conducted in 2001, in Toulouse, southern France (for general results about the 2001 survey see *anonymous*). The 2001 survey was itself a replication of a survey procedure designed by Fischer (1982), which was based on a selection of geographical zones reflecting a variety of housing and living standards. In our survey, these zones included the city center, the greater Toulouse municipality, and suburban areas, as well as zones in a nearby medium-sized city (Albi) – of 99,293 inhabitants in 2016 – and rural zones. Each zone was selected based on median income and composition in terms of occupational categories, to reflect the social composition of the agglomeration.

Figure 1: Zones selected in the 2017 survey



Using telephone directories, we randomly selected potential respondents. While in 2001 the vast majority of households had a fixed telephone line, this was much less the case in 2017. Therefore, in 2017, we used a private directory aggregator in order to include mobile phone numbers. We then tried to rebalance our sample by targeting potential respondents in front of supermarkets within the selected zones¹.

After the delivery of an introductory letter, investigators (a total of 9 in 2017 and 2 in 2001) contacted these people and scheduled face-to-face interviews with them. While in 2001 paper questionnaires were used, interviewers in 2017 used an online survey platform. The survey included several questions about each respondent's socio-demographic profile, as well as several name-generators in which the respondent was asked to mention the persons (first name or initials of any person, family, colleague, friend, neighbor, spouse, etc.) with whom he or she had certain types of relationships, with no limitations in terms of number of names.

The questionnaire was somewhat altered between 2001 and 2017. Table 1 shows the generators used in each of the two surveys. In 2001, the name generators were directly transposed from Fischer's questionnaire, which aimed to capture various relational circles (neighborhood, family, colleagues, friends, etc.). In 2017, some of these generators were abandoned (those involving, for example, domestic help or discussions about work problems) in favor of new generators (e.g., regarding people with whom interviewees discussed politics).

¹ We studied 40 respondents recruited in public places, as well as 112 non-kin relations, in this specific category. Surveying respondents in public [did not seem](#) to affect our results: there are no significant differences of similarity rates in personal relationships in terms of education, age or family status between respondents targeted in public places and those interviewed elsewhere.

Table 1: Name generators used in the 2001 and 2017 surveys (bold characters indicate the name generators used for the selection of the alter subsample).

	2001	2017
Taking care of the house when you are away	x	x
Discussions about job and work	x	
Help with domestic tasks	x	
Going out	x	x
Discussions about leisure	x	x
Discussions about personal matters	x	x
Advice for important decisions	x	x
Lending money	x	x
Political discussions		x
Advice for choosing books, films, games and music		x
Colleagues seen outside of the workplace		x
People from social groups		x
Lost contacts	x	x

We then selected a subset of alters to ask further specific questions about. The procedure for selecting the alter subset was the same in 2001 and 2017: the first name mentioned in six generators (in bold in Table 1) and not already selected, with a maximum of five names selected in total. Both kin and non-kin names could be selected. Unlike Fischer's questionnaire, members of the same household could also be included. We made sure in 2017 to keep these six generators identical and in the same order, and to maintain the same subset of names in the two surveys². Each respondent was asked to answer a large number of questions about this subset of alters: various socio-demographic information (age, level of education, occupation, etc.), type of relationship, living place, length of acquaintance, context of encounters, and frequency of interactions. This subset provides a depiction of the various social circles in which an individual is invested, instead of a random sample of relationships which would overrepresent friends or family to the detriment of weak ties. We obtained a total sample of 399 individuals in 2001 and 663 individuals in 2017³, and 1572 alters (including 943 non-kin ties) and 2932 alters (including 1845 non-kin ties) respectively.

2.2. Differences between the 2001 and 2017 surveys

We have tried to replicate the 2001 survey almost identically, in order to rigorously measure changes over time. However, some remaining differences have had a marginal effect on comparability. First, we have added four additional zones to the sample: a medium-sized city,

² Skipping two name generators (help with domestic tasks and discussions about job and work) has no effect on the study, because they were not used in 2001 for selecting the subset of alters.

³ We have not identified common respondents to both surveys.

a disadvantaged neighborhood with a high proportion of unemployed residents, a wealthy neighborhood with many highly-skilled professionals, and a middle-class enclave. The other areas under study were surveyed in the same manner as in 2001. In this article, we made sure to check our analyses, and to test the consistency and validity of our results, by restricting our focus to those areas also surveyed in 2001.

Table 2: Number of names cited in 2001 and 2017.

	2001	2017	% of change
Ties with detailed information	3.940	4.539	+15.2%
Non-kin ties with detailed information	2.586	3.030	+17.2%
Taking care of the house	1.539	2.953	+91.9%
Going out	18.524	22.058	+19.1%
Discussions about leisure	6.414	8.117	+26.6%
Discussions about personal matters	2.574	4.121	+60.1%
Advice for important decisions	1.790	2.555	+42.7%
Lending money	1.686	2.203	+30.7%

There are additional differences between the two questionnaires. While many of the questions in 2001 focused on respondents' geographical trajectories, we abandoned this section in 2017 in favor of a selection of questions about ICT use. The questionnaire is almost the same length in 2001 and 2017 in terms of the time needed to complete it.

It is also important to note that the training work for interviewers was more focused in 2017 than in 2001, and that we gave more precise instructions for the name generating questions. The number of names cited for each generator is higher in 2017 than in 2001 (Table 2), which could reflect an overall increase in network size over time but which may also be an effect of more effective interviewer training. Nevertheless, if the number of names cited in a name generator is generally very sensitive to interviewer effect (Fischer and Bayham, 2019; Paik and Sanchagrín, 2013), we assume that name interpreters - which are used in this study - are less sensitive to this effect since respondents are confronted to predefined categories to answer these questions. We therefore consider that the effect of interviewer training is negligible for the work presented here⁴.

Table 3: Differences in the samples between 2001 and 2017

Survey		France national census		Toulouse Urban Area	
2001	2017	1999	2015	1999	2015

⁴ Nevertheless, this slightly changes the structure of the subsample of relationships in the two surveys (2.6 names in 2001 versus 3 in 2017, see Table 2). We assume that this has little effect on the comparability of our data.

Gender	Female	50.1%	52.9%	-	-	-	-
	<= 25	12.3%	16.3%	8.6%	7.7%	19,6%	19,6%
Age	26 – 30	13.8%	9.8%	9.7%	7.8%	10,2%	10,1%
	31 – 45	35.8%	18.4%	29.6%	25.3%	26,4%	25,0%
	46 – 60	24.1%	22.8%	24.6%	26.4%	24,5%	21,7%
	61 – 75	10.8%	25.0%	18.0%	20.6%	12,4%	14,9%
	76 and more	3.3%	7.7%	9.4%	12.2%	6,9%	8,7%
Family status	Single	34.3%	39.3%	32.7%	37.2%	21,4%	25,6%
	Couple	23.1%	36.2%	26.2%	27.1%	26,0%	22,5%
	Couple with children	34.6%	18.5%	33.3%	26.8%	43,4%	40,3%
	Single with children	8.0%	6.1%	7.8%	9.0%	9,2%	11,6%
Education	No diploma	31.9%	19.9%	70.8%	54.7%	52,9%	32,6%
	Bac	16.7%	22.5%	11.4%	16.7%	17,8%	22,9%
	Bac +2	27.3%	28.7%	9.0%	12.1%	12,6%	18,2%
	Bac +4	24.1%	28.9%	8.8%	16.4%	16,7%	26,2%
Zone	Rural	24.8%	22.9%	-	-	-	-
	Medium city	-	21.4%	-	-	-	-
	Suburb	50.4%	22.8%	-	-	-	-
	City center	24.8%	32.9%	-	-	-	-
N		399	663				

Finally, due to both societal changes and changes in the sampling procedure, we found differences in the composition of the sample that need to be statistically controlled. Table 3 shows the differences between the two samples, and comparisons with the French censuses of 1999 and 2015 (both at the national scale and that of the Toulouse urban area). Our samples represent the population of Toulouse with accuracy: The local economy is dominated by aeronautics and space industries, which require advanced job skills and draw from a large population of students. As a result, the population of Toulouse is younger and more educated than that of France as a whole. Nevertheless, we can see an over-representation of young retirees in our 2017 sample, which is related to the use of telephone directories in reaching respondents. As these populations, in 2017, were more often equipped with landlines, they were therefore more likely to participate in the survey. We can also observe in both years an under-representation of individuals with no diploma, and of people living as a couple with children.

Other differences between our two samples are due to structural changes in French society, such as the increase in the number of singles. This is also the case for education level, which increases clearly in our sample.

2.3. Measurement and modeling

Dependent variables

We have four dependent variables: similarity by age, education level, partnership, and child-rearing status. Age similarity is measured using a binary variable indicating if the absolute age difference between ego and alter is less than 10 years, signaling whether they are of approximately the same generation⁵ (1- similar, 0- dissimilar). Level of education is measured using the French system, in which the *baccalaureat* marks the end of secondary education and the beginning of higher education. Four categories are used: pre-*Baccalaureat*, *Baccalaureat*, Bac+2 (short higher education), Bac+4 and above (long higher education). Similarity by education is measured with a binary variable indicating whether ego and alter have the same education level⁶. Finally, we record family status similarity using two binary variables: whether alter/ego live alone or as part of a couple, and whether both live with children or without⁷.

Table 4: Raw changes in the different types of similarity in personal ties between 2001 and 2017

	2001		2017		sig
	% of similarity	N of dyads	% of similarity	N of dyads	
Education					
No diploma	50.5%	222	48.2%	228	
Bac	28.6%	119	33.3%	204	
Bac+2	34.8%	207	40.9%	394	
Bac+4	48.1%	216	61.8%	489	***
Living with children					
Live without children	49.9%	339	79.4%	714	***
Live with children	74.8%	401	69.1%	456	*
Living as a couple					
Live single	44.7%	264	54.5%	466	**
Live as a couple	87.4%	476	77.7%	704	***
Age (<10 years)					
<= 25	95.4%	130	93.1%	262	
26 – 30	82.6%	138	90.2%	183	*
31 – 45	76.3%	359	85.1%	376	**
46 – 60	73.3%	206	69.3%	429	
61 – 75	50.6%	83	72.7%	473	***
76+	48.0%	25	58.8%	113	

Note: Chi² test, * p<.05; ** p<.01; *** p<.001

For each of the dependent variables, we select a subsample of the egos and a subsample of the alters. We work exclusively on non-kin relationships, excluding all declared as family ties (parents, siblings and children). Partners are taken into account in order to study education

⁵ Kowald and Axhausen (2016) also use this indicator, because age absolute differences usually do not follow a normal distribution.

⁶ We also controlled our result by using the difference in level of education instead of using a binary variable. Our results remain the same with this alternative measurement of education similarity.

⁷ In many contexts, personal networks are strongly segregated by ethnicity (Hofstra et al., 2017; Marsden, 1987), we have not been able to study this because French law prohibits measurement of ethnicity.

and age similarity, but are excluded from the analysis of family status similarity as their status is by definition similar in most cases to that of the egos. For education, we also exclude the student population from the analysis. Finally, for our analysis of similarity by family status (partnership or child-rearing status), we exclude those over 65 years of age, as questions of children or partnership present greater ambiguity in these cases, and do not reveal much about such subjects' lifestyle (i.e., they may not account for children who may have left the family home, or spouses who may be deceased).

Table 4 shows the raw rates of similarity in personal ties in 2001 and 2017. We can see significant changes for education level, child-rearing status, partnership status and age. We use multilevel binary logistic regressions which allow us to control for the hierarchical structure of ego-network data (for an overview see Snijders, 2011). The level of analysis is that of the relationships, but we take into consideration the level of variance within each ego. Such an approach also allows us to control for the large differences in ego samples. We then focus on the 'evolution' variable, indicating the differences between 2001 and 2017, and interaction variables, to identify changes among specific categories of population between the two periods.

Control variables

We control for variables at the ego level: age category, gender, education, partnership and child-rearing status, as well as the level of urbanization of the ego's residence (rural zone, medium city, suburb and city center)⁸. At the alter level, we control for the role of the relationship (partner, friend, colleague or neighbor/acquaintance). For education similarity we also control for the absolute age difference between ego and alter, in order to account for the different education-level averages among generations.

We must also control for the relative sizes of the groups within a society, and the numerical shifts among those groups. We use a variable called 'evolution of groups size', indicating the proportion of each category within the Toulouse urban-area population in both 2001 and 2017. If a specific category increases or decreases within the population, we would expect to see a corresponding change among personal networks. For example, in order to assess education similarity, we assign to each alter – for this 'evolution of groups size' variable – a citation probability equal to the proportion of the Toulouse population having the same level of education (for example of 0.167 in 2001 and 0.262 in 2017, if alter has a Bac+4 level). By

⁸ This variable indicates the distance from the respondent's place of residence to the city center of Toulouse. Toulouse has a core-periphery structure with regards to housing prices and population density (Cusin, 2016); the closer the city center, the higher the prices. This makes an ordinal indicator a good proxy for the level of urbanization.

adding this variable, we can isolate changes in personal network homogeneity which are not explained by the evolution of the relative size of the groups. For this purpose, we drew on data which is closest to our surveys, from the 1999 and 2015 French censuses.

Other scholars who have studied the evolution of personal network homogeneity over time used *case-control analysis* (Kmetty et al., 2017; Smith et al., 2014). This method consists of using ego/alter dyads as cases, and simulating controls by creating random dyads with national census data representing a sample of non-relationships. This makes it possible to treat all forms of similarity in a single model, where the dependent variable is the existence of a relationship or lack thereof. This method is an undeniable step forward in addressing the evolution of homogeneity in social relationships while endogenizing the evolution of the population structure itself. Nevertheless, we use an alternative and simpler method here for four reasons:

1. We wish to isolate changes in similarity in personal relationships according to specific categories of the population (for example, the change in educational similarity rates according to diploma level, or those of family status according to partnership). By treating all these forms of similarity in personal relationships simultaneously, we are not able to visualize these differentiated effects;
2. The evolution of the structure in itself is a phenomenon which deserves attention. Controlling for it directly leads to conclusions with minor changes and excludes, by definition, important structural changes. We need to first control our sample differences between the two periods. Smith et al. (2014) and Kmetty et al. (2017) were able to do this with descriptive statistics, as they had large census data which accurately represented American and Hungarian societies;
3. Since our sample is not sufficiently representative of French society, we cannot, from our data, generate 'non-relationships' that are representative of 'non-relationships' in the French population;
4. With multilevel regressions we are able to control for the hierarchical structure of ego-network data, which is not possible using case-control analysis.

We also checked our results using the attraction/repulsion measures proposed by Skvoretz (2013), also used recently by Tulin et al. (2019), which take into direct account the probability of citing a similar person given the proportion of similar people in the wider population. These ego scale measures report the proportion of similar people in the ego network relative to the proportion of similar people in a society at large. We finally decided to analyze our data at the scale of relationships because the use of attraction/repulsion measures forces us to exclude from the analysis individuals having only one non-kin tie. We also sought to identify significant changes in homogeneity within personal networks with descriptive statistics by

comparing them with a theoretical change based on population censuses. The results presented in this article remain stable regardless of the methods used.

Finally, after isolating significant changes in rates of similarity in personal relationships between 2001 and 2017, and after controlling for the evolving relative sizes of groups, we then focus on specific populations and look at encounter contexts to see if these changes are related to them. For each of the selected alters, respondents were asked to indicate the context in which their relationship was formed. We group these contexts into 6 categories: during childhood, in the neighborhood, through common acquaintances (including partners, family members, friends, or children), during higher education, at work, and “other”.

Table 5: Multilevel binary logistic regression of education similarity in personal relationships

		Model 1		Model 2		Model 3		Model 4					
		Coef	Std err	Coef	Std err	Coef	Std err	Coef	Std err				
Respondent													
Intercept ⁹		0.098	0.276	-0.001	0.280	0.243	0.305	-0.245	0.332				
Gender (ref. Female)		-0,197	0.109	-0.188	0.109	-0.186	0.109	-0.185	0.109				
Age (ref. 46-60)	More than 75	0.329	0.336	0.251	0.338	0.220	0.340	0.200	0.341				
	61-75	0.137	0.262	0.064	0.264	0.054	0.266	0.035	0.266				
	31-45	0.227	0.257	0.178	0.258	0.162	0.260	0.173	0.260				
	26-30	0.337	0.257	0.330	0.256	0.324	0.258	0.322	0.258				
	Less than 25	0.116	0.277	0.106	0.277	0.109	0.279	0.091	0.279				
Live with children (ref. Without children)		-0,181	0.140	-0.154	0.140	-0.175	0.141	-0.181	0.141				
Live in a couple (ref. Single)		-0,126	0.125	-0.136	0.125	-0.110	0.125	-0.120	0.126				
Education (ref. No diploma)	Bac+4	0.339	0.153	*	0.294	0.154	-0.134	0.235	0.089	0.243			
	Bac+2	-0.507	0.154	**	-0.540	0.155	***	-0.788	0.240	***	-0.591	0.246	*
	Bac	-0.806	0.179	***	-0.840	0.180	***	-1.028	0.283	***	-0.906	0.286	**
Level of urbanization (ref. Rural)	City center	-0.146	0.158		-0.170	0.158		-0.205	0.159		-0.169	0.160	
	Suburb	0.021	0.144		0.057	0.145		0.006	0.147		0.036	0.147	
	Middle city	0.198	0.193		0.127	0.196		0.120	0.197		0.159	0.197	
Alter													
Relationship (ref. Friend)	Partner	0.259	0.124	*	0.253	0.124	*	0.259	0.124	*	0.257	0.125	*
	Neighbor/acquaintance	-0.130	0.169		-0.101	0.170		-0.104	0.170		-0.169	0.172	
	Colleague	0.441	0.152	**	0.456	0.153	**	0.486	0.153	**	0.501	0.154	**
Age difference		-0,024	0.007	***	-0.023	0.007	***	-0.023	0.007	***	-0.025	0.007	***
Evolution													
2017 (Ref. 2001)				0.241	0.121	*	-0.194	0.236		-0.135	0.239		
Interaction (ref. 2001 * No diploma)	2017 * Bac+4						0.737	0.303	*	0.618	0.306	*	
	2017 * Bac+2						0.473	0.313		0.378	0.315		
	2017 * Bac						0.380	0.368		0.356	0.369		
Evolution of groups size (Education)								1.374	0.367	***			
AIC		9014.063		9018.135		9026.816		9046.182					
ICC		0.048		0.047		0.047		0.046					

Note: Nested by respondents, 2076 relationships, 820 respondents (without students), * $p < .05$, ** $p < .01$, *** $p < .001$

⁹ In the empty model, the intercept is -0.15, with AIC=8905.115

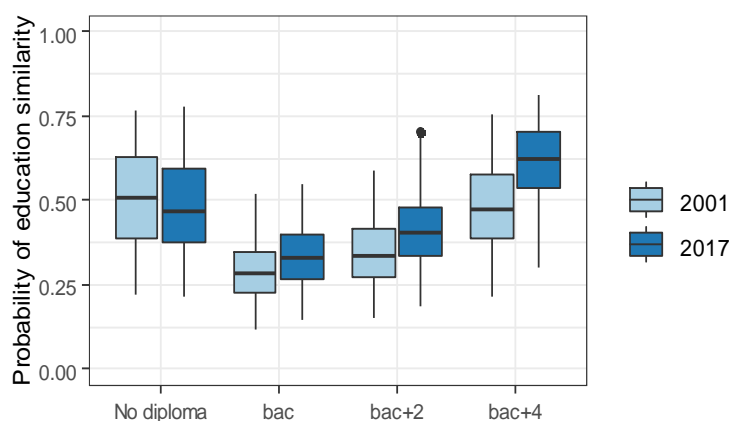
3. Results

3.1. Education

Model 1 shows education-level similarity in relationships, without variables indicating the differences between the two periods (cf. Table 5). Rates of similarity by education follow a U curve, with a high rate of homogeneity among the least educated personal networks, a lower rate for Bac and Bac+2 respondents, and the highest rate for the most educated (Bac+4) (see fig.2). Relationships with colleagues and spouses are more often similar by education than relationships between friends. Model 2 takes into account the evolution between the two periods (the AIC being a little, but nonetheless significantly, higher than in the first model). This shows a statistically significant increase in rates of education-level similarity between 2001 and 2017.

Model 3 includes the interaction effects between the 2001-2017 evolution and levels of education, and shows that this increase is concentrated only among the relationships of the most educated people. Such concentration is partly explained by a demographic shift making it more likely that people with a higher level of education will be cited, because there are twice as many people with higher degrees in 2017 than in 2001; however, we should also find fewer similar-by-education relationships among less educated people, but this does not seem to be the case. Model 4 takes into account the evolution of the relative group size in the Toulouse urban area. This variable positively and significantly explains education similarity in personal relationships, but does not erase the trend. Personal network homogeneity among the most highly educated seems to have increased from 2001 to 2017 beyond what we would expect according to demographic changes.

Figure 2: Evolution of education similarity in personal relationships (predicted probabilities of Model 4)



The rate of education-level similarity in personal relationships increased from 48.1% in 2001 to 61.8% in 2017 among the most educated (cf. Table 4). As noted above, this may be due to changing encounter contexts. Table 6 shows the shifts in encounter contexts for this sub-population between the two periods, and the proportion of relationships between highly educated people created in each context. We do not observe significant changes in terms of encounter contexts among the most educated, though we see slightly fewer relationships created within the workplace (from 28.6% to 16.9%). But neighborhood encounters, in particular, occur more frequently between people with similar education levels in 2017 than in 2001, which could, as suggested, indicate an effect of urban segregation. But the biggest increase can be seen among relationships created through common acquaintance, a mechanism that could be described as relationship transitivity (Louch, 2000): from 21.6% similarity in 2001 to 59.5% in 2017. This trend could indicate an increase in homogeneity in terms of private sociability, and in informal social settings.

Table 6: Evolution of encounter contexts for the most educated (Bac+4) between 2001 and 2017

	% of contexts		% of similarity by contexts		Sig
	2001	2017	2001	2017	
During childhood	8.6%	4.7%	55.6%	80.0%	
In the neighborhood	10.5%	13.1%	14.3%	39.3%	*
Through common acquaintance	23.2%	25.3%	21.6%	59.5%	***
During higher education	9.5%	11.0%	85.7%	89.7%	
At work	28.6%	16.9%	69.8%	70.9%	
Other	19.5%	29.0%	42.9%	50.4%	

3.2. Age

Model 5 explains age similarity in personal relationships, without taking into account changes between 2001 and 2017 (Table 7). We consider that *ego* and *alter* are similar in age if they have less than ten years of age difference. Age similarity decreases over a lifespan: While those under 25 years of age tend to have extremely homogeneous relationships – as most are still at school or recently employed – personal networks become more heterogeneous and diversified over the life course, with the addition of new interaction contexts: neighbors, friends, colleagues, etc. Age similarity is highly correlated to urbanization: the closer the respondent's living place was to the city center of Toulouse, the more similar his or her relationships were in terms of age. Age similarity is also quite evident when looking at relationship type: Partners were more often similar in terms of age than friends, who in turn were more similar in age than neighbors, acquaintances and colleagues.

Table 7: Multilevel binary logistic regression of age similarity in personal relationships (<10 years)

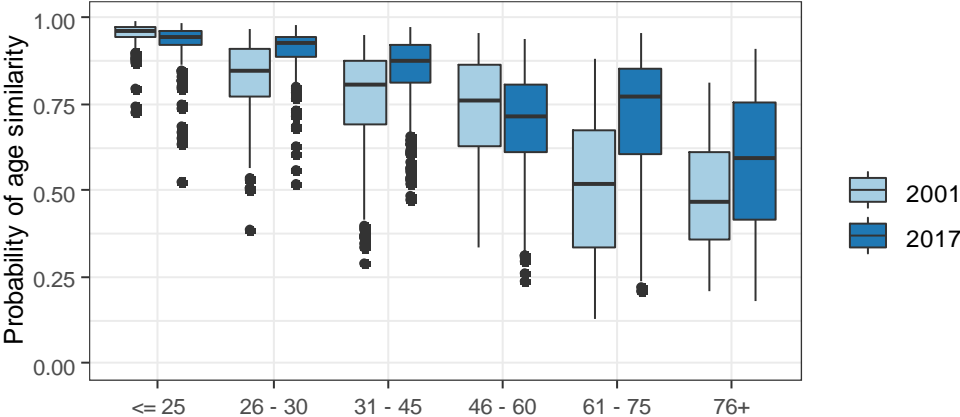
		Model 5		Model 6		Model 7		Model 8					
		Coef	Std err	Coef	Std err	Coef	Std err	Coef	Std err				
Respondent													
Intercept ¹⁰		0.362	0.204	0.202	0.224	0.619	0.263	*	0.492	0.344			
Gender (ref. Female)		0.153	0.116	0.163	0.116	0.153	0.116		0.151	0.117			
Age (ref. 46-60)	More than 75	-0.128	0.255	-0.164	0.256	-0.337	0.526		-0.112	0.522			
	61-75	0.069	0.175	0.044	0.176	-0.867	0.348	*	-0.706	0.352			
	31-45	0.588	0.155	***	0.631	0.157	***	0.118	0.241	0.099	0.248		
	26-30	1.058	0.223	***	1.112	0.225	***	0.547	0.326	0.639	0.332		
	Less than 25	2.147	0.274	***	2.169	0.273	***	2.055	0.494	***	2.141	0.498	***
Live with children (ref. Without children)		0.034	0.150		0.059	0.150		0.035	0.150		0.029	0.154	
Live as a couple (ref. Single)		0.418	0.128	**	0.409	0.128	**	0.413	0.128	**	0.407	0.129	**
Education (ref. No diploma)	Bac+4	0.015	0.163		-0.030	0.165		-0.004	0.165		-0.012	0.166	
	Bac+2	0.164	0.161		0.133	0.162		0.134	0.163		0.145	0.164	
	Bac	-0.279	0.177		-0.311	0.178		-0.287	0.178		-0.277	0.180	
Level of urbanization (ref. Rural)	City center	0.611	0.195	**	0.655	0.196	***	0.583	0.197	**	0.595	0.199	**
	Suburb	0.357	0.149	*	0.404	0.152	**	0.412	0.152	**	0.428	0.153	**
	Middle city	0.188	0.192		0.125	0.195		0.104	0.196		0.117	0.196	
Alter													
Relationship (ref. Friend)	Partner	0.916	0.177	***	0.913	0.178	***	0.921	0.178	***	0.917	0.178	***
	Neighbor/acquaintance	-1.377	0.140	***	-1.358	0.140	***	-1.381	0.141	***	-1.389	0.142	***
	Colleague	-0.539	0.153	***	-0.529	0.154	***	-0.537	0.154	***	-0.543	0.155	***
Evolution													
2017 (Ref. 2001)				0.246	0.142		-0.343	0.238		-0.314	0.244		
Interaction (ref. 45-60 * 2001)	2017 * More than 75						0.299	0.590		0.186	0.577		
	2017 * 61-75						1.192	0.382	**	1.126	0.383	**	
	2017 * 31-45						0.854	0.321	**	0.839	0.329	*	
	2017 * 26-30						0.942	0.449	*	0.910	0.454	*	
	2017 * Less than 25						0.199	0.572		0.166	0.577		
Evolution of groups size (Age)										0.348	1.018		
AIC		13257.38		13271.81		13307.149		13289.531					
ICC		0.041		0.040		0.037		0.008					

Note : Nested by respondents, 2770 relationships, 991 respondents, * $p < .05$, ** $p < .01$, *** $p < .001$

10 In the empty model, the intercept is 1.272, with AIC=12581.8

Models 6 and 7 indicate a small increase in age similarity for the 26-30 and the 31-45-year-old age groups, and a greater increase for 61-75-year-olds: young workers and young retirees. For these categories, age homogeneity within personal networks seem to be increasing, and resistant to broader changes within the population structure (the average age of the population has only slightly changed between the two periods, and the AIC does not increase significantly when adding the 'evolution of groups size' variable in model 8).

Figure 3: Evolution of age similarity in personal relationships (Predicted probabilities of model 8)



The rate of relationship similarity by age increased from 82.6% to 90.2% for 26-30 year-old respondents, 76.3% to 85.1% for 31-45 year-old respondents, and 50.6% to 72.7% for 61-75 year-old respondents (cf. Table 4). Encounter contexts were found to have changed very little between 2001 and 2017 for 26-30 and 31-45 year-olds (cf. Table 8), except that fewer relationships were created in the workplace, and more relationships had been established during childhood (only for 26-30 year-olds). Following the trend observed with regard to education, the rates of age similarity in relationships created through transitivity (i.e. through common acquaintances) is higher in 2017 than in 2001, which could also indicate a rise in homogeneity-by-age within informal social settings, for these categories. For 31-45 year-olds, the increase is also significant in encounters during higher education.

There appears to be a distinctive variation among the 61-75 year-olds. We find few significant changes in the encounter contexts within this age group, except for a few more encounters at the workplace and a few less encounters in the neighborhood and through common acquaintances. In the meantime, rates of age similarity are slightly higher in 2017 among relationships formed at work or in the neighborhood. We can interpret this trend as

indicative of a prolongation of active social life. The postponement of the retirement age in France (on average, from 61 years in 2004 to 62.5 years in 2015), as well as the prolongation of good health and increase in life expectancy, seem to explain this phenomenon. The personal networks of 61-75 year-olds in 2017 thus resemble those of 46-60 year-olds in 2001 (this is particularly clear in Figure 3).

Table 8: Evolution of encounter contexts for specific age categories between 2001 and 2017

		% of contexts		% of similarity by contexts		Sig
		2001	2017	2001	2017	
26 - 30	During childhood	10.8%	19.1%	100.0%	97.1%	
	In the neighborhood	6.5%	7.3%	55.6%	61.5%	
	Through common acquaintance	31.7%	27.0%	77.3%	95.8%	**
	During higher education	13.7%	12.9%	94.7%	100.0%	
	At work	17.3%	9.6%	70.8%	88.2%	
	Other	20.1%	24.2%	92.6%	81.4%	
31 - 45	During childhood	6.9%	6.3%	95.8%	100.0%	
	In the neighborhood	11.9%	10.9%	58.1%	60.0%	
	Through common acquaintance	32.5%	30.2%	78.6%	93.6%	***
	During higher education	5.0%	7.3%	77.8%	100.0%	*
	At work	28.1%	18.2%	76.2%	80.3%	
	Other	15.6%	27.2%	76.8%	81.0%	
61 - 75	During childhood	2.4%	4.2%	100.0%	100.0%	
	In the neighborhood	25.3%	19.7%	28.6%	58.1%	*
	Through common acquaintance	25.3%	20.0%	61.9%	79.8%	
	During higher education	2.4%	2.3%	100.0%	100.0%	
	At work	14.5%	18.9%	33.3%	65.2%	*
	Other	30.1%	34.8%	60.0%	76.2%	

3.3. Family status

We distinguish here partnership similarity and child-rearing similarity. Model 9 (without evolution) shows that rates of similarity by partnership status decrease with age. People living with children and people living as part of a couple also have more homogeneous networks in terms of partnership status than childless individuals or singles. Men have more homogenous personal networks – in terms of partnership status – than women, as well as people living in suburban areas.

Model 10 considers the evolutions between 2001 and 2017, and shows minor changes in rates of similarity according to partnership status (the increase of the AIC is not significant). But Model 11 reveals important counter-shifts (with a notable increase of the AIC): Singles tend to cite significantly more relationships with other singles in 2017 than in 2001, and people living in a couple tend to cite fewer relationships with coupled others. The structural

evolution of the French population does not particularly explain this (the increase of the AIC in Model 12 is not significant).

Table 9: Multilevel binary logistic regression of 'living as a couple' similarity in personal relationships

		Model 9			Model 10			Model 11			Model 12		
		Coef	Std err		Coef	Std err		Coef	Std err		Coef	Std err	
Respondent													
Intercept ¹¹		-0.883	0.234	***	-0.848	0.256	***	-1.132	0.265	***	-1.367	0.333	***
Gender (ref. Female)		0.298	0.131	*	0.295	0.131	*	0.271	0.131	*	0.257	0.132	
Age (ref. 46-60)													
	61-75	0.401	0.263		0.408	0.264		0.293	0.260		0.302	0.261	
	31-45	0.321	0.155	*	0.312	0.157	*	0.323	0.157	*	0.323	0.158	*
	26-30	0.389	0.197	*	0.379	0.199		0.305	0.200		0.316	0.200	
	Less than 25	0.761	0.371	*	0.753	0.372	*	0.742	0.370	*	0.750	0.371	*
Live with children (ref. Without children)		0.521	0.151	***	0.520	0.151	***	0.411	0.153	**	0.389	0.154	*
Live as a couple (ref. Single)		1.181	0.138	***	1.182	0.138	***	1.952	0.229	***	1.939	0.230	***
Education (ref. Bac+4)		0.175	0.188		0.184	0.190		0.149	0.190		0.155	0.190	
No diploma)													
	Bac+2	0.028	0.184		0.033	0.185		-0.005	0.185		0.002	0.186	
	Bac	0.120	0.217		0.125	0.217		0.128	0.218		0.138	0.218	
Level of urbanization (ref. Rural)													
	City center	0.227	0.210		0.221	0.211		0.212	0.212		0.227	0.213	
	Suburb	0.537	0.179	**	0.526	0.183	**	0.502	0.184	**	0.502	0.184	**
	Middle city	0.031	0.244		0.049	0.250		0.029	0.245		0.035	0.246	
Alter													
Relationship (ref. Friend)													
	Neighbor/acquaintance	-0.186	0.183		-0.192	0.184		-0.169	0.186		-0.160	0.187	
	Colleague	-0.325	0.171		-0.330	0.171		-0.329	0.173		-0.342	0.174	*
Evolution													
2017 (Ref. 2001)					-0.054	0.160		0.563	0.215	**	0.591	0.216	**
Interaction live as a couple * 2017								-1.175	0.274	***	-1.168	0.275	***
Evolution of groups size (Family status)											0.754	0.655	
AIC		6836.947			6839.590			6880.050			6867.989		
ICC		0.016			0.016			0.009			0.006		

Note: Nested by respondents, 1538 relationships, 647 respondents (without over-65s, and without relationships with partners)

* $p < .05$, ** $p < .01$, *** $p < .001$

11 In the empty model, the intercept is .608, with AIC=6681.528

Table 10: Multilevel binary logistic regression of 'living with children' similarity in personal relationships

		Model 13		Model 14		Model 15		Model 16			
		Coef	Std err	Coef	Std err	Coef	Std err	Coef	Std err		
Respondent											
Intercept ¹²		0.385	0.239	0.007	0.261	-0.481	0.268	-0.169	0.330		
Gender (ref. Female)		-0.126	0.135	-0.091	0.136	-0.090	0.134	-0.082	0.138		
Age (ref. 46-60)	61-75	0.407	0.275	0.331	0.276	0.126	0.277	0.124	0.281		
	31-45	0.205	0.158	0.301	0.160	0.299	0.157	0.282	0.161		
	26-30	0.523	0.209	0.639	0.212	0.640	0.211	0.669	0.213	*	**
	Less than 25	0.647	0.417	0.745	0.417	0.789	0.419	0.739	0.416		
Live with children (ref. Without children)		0.060	0.155	0.077	0.155	1.068	0.217	0.533	0.227	*	
Live as a couple (ref. Single)		0.157	0.147	0.155	0.147	0.060	0.146	0.058	0.148		
Education (ref. No diploma)	Bac+4	0.196	0.191	0.097	0.193	0.158	0.191	0.114	0.195		
	Bac+2	0.260	0.191	0.210	0.192	0.286	0.190	0.290	0.195		
	Bac	-0.061	0.222	-0.113	0.223	-0.049	0.220	-0.059	0.224		
Level of urbanization (ref. Rural)	City center	-0.073	0.220	-0.006	0.221	0.008	0.220	0.006	0.224		
	Suburb	0.001	0.182	0.124	0.185	0.112	0.183	0.113	0.189		
	Middle city	-0.015	0.258	-0.232	0.265	-0.319	0.261	-0.272	0.263		
Alter											
Relationship (ref. Friend)	Neighbor/acquaintance	-0.163	0.172	-0.112	0.173	-0.141	0.176	-0.157	0.178		
	Colleague	-0.319	0.163	-0.281	0.164	-0.277	0.166	-0.259	0.169		
Evolution											
2017 (Ref. 2001)				0.596	0.164	1.482	0.214	1.331	0.218	***	***
Interaction live with children * 2017						-1.772	0.273	-1.528	0.281	***	***
Evolution of groups size (Family status)								-0.078	0.638		
AIC		6765.744		6780.499		6818.250		6839.223			
ICC		0.067		0.064		0.048		0.000			

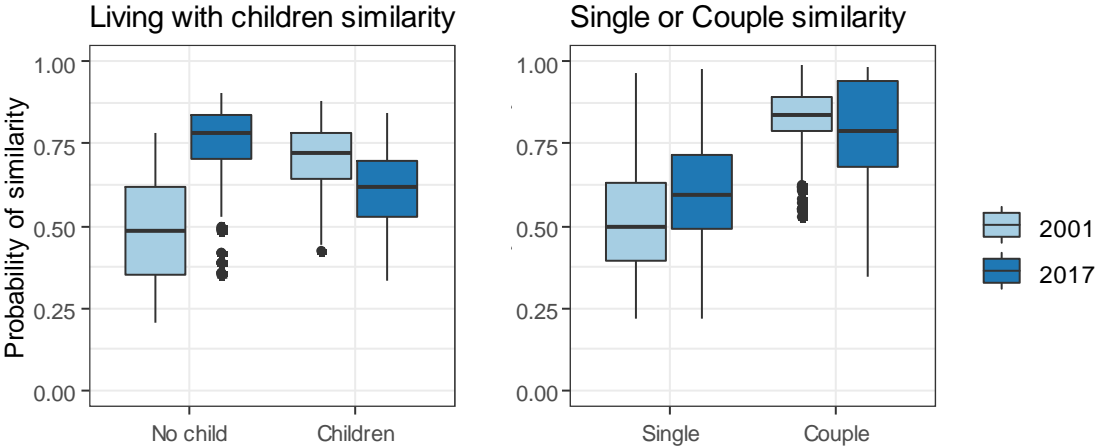
Note: Nested by respondents, 1538 relationships, 647 respondents (without over-65s, and without relationships with partners), * $p < .05$, ** $p < .01$, *** $p < .001$

12 In the empty model, the intercept is .702, with AIC=6720.024

In 2001, 44.7% of alters cited by single individuals were also single, compared to 54.5% in 2017. Encounter contexts do not seem to explain this shift. For this category there are slightly fewer relationships created at work. Apart from this, no context can be isolated to explain this increase in the rates of similarity according to partnership status. (Table 11). However, we note that the increase seems to be associated with recreational relationships (alters cited in the "going out" and "leisure discussions" name generators). In contrast, the similarity rates of relationships among people living in couples decreased from 87.4% in 2001 to 77.7% in 2017 (Table 4). With respect to this category, it is difficult to explain such change using a specific encounter context, as similarity rates decrease a little in most of them (cf. Table 11).

Model 13 shows the general trends for rates of similarity according to child-rearing status: such similarity is more prevalent amongst the youngest, and least so among colleagues. Models 14 and 15 show a significant change in rates of similarity by child-rearing status among personal relationships between 2001 and 2017, a change paralleling that found in rates according to partnership status. There is a significant increase in the rates of similarity according to child-rearing status among the relationships of those without children – even when controlling for the evolution of the relative size of the groups (Model 16) – with a very slight downward shift for people with children.

Figure 4: Evolution of family status similarity in personal relationships (predicted probabilities of model 12 and 16)



The similarity rate in relationships of people without children thus increases from 49.9% in 2001 to 79.4% in 2017 (Table 4). Here again, similarity according to child-rearing status in relationships created through common acquaintances is higher in 2017 than in 2001 (56.8% in 2001 and 83.9% in 2017), which could also indicate a rise in homogeneity among informal social settings for childless people. (Table 11). Here also the increase seems to be related to the alters mentioned in the "going out" and "leisure discussions" name generators.

Conversely, similarity among relationships of people living with children seems to decrease for neighborhood-based relationships.

Table 11: Evolution of encounter contexts of respondents of different family status categories between 2001 and 2017

		% of contexts		% of similarity by contexts		Sig
		2001	2017	2001	2017	
No child	During childhood	10.4%	23.2%	83.9%	93.8%	
	In the neighborhood	6.4%	6.8%	52.6%	69.7%	
	Through common acquaintance	29.9%	23.0%	56.8%	83.9%	***
	During higher education	18.5%	15.0%	92.7%	93.2%	
	At work	19.1%	10.3%	63.2%	72.0%	
	Other	15.8%	21.8%	63.0%	81.1%	*
Live with children	During childhood	6.9%	9.4%	56.3%	66.7%	
	In the neighborhood	15.2%	14.7%	82.9%	39.3%	***
	Through common acquaintance	32.0%	30.9%	68.9%	71.2%	
	During higher education	2.6%	6.3%	83.3%	66.7%	
	At work	27.7%	18.3%	67.2%	60.0%	
	Other	15.6%	20.4%	61.1%	59.0%	
Single	During childhood	10.0%	22.7%	68.0%	72.6%	
	In the neighborhood	8.8%	6.9%	31.8%	44.8%	
	Through common acquaintance	26.9%	25.8%	58.2%	66.7%	
	During higher education	18.5%	13.8%	69.6%	74.1%	
	At work	18.5%	9.1%	34.8%	50.0%	
	Other	17.3%	21.7%	60.5%	64.8%	
Couple	During childhood	7.9%	13.9%	81.8%	66.7%	
	In the neighborhood	11.4%	12.4%	84.4%	65.6%	
	Through common acquaintance	34.3%	24.3%	75.8%	74.6%	
	During higher education	5.4%	10.4%	66.7%	66.7%	
	At work	26.8%	18.1%	86.7%	72.3%	*
	Other	14.3%	20.8%	84.6%	61.1%	*

4. Discussion

Overall, with respect to homogeneity, personal networks have changed relatively little between 2001 and 2017. This trend toward the stability of personal networks has already been highlighted (Fischer, 2011; Mollenhorst et al., 2014); despite significant technological and demographic changes, networks present a considerable degree of stability over time. These findings extend previous research in the United States (Smith et al., 2014) and Hungary (Kmetty et al., 2017) by further illustrating the overall stability of homogeneity within personal networks.

However, we also found evidence of an evolution toward greater homogeneity within personal networks among specific categories of the population. The changes are not drastic but, given the period of 16 years, we believe they are noteworthy. Certainly, some of this

evolution is related to demographic changes in the relative size of groups. Because the education level in Toulouse is higher in 2017 than in 2001, personal network homogeneity increases for the most educated but not for the least educated, as we would expect (H1.1 is only partially validated). Accordingly, because there are fewer couples and people living with children, single and childless people have more homogeneous networks (as expected in H1.2 and H1.3).

But homogeneity of personal networks increases beyond what we would expect according to the evolution of the relative size of the groups. We observe a slight increase in similarity in personal relationships of the most educated; of 26-30, 31-45 and 46-60 year-olds ; and a larger increase in personal relationships of childless and single people, counterbalanced by a slight decrease in the homogeneity of the networks of people in couples and, marginally, of people with children.

Education

The increase in rates of similarity by education could partly be explained by neighborhood relationships among the most highly educated - which occur with other highly educated people more frequently in 2017 than in 2001. This would be consistent with the trend toward greater spatial segregation in French cities (Préteceille, 2006) (H2.2). However, H2.1 does not seem to be verified, as there was no increase in the share of relationships formed at school during the 16-year period.

But similarity-by-education rates are also particularly higher for relationships created through transitivity (a person met through a common acquaintance) in 2017 than in 2001. Transitivity is a mechanism that strengthens the homogeneity of personal networks by creating relationships between people in the immediate social environment (Louch, 2000), which leads to the reinforcement of trends already present in an individual's personal network. This increase could be explained by an increase in the number of social settings that people share in common, or by the fact that such social settings are more homogeneous (Feld, 1982). At this stage, it is not possible to conclude.

These results are consistent with those concerning the increase in education-related similarity in confidant relationships observed in the USA between 1985 and 2004 (Smith et al., 2014) and in Hungary for the recent period (Kmetty et al., 2017), as well as the increase in homogamy observed among the most educated over the past 50 years in France (Bouchet-Valat, 2014). In western societies, an individual's level of education is often considered an important indicator of his or her social status, and occupations and careers

are largely determined by education. The general increase in education levels in France, as in the United States and Hungary, seems to have bolstered the social salience of the diploma. When higher educated people become more numerous – even to a majority, as in young generations – the social status of those who are less educated changes: the difference becomes a social marker. These structural changes become norms, which could produce social selection among the more educated but not for the less so, who are proportionately fewer in number as stated in H4.

Age

The tendency toward increasing age homogeneity in personal networks beyond what we would expect according to the evolution of the relative size of the groups is consistent with the changes observed in Hungary and in the USA. But while Kmetty et al. (2017) explained this increase by way of specific Hungarian political and economic transitions (simultaneous openings and closures, up and downsizings of job positions), the mechanisms in France are different. As expected (H2.1), in a society where people are more likely to be in school for a longer period of time, the youngest are exposed to fewer contexts in which they might encounter older people, and thus tend to compartmentalize their relationships within their own age group (this mechanism seems to be observed in the USA as well, as described by Smith et al., 2014). This increase is also mostly linked to transitivity. This mode of encounter tends to create more relationships among young people of the same age, based partly on shared interests such as sports or cultural practices. Such transitivity could also be linked to the development of ICTs since 2001 (H3.1). We may consider that such technologies have promoted transitivity by amplifying social coordination among the youngest. But the effect could also result from the increase in the size of the urban area (H1.4), as the size of a city correlates to age similarity (Fischer, 1982). It is not possible at this stage to conclude. For 61-75 year-olds, the trend seems slightly different. The postponement of the retirement age in France, and the prolongation of good health and life expectancy, could explain this phenomenon.

Family status

For family status similarity, the results reflect the transformation of family patterns. The “couple with children” model was at the core of French society in 2001, and this was reflected in homogeneity rates in personal networks at that time. Entry into coupledness and, even

more, the first arrival of a child, considerably homogenizes an individual's personal networks (Bidart et al., 2020; Bidart and Lavenu, 2005). In our data, such is clear for 2001, but much less so for 2017. We observe a diversification of the relationships in these categories to the benefit of more diverse household compositions. But at the same time, the personal networks of singles and people without children have grown more homogeneous. These trends occur as if the traditional family model breaks down, and the distinctions between categories blur.

The development of ICT could explain this phenomenon: reduced constraints on relationships and ease of communication may give way to social selection and elective sociability for minority groups (H3.1 and H3.2). This is supported by the fact that the increase is observed in the 'going out' and 'leisure discussions' name generators and in relationships. The increase in the homogeneity of singles' networks could also be explained by the increase in the size of the urban area (Fischer, 1982). But the evolution of social structures may serve as another explanation (H4): the diversification of lifestyles, the increase in the number of divorces and re-partnerships, and the increase in the proportion of stepfamilies indicate weakened norms, which lead to variations in sociability. Similarly, the arrival of a child, or the act of entering into a couple, no longer seem to constrain similarity in relationships as much as they once did.

General tendencies

The general tendency is toward increased personal network homogeneity, which seems only partially explained by demographic changes and encounter contexts. These are the only factors that we can rigorously isolate. There remains a net increase of personal network homogeneity, for which we can only speculate as to explanations: an increase in social selection trends related to changes in the social structure, or a weakening of constraints on the creation and maintenance of relationships, resulting from communication technologies or increasing urbanism in the region. There is no evidence that allows us to definitively affirm or refute the H3 and H4 hypotheses. At the same time, the increase in personal network homogeneity seems to be closely related to relationship transitivity (people introduced through mutual acquaintance), an unexpected result. This trend indicates that informal social settings among the younger generations, more highly educated people and people without children could be more homogeneous than they were before.

The consistency of our results with those observed in Hungary (Kmetty et al., 2017) and the USA (Smith et al., 2014) – concerning the increase in rates of similarity by age and

education, together with an increase in personal network homogeneity among singles and childless people – leads us to believe that the parallel shifts in these countries increase the social salience of specific individual characteristics within their societies. The effects of rising education levels, the segmentation of social contexts in terms of age, and the transformation of family models – all of which can be observed in most western countries – suggest that this tendency may be generalizable in other political and cultural environments.

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