Who Contacts Whom? Educational Homophily in Online Mate Selection

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Data from an online dating platform are used to study the importance of education for initiating and replying to online contacts. We analyse how these patterns are influenced by educational homophily and opportunity structures. Social exchange theory and mate search theory are used to explain online mate selection behaviour. Our results show that educational homophily is the dominant mechanism in online mate choice. Similarity in education significantly increases the rate of both sending and replying to initial contacts. After controlling for the opportunity structure on the platform, the preference for similar educated others is the most important factor, particularly among women. Our results also support the exchange theoretical idea that homophily increases with educational level. If dissimilarity contacting patterns are found, women are highly reluctant to contact partners with lower educational qualifications. Men, in contrast, do not have any problems to contact lower-qualified women. Studies of educational homogamy generally show that couples where women have a higher level of education are rare. Our study demonstrates that this is mainly the result of women's reluctance to contact lower qualified men.

Introduction

The remarkable individual propensity to associate with a partner who has similar characteristics is a recurrent empirical finding in the study of mate selection (see, for a recent study, Blossfeld, 2009). From a social structural point of view, this homophily has far-reaching consequences for the reproduction of social inequalities in modern society. One aspect that is particularly important for the process of homophily is an individual's education. More than ever before, education has become the pivotal determinant of occupational success, and it also reflects the cultural resources influencing individuals' preferences for specific partners. Therefore, educational homophily suggests that the degree of social inequality engendered in individuals' life courses will be further enhanced through their marriage choices, because the advantageous (and disadvantageous)

economic and sociocultural resources of two individuals are then pooled and cumulated (e.g. Mare, 1991; Blossfeld and Timm, 2003).

Several recent empirical studies show that educational homogamy[1] has even increased in many industrialized countries in recent decades (see, for an overview, Mare, 1991; Kalmijn, 1998; Blossfeld, 2009). Blossfeld and Timm (2003) argued that the formation of similarly educated couples is largely influenced by structural contact opportunities in the educational system. In addition, women's changing economic role in dual-earner societies has increased the importance of their education and labour force attachment (Blossfeld and Drobnič, 2001). As a consequence, men in more recent birth cohorts should increasingly prefer highly qualified women, and this should accentuate the level of homogamy even more as the traditional marriage pattern of the male breadwinner declines.

Despite numerous studies reporting empirical evidence favouring either the structural or the intentional mechanisms of mate selection (see, for recent reviews, e.g. Kalmijn, 1998; Blossfeld, 2009), we still do not know how structural opportunities and individual strategies actually operate together: is educational homogamy primarily a consequence of the structure of the educational system, and thus, simply an institutionally preformed phenomenon? Or is educational homogamy more a result of homophily, implying that it is actors making intentional choices who systematically want to associate with similarly educated partners? The present study addresses this question by analysing the process of mate selection in online dating. We focus on education-specific patterns of assortative mating and examine whether and to what extent similarly educated participants in online dating platforms contact each other on a specific German Internet dating website and also whether there are gender-specific variations in their decisions.

The Internet marriage market has grown rapidly in the last few years, and is now regularly used for mate search by about 5.5 million Germans (Schulz et al., 2008). Since becoming a mass phenomenon, online dating is often regarded in the literature as a driving force in the reduction of social inequalities, because such online platforms are less restricted and quite open (Illouz, 2006). The implication is that people meet and mate beyond traditional social barriers. If this was indeed the case, the recent macro-level findings indicating high levels of homogamy should primarily be an outcome of structural or institutional selection effects on local marriage markets rather than homophile individual preferences and strategies. Up to now, there have been only a few empirical studies of online dating (e.g. Fiore and Donath, 2005; Hitsch et al., 2009, in press; Lee, 2008), and there is need for more empirical evidence to assess the relevance of preferences in the process of mate selection.

Our choice of the digital marriage market to analyse mate selection has at least one substantive and one methodological advantage. Substantively, access to online dating platforms is neither restricted, nor is the context institutionally prestructured or selective compared with many contexts in everyday life.[2] Although there might still be a remarkable digital divide in modern societies (e.g. Dewan and Riggins 2005; Schulz et al., 2008), once this barrier has been passed, the digital marriage market is an open meeting space compared with the restricted contact opportunities in everyday life. If users continue to frame their decisions along educational divides, we can conclude that this is an expression of individual preference.

Methodologically, online dating offers unique data for sociological analyses, because it enables us to explicitly study social interactions on the micro level. Particularly when investigating the very early phase of the mate selection process, this is an excellent source of information. It enables us to work with non-reactive observational data on mutual contact processes recorded without contacting the platform users. Every action and decision on this online dating platform, from a single mouse click to long e-mail messages, is logged in a database, allowing an accurate time-dependent reconstruction of the single phases of the mate selection process. Thus, we are able to analyse the very early decisions in the partner selection process in great detail by looking at who contacts whom first by e-mail (initial contact) and who replies to whose contact offers. Indeed, it is during this phase of the mating process that decisions are made about whether a resource relation between two users might be rewarding, and these early decisions condition every later phase. According to the hypothesis on the path dependence of social phenomena, these early decisions in the process of partner choice set the course for the further development of relationships.

In the following, we will develop the theoretical framework for our analysis. This framework is based mainly on exchange theory, and allows us to derive hypotheses on education-specific contact behaviour for men and women within the context of online mate search. We will then present our empirical results, before finally drawing several conclusions on what can be learned from our study.

Online Mate Selection: Theories and Hypotheses

The choice of a (marriage) partner is based on a longer process involving many successive decisions. Conceptually, actors pass through many consecutive phases of filtering the field of eligible partners until eventually only one actual marriage partner remains (e.g. Kerckhoff and Davis, 1962; Murstein, 1970). From the perspective of a dynamic analysis of social structure, the very first steps of mating, and especially the initial contact between two potential mates, are of decisive importance for the emergence of collective patterns of mate selection and thus for the production and reproduction of social inequality in society (e.g. Mare, 1991; Blossfeld, 2009). Hence, in our first step, we concentrated on the actor's propensity to initially contact other users in the online dating environment.

Nonetheless, it is clear that studies of initial contacting behaviour in online dating such as Lee (2008) for Korea, Hitsch *et al.* (2009; in press) and Fiore and Donath (2005) for the United States, or Skopek *et al.* (2009) for Germany address just one side of the coin.[3] Partner choices are consensual choices. Whereas the person who is initially contacting the other takes the necessary first step to start a potential relationship, the future of this process also depends on the contacted person's decision whether or not to reply. The necessary and sufficient premises for forming a stable relationship require both actors to approve the partnership and understand themselves as a couple. Hence, if an initial contact on the dating site remains unanswered, the process of partnership formation will simply cease, meaning that the individual, one-sided choice of one actor has failed. Therefore, the reply to an initial contact offer is the very first consensual decision setting the course for the further interaction process. Based on these considerations, our second step was to analyse the reply behaviour to initial contacts in online dating. This enables us to empirically assess how gender- and education-specific patterns of mate selection emerging from the first contacts are mutually reinforced or may change.

Based on Korean data, Lee (2008) argued that the selection at the very beginning of the mating process, namely, the initial contact and the possible reply that follows, are quite good indicators for the actual preferences and aspiration levels of the actors that eventually account for their marriage decisions. Whereas the study of initial contact behaviour permits fairly good assessments of individual dispositions and preferences (see Skopek *et al.*, 2009), an analysis of the reply patterns casts more light on online mating patterns by explicitly addressing the mutual consensuality of the mating decision.

The Structural Logic of the Marriage Market

When looking for a partner, individuals are constrained by the structural conditions of their marriage markets (Becker, 1974; Blau, 1994). Individual freedom of choice, and thus the chance of realizing individual intentions, is limited by institutional and social structures, and mate selection is particularly constrained by the available opportunities to meet and interact with potential partners in everyday life (Verbrugge, 1977). Social, economic and cultural contexts like the educational or the employment system, neighbourhoods or the circle of friends, structure actors' social networks and have to be considered as selective, numerically limited and institutionally organized submarkets (Kalmijn and Flap, 2001). Hence, the chances of meeting potential mates in everyday life vary in different phases of the life course and their corresponding (social) spaces and activities (see Feld, 1981; Kalmijn and Flap, 2001). From a structural point of view, educational homogamy in couples can then be explained simply by the probabilistic logic of opportunities determined by population structures on the one hand, or by focused activities in educationally segregated marriage submarkets on the other hand.

However, the process of mate selection cannot be explained by social structures alone, because these do not operate directly on social behaviour. After all, no couples will be formed if the individuals in question do not want to take advantage of the possibilities in their marriage markets (e.g. Homans, 1985). This is especially relevant for the analysis of the digital marriage market, because online dating systems are primarily designed for mating purposes, providing special environments to facilitate the process of forming intimate relationships. Alongside other seminal features such as anonymity, the irrelevance of space and time for meeting online or the new possibilities of self-presentation, the presumably most important characteristic of the Internet compared to the organized settings of everyday life is the broad absence of institutional selection processes (e.g. Ben-Ze'ev, 2004; Geser, 2007; Skopek *et al.*, 2009). Thus, online dating systems offer a great potential for sociologists to analyse individual partner choices in a rather 'open' marriage market, because users need to consciously select their 'favourites' from an observable, rather heterogeneous field of eligibles in terms of basic socioeconomic attributes like education.[4]

Mate Selection as Social Exchange

Drawing on social exchange theory, we assume that actors looking for partners on the marriage market are trying to increase their expected subjective utility compared to living alone by (socially) exchanging resources with other actors. Accordingly, the process of establishing and maintaining an intimate relationship is characterized by a long-term, mutual arrangement of 'giving and taking' resources between the actors involved (see Blau, 1964; Edwards, 1969; Blossfeld and Timm, 2003; Skopek *et al.*, 2009). Following Becker (1974), women and men will only form couples if they expect profitable gains from the corresponding exchange relation. To qualify as potential exchange partners on the marriage market, actors must signal

their specific resources (e.g. education) to members of the opposite gender (see, e.g. Edwards, 1969; Anderson and Hamori, 2000). Rationally acting individuals on this market will therefore strive only for relations with an optimal cost-benefit balance: the higher the value of one's own resources, the higher the value of resources one can reasonably demand from possible partners.

Nonetheless, partner search is a rather difficult type of decision-making process under uncertainty because of, for instance, incomplete or asymmetrical information about the 'offerings' or the utility of further search activity. Thus, an optimal solution of the decision problem is hard to achieve in everyday life (e.g. Oppenheimer, 1988; Todd and Miller, 1999; Blossfeld and Timm, 2003). This suggests that rational actors with limited time and knowledge will normally base their mating decisions on fast and frugal heuristics (Todd and Miller, 1999), particularly by applying a kind of satisficing heuristic with a minimal aspiration level (see Simon, 1956). Such satisficing takes a shortcut by setting an adjustable aspiration level and ending the search as soon as one alternative is encountered that exceeds this standard. Hence, rational actors make feasible decisions on the marriage market by trying to ensure that they do not sell themselves at less than fair value, thereby systematically rejecting potential mates with lower resources. Following Todd and Miller (1999), we assume that the adjustable aspiration level is based on an individual's own mate value, which, in turn, is based on past life course experiences and the mate values of those who do or do not show interest. Thus, the more 'attractive' and 'desirable' an actor is on a marriage market, the higher her or his own aspiration can be, and the more restrictive will be the specific set of acceptable partners.

Education-specific Mechanisms of Mate Selection

Applying this model to our question of mate selection on the Internet, we assume that users of online dating systems only contact people or reply to contact offers by others if they subjectively anticipate reciprocity. Following our exchange theory model, this is most likely when both partners have similar resources. No rational actor will accept a negative cost-benefit ratio, and thus both will refrain from contacting people with lower resources and reject contact offers from other users with lower resources. Due to the competition on the marriage market, the dominant outcome pattern in mate selection should prove to be couples with similar resources (see Edwards, 1969; Becker, 1974; and for empirical findings, e.g., Kalmijn, 1998; Blossfeld and

Timm, 2003). This mechanism should operate for different attributes (e.g. Kalmijn, 1994; Kalmijn and Flap, 2001), and is expected to be stronger when actors have more valuable resources. Furthermore, the mechanism is basically symmetrical and thus rather gender neutral (e.g. Skopek *et al.,* 2009).

The idea that 'like is attracted to like' is also the basis for Becker's (1974) hypothesis of positive sorting by non-market traits on the marriage market. Becker predicts that the gains from marriage, compared to living alone, are highest when men and women resemble each other as much as possible in all personal attributes. The history of mate selection research reveals an extensive discussion of education as one of these attributes (Blossfeld, 2009). Education is regarded as a rather enduring attribute that is also highly recognizable and intersubjectively comparable. Moreover, it is a very rich indicator for numerous dimensions of everyday life that are commonly accepted as being associated positively with stable and satisfying partnerships or marriages. Educational similarity makes it easier to establish a joint lifestyle (Kalmijn and Bernasco, 2001), it is normally accompanied by similar (cultural) interests (e.g., DiMaggio and Mohr, 1985), it increases the chance of conflict-free communication, and thus it is more likely to create positive emotions and social affirmation within intimate relationships (Kalmijn, 1994).

This homophily hypothesis is the central theoretical concept that this study tested with empirical data from online dating. We focused on educational homophily, because earlier research has shown repeatedly that similarity in educational background positively facilitates meeting, mating and marrying (e.g. Kalmijn, 1998; Blossfeld, 2009). Applied to the contact and reply behaviour in online dating, we hypothesized that users would be (hypothesis a) more likely to send an initial contact offer to an equally educated user, and (hypothesis b) more likely to reply to a contact offer from an equally educated user. If this proved to be true, then the process of contacting and interacting in online dating would systematically enforce the selection of educationally similar couples, and reduce the percentage of educationally dissimilar couples over time. Indeed, first analyses of contact behaviour in online dating in the United States and Korea have suggested that mate selection on the Internet is indeed based on homophily, indicating strong binding effects of similar education (Fiore and Donath, 2005; Hitsch *et al.*, 2009, in press; Lee, 2008).

Furthermore, we did not just expect that similarity in education would significantly increase the contact probability and the probability of replies between

users; we also expected educational homophily to vary across different levels of education as predicted by the above-mentioned model of exchange. Hence, we hypothesized (hypothesis c) that educational homophily would be higher for actors with higher educational status.

Even though many empirical studies have supported the homophily and homogamy hypothesis, it is still quite common for men and women to at least partly follow traditional gender and family roles (see Blossfeld and Timm, 2003). This is particularly the case in a conservative welfare regime like Germany. Germany has a strongly gendered division of labour in society, reflected, for example, by segregated labour markets, gender-specific income and occupational structures or an unequal distribution of housework and childcare between men and women (see, for an overview, e.g. Blossfeld and Drobnič, 2001). The stronger the traditional gender roles in a society, the more men will invest in labour market skills (with a high income potential) and women in non-market skills (qualifying them for homemaking and care giving). If they seek such a traditional family model with a male bread-winner, women will search mainly for men with good socioeconomic resources such as a high income potential, which can, in turn, be approximated by good education (Oppenheimer, 1988). Traditionally oriented men, however, will primarily search for women with high competencies in the non-market sphere, for example, in homemaking. On the aggregate level, this leads to a negative sorting along market traits (Becker, 1974) that systematically matches men and women with quite different market resources; in the traditional case, for example, highly educated men also look for less educated women.

Of course, this model is being challenged increasingly by the changing economic role of women in modern societies. During the course of their increasing educational and labour market participation, and the transition from male breadwinner to dual-earner societies (Blossfeld and Drobnič, 2001), women's high educational resources are also becoming distinctive attributes in the mate selection process. In this respect, traditional gender-related patterns of mating should lose their empirical relevance, although we do not expect them to disappear completely in Germany.

The decline in traditional couples also implies increasing rates of homogamy and increasing downward marriage by women. However, women do not marry downwardly as we would expect from a structural perspective (Blossfeld and Timm, 2003). Especially from their standpoint, this is quite a relevant problem: as women participate increasingly in higher educational tracks and thus have higher educational attainment levels, whereas some qualified men still marry downwardly, the number of appropriate partners for educated women at the top of the educational distribution decreases sharply. The implications may well be that they have to lower educational standards for partners, engage in prolonged search, or stay single. Research still lacks explanations regarding how this structural phenomenon can be traced back to individual decisions, and, in particular, it is not known who—men, women, or both—systematically shy away from these constellations. We wish to contribute to solving this puzzle in our study of choosing behaviour in online dating.

As a preliminary hypothesis, we suggest (hypothesis d) that both men and women systematically avoid a couple constellation in which the woman is better educated than her male partner.

Data

We obtained our data from the provider company of a German online dating site that allowed us to access its database. The data cover user activities over a randomly chosen time period of about half a year between January and June 2007. The site targets a broad audience in Germany and does not just address specific populations in terms of region or social groups. Registered users can create their own user profiles (an online equivalent of a personal ad), look for other people by filtering the database using search forms and contact other people through an internal messaging system. The user profiles contain self-descriptions filled with standardized information like age, height, weight, educational attainment level, gender, marital status as well as photographs and also free-text descriptions.

The dataset used in the present analysis contained user profile data and time-related data on e-mail exchanges between profiles. We could use these to reconstruct who sent an initial contact e-mail, and whether the contacted user replied to this e-mail. In addition, we had information on which other users' profiles a given user had been browsing through. Since a profile cannot be contacted before it has been browsed, we could distinguish between those profiles she or he was looking at both with and without a subsequent contact trial. Although the whole database was completely anonymized, we were able to use sociodemographic descriptors to characterize users. We focused on educational resources as the main

independent variable while controlling for other attributes like gender, age and physical appearance.

We interpreted a first contact trial as a sign of the user's willingness to engage with the addressed user. Therefore, we call the former user the initiator and the latter the receiver. A given user can be either initiator or receiver, but not both in the same dyad. We applied the label reciprocal contact when a first contact trial by an initiator was answered by the receiver, thereby reflecting some kind of first consensual decision.[5]

Our empirical analysis is divided into two parts: The first analyses first-contact and first-reply behaviour in male and female users. It considers (a) the probability of a contact when a user has been browsed and (b) the probability of a reply when a user has been contacted. The second part narrows the focus of the analysis to educational homophily by estimating the probability of contacting other users displaying the same education in their profile. To disentangle intentional homophily from the structurally induced opportunity to meet, we incorporated the gender-specific educational opportunity structure of site users in our model. The model was also estimated for reciprocal contacts, assessing whether homophily is reinforced when the consensuality of selection is taken into account.

Sample

Our sample consisted of users who sent at least one message to another user regardless of whether it was a first contact or a reply in our observation window (13,573 users). We excluded users who declared themselves 'unfaithful' or said they were looking for 'a mate for leisure and sporting activities.' The major part of the remaining sample (over 80 per cent of the original database dump) indicated that they were explicitly looking for a 'serious relationship.' In addition, we excluded a small number of users stating homosexual preferences in their profile and removed all same-sex interactions as well as self-directed messages. In a final step, we restricted the sample to first contact messages by cutting all subsequent messages in a dyad, retaining only the information on whether the receiver replied to a first contact.

Our final sample contained 12,608 users (59 per cent male, 41 per cent female) and 116,138 first contacts. The average age of users was 36 years and did not differ significantly between men and women. Well over 80 per cent of both female and male users were aged between 20 and 50 years. This was about twice as high as the proportion of the overall population of Germany in this age range. Slightly more than 9 out of 10 users were unmarried or separated/divorced from a former partner. Whereas there were more men in the first group, women were overrepresented in the second one. The average man browsed about 138 profiles, sent about 12 first contact messages, and received about 4 answers. In contrast, women were less active on the platform in terms of browsing and sending e-mails. However, with almost the same average number of answers, they were evidently more successful in receiving replies to their contact offers. Table 1 summarizes the distributions for important profile characteristics as well as basic contact statistics.[6]

Table 1 Sociodemographic characteristics of users and contact statistics (column percentages)

	Men	Women	Total
Educational level			
Not specified	16.57	17.94	17.13
Basic secondary	5.36	4.98	5.20
Vocational secondary/ apprenticeship	28.88	33.01	30.58
University entrance	19.81	20.93	20.27
University degree	29.38	23.14	26.82
Age (years)			
Not specified	0.05	0.04	0.05
<20	1.45	3.92	2.47
20–29	28.38	31.42	29.63
30–39	34.23	23.77	29.93
40–49	24.25	26.59	25.21
50–59	9.14	11.86	10.26
>60	2.49	2.39	2.45
Marital status			
Not specified	0.85	0.31	0.63
Single	70.98	56.95	65.22
Married	3.31	2.55	3.00
Separated/divorced	23.47	36.44	28.80
Widowed	1.39	3.75	2.36
Desired relationship			
Not specified	11.28	6.86	9.46
Chat/e-mail friendship	6.15	10.80	8.06
Serious relationship	82.57	82.35	82.48
Body mass index (mean)	24.47	22.88	23.87
Height (mean)	180.95	167.94	175.61
Contact statistics (mean)			
Browsed profiles	138.49	73.01	111.73
First contacts sent	11.72	5.61	9.21
Replies to first contacts sent	3.64	4.39	3.95
Individuals (N)	7,430	5,178	12,608

Calculations based on the sample of active users.
Source: database dump of a German dating site, first half-year of 2007.

Variables

Our central variable was educational attainment level. Users of the dating platform could choose between the standardized options 'basic secondary school', 'vocational secondary school', 'apprenticeship', 'university entrance qualification' and 'university degree'.[7] Because we had no information on educational attainment level for 17 per cent of the women and 18 per cent of the men in our sample, we excluded these cases from our analysis. We combined 'apprenticeship' (only few cases) and 'vocational secondary school' into one category. Men had a slightly higher educational level than women. Compared to the German population, more highly educated people were overrepresented on the platform and less well-educated people were underrepresented. This reflects a result known from other studies regarding the digital divide in using online dating websites (see Schulz et al., 2008; Sautter et al., 2009). We classified two users stating the same educational level as having educational equality. To enter education into our regression analyses in a parsimonious way, we treated it as a metric variable ranging from 1 to 4.[8]

Research has identified age and the relative age of partners as crucial factors for mate selection, and age homogamy is a particularly significant outcome in marriage markets (see Van Poppel et al., 2001). Therefore we controlled for age based on the dates of birth users reported in their profiles. Two users were classified as having age equality when their age difference did not exceed 2 years.

We also controlled for physical attractiveness, which is regarded as another crucial factor in mate selection research (for online dating, see Hitsch et al., 2009, in press; Lee, 2008). As a proxy variable (see Tovée et al., 1998), we calculated the body mass index (BMI) from users' weight and height information and classified users according to the recommendation of the World Health Organization (WHO) into eight discrete body types: severe, moderate, and mild underweight; normal weight; overweight; and three degrees of obesity.[9] We interpreted deviations from normal weight as an indicator of being less attractive.[10] Two users sharing the same class of body type were classified as having similar physical attractiveness. Finally, we controlled for body height (in cm) in an attempt to correct the BMI to make it an even more meaningful proxy of physical attractiveness. Two users were classified as having height equality when their difference in height did not exceed 2 cm.

Empirical Results

Effect of Attribute Similarity on Contacting and Replying

We first estimated the probability of sending a first contact message. Note that the probability of user A contacting user B always depended on A having visited B's profile beforehand. Because the data were hierarchical, that is, browsing events were nested in initiating users,[11] and observations correlated significantly within users, we estimated multilevel models. The dependent variable was binary, taking the value one if the browsed profile was contacted and otherwise zero. Explanatory variables were the relation between initiator (i) and receiver (r) in terms of educational level, controlling for age and physical appearance (x_{ir}). Moreover, on the level of the choosing individual, we controlled for fixed effects on contacting probability (a_i) and accounted for interindividual heterogeneity by introducing a subject-specific random effect (u_i). This split the total variance of the model into a residual variance term and an intercept variance term (see, e.g. Rabe-Hesketh and Skrondal, 2005). Assuming logistically distributed error terms (ε_{ir}), this resulted in the following model

$$\text{logit}\{\Pr(y_{ir}=1|x_{ir},a_i,u_i)\} = a + x_{ir}'\beta + a_i'\gamma + u_i + \varepsilon_{ir}.$$

We estimated the probability of replying to a given contact analogously by simply reversing sender and receiver. In that case, observations represented first contact events.

Table 2 presents the results of the probability estimation for initial contacts and their replies. Models 1a and 2a show the effects of attribute similarity between users on the probability of contacting. When browsing profiles, both male and female initiators contacted other people with a higher probability when these people were similar in terms of educational level. For instance, the odds of a male user contacting a woman increased by a factor of about 1.1 in the case of educational similarity (Model 1a); for a female user, there was a factor change in the odds of about 1.3 (Model 2a). This supported our hypothesis that educational homophily is basically symmetrical across gender. Models 1b and 2b report the effects of educational dissimilarity on the probability of an initial contact when browsing a profile. For example, when holding everything else constant, the coefficient of 'Educational level: $r<i$' reports the difference in logits when the initiator (i) had a higher level of education than the browsed receiver (r) compared to the logits for having the same educational attainment level. If the

Table 2 Probability of an initial contact given a browsed profile and the probability of replying given a received first contact

| | Probability of first contact | | | | Probability of reply | | | |
| | Male initiators | | Female initiators | | Male receivers | | Female receivers | |
	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b
Constellations – similarity								
Same educational level	0.08***		0.29***		0.21***		0.16***	
Similar age	0.11***		0.32***		0.18**		0.18***	
Similar phys. attractiveness	0.16***		0.16***		0.12*		0.14***	
Similar height	−0.10*		−0.35***		−0.37**		−0.32***	
Constellations – dissimilarity								
Educational level: $r<i$		−0.13***		−0.62***		0.17*		−0.05
Educational level: $r>i$		−0.01		0.02		−0.36***		−0.24***
Age: $r<i$		0.11***		−0.76***		−0.34***		−0.17***
Age: $r>i$		−0.89***		−0.16***		−0.12*		−0.24***
Phys. attractiveness: $r<i$		−0.34***		−0.20***		0.19*		0.26***
Phys. attractiveness: $r>i$		0.20***		−0.06		−0.27***		−0.22***
Height: $r<i$		0.20***		−0.44**		−0.26		0.35***
Height: $r>i$		−0.66***		0.40***		0.42***		−0.33*
Attributes of individual[a]								
Educational level	−0.06*	−0.04	−0.19***	−0.05	0.04	0.14***	0.08*	0.12***
Age	−0.03**	−0.06***	−0.10***	−0.10***	0.04	0.02	0.06***	0.06***
Age²	0.00	0.00**	0.00***	0.00***	−0.00	−0.00	−0.00	−0.00
Phys. attractiveness[b]	0.01	0.24***	−0.10	−0.04	−0.02	0.17*	−0.15***	0.04
Height	−0.01	−0.01**	0.02**	0.02***	0.01	0.00	−0.00	−0.00
Intercept	−0.69	−0.120	−2.47*	−3.75***	−3.20**	−3.22**	−3.15***	−4.63***
Random effects variance: $\ln \sigma_u^2$	0.44***	0.47***	0.90***	0.91***	−0.04	−0.02	0.49***	0.51***
Log-likelihood	−41,728	−41,126	−16,792	−16,625	−5,834	−5,796	−15,679	−15,642
Intraclass correlation (ρ)	0.32	0.33	0.43	0.43	0.23	0.23	0.33	0.34
Observations[c]	133,947	133,947	64,845	64,845	10,922	10,922	39,552	39,552
Individuals	5,239	5,239	2,421	2,421	4,592	4,592	6,542	6,542

Source: Database dump of a German dating site, first half-year of 2007; own calculations, logit coefficients and levels of significance are reported.

[a]*In Models 1a–2b, individuals are initiators; in Models 3a–4b, receivers of first contacts.*

[b]*Coding: 1–5 according to WHO weight classes, with 5 being normal weight and 1 being third-grade obesity as the largest deviation from normal weight.* [c] *Models 1a–2b: For users revealing more than 50 browsing events, we took a random sample of 50 events. Models 3a–4b: In order to avoid an inflation of the receiver sample, we excluded first contacts from the 1 percent of initiators making the most contacts for each sex, declaring them to be 'mass' senders.*

Significance: *P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001.

browsed user had a lower educational attainment level, the results revealed a negative effect on contacting probability for both men and women. Thus, compared to educational similarity, both male and female users avoided contacting people with lower educational attainment levels. Note that selecting a partner with higher education did not differ significantly from similarity constellations, showing that users had a strong preference for a partner with the same or higher level of education. Given the rather traditional male breadwinner family model in Germany, we had not expected this result for men, although still for women.

Homophily also seemed to be a dominant mechanism for replies to initial contacts. Models 3a and 4a show that similarity in educational level significantly increased the logits for a reply. Thus, receivers replied to users' first contacts more often when they resembled them in terms of educational level. In sum, we can conclude that the probability of getting in contact was higher for educational similarity than for educational dissimilarity. This mechanism even seemed to be reinforced when it came to replies. The effects of dissimilarity revealed analogous results to our similarity models. Contacts stemming from people with a lower educational level had a significantly lower probability of receiving a reply. Surprisingly, there was a positive effect for male receivers who were contacted by better educated women, and even a small negative (albeit not significant) effect for female receivers. Theoretically, we would have expected the effects (if there were any at all) to take the opposite direction. However, it is important to see that 'Educational level: $r < i$' was the most frequent constellation for males contacting females in our sample (37.7 per cent compared to $r = i$: 33.5 per cent and $r > i$: 28.8 per cent). This educational constellation had the lowest proportion of females contacting males (18.7 per cent compared to $r = i$: 38.2 per cent and $r > i$: 43.1 per cent). One explanation might be that contacts with better educated women represented particularly valuable opportunities for these men. Men in online dating seemed to have fewer reservations than women regarding all couple constellations in which women were better educated than men. This puzzle could, nonetheless, be a good starting point for further research.

Turning to the control variables, our models showed that similarity in age and physical attractiveness significantly increased the probability of both contacting and replying. There was also evidence for the importance of age homophily here (see the negative effects for dissimilarity). For physical attractiveness,

our models indicated that contacting and replying to somebody who was less physically attractive was less likely than contacting and replying to somebody who was similar. In addition, more attractive users were contacted or replied to with a higher probability than similar ones. Thus, at least for physical attractiveness, the principle of 'the more the better' seemed to apply. With regard to height, we found a quite gender-specific choice mechanism, with women (men) more likely to contact or reply when the man (women) was taller (shorter).[12]

Effects on Educational Homophily

Based on the models in Table 2, we analysed how far attribute constellations facilitated first contacts or replies. This revealed that attribute similarity, especially in terms of education, favoured (mutual) contacting. As homophily seemed to be the dominant mechanism, the second step in our analysis was to change our perspective and explain homophily in contact relationships directly by estimating the probability of an attribute constellation (here: educational similarity). In more technical terms, we now took the constellation as the dependent variable to be explained by covariates. This tested the hypothesis that homophily would vary with the level of own resources. A major advantage of our research setting was that we could analyse choices while controlling for opportunity structure in the online dating environment. Thus, we could disentangle the effects on homophily due to distributional chances from those that were based on the preferences of the actor.

To analyse educational homophily in online dating, we needed to compare actual choices with the choices to be anticipated theoretically under conditions of statistical independence (see Verbrugge, 1977). In other words, we drew on a statistical reference model providing information on the probability of contacting somebody from the other sex category with a certain educational level if choosing were to take place randomly (see, for similar approaches, e.g. Blossfeld and Timm, 2003; Fiore and Donath, 2005). The reference model is reported in Table 3. If theoretically expected and empirically observed choices were to prove congruent, we would have to assume that educational matching is based mainly on the distribution of education in the population of users. The more empirical observations differ from the theoretical expectations of the statistical independence model, the stronger is the empirical evidence for intentionally choosing individuals.

Since users differed strongly in the number of initiated or replied contacts, and as these events

might not be distributed identically and independently within users, we weighted the single events by all events of each user. Otherwise, the analysis of homophily might be biased through highly active users who communicated a lot. This problem is quite common in studies of sociometric choice (see Signorile and O'Shea 1965). Events nested in users were weighted by taking the inverse value of the total number of events per user; all weights therefore summed to one for a given user. In this vein, we equated users who generated more information by being more active senders with users who might have sent only one contact and therefore left behind only sparse information. Technically speaking, we assigned low weights to the message events of the first group, and high weights to the latter. Thus, we connected

the interpretation intuitively to the average user, however, averaging out all variation created within individuals. Navigating our way between the Scylla of overrepresenting idiosyncrasies and the Charybdis of potentially losing valuable within variance, we decided that, as we were analysing intentions in terms of educational homophily, an interpretation based on users was preferable to one based on message events.[13]

For descriptive purposes, we first calculated the mean proportion of contact relations per user by educational constellation. Table 4 shows the results for the initiator by gender as well as by the observed proportion of contacts and the proportion expected by the independence model. We also calculated a factor expressing the amount of 'overchoosing' when it exceeded one and the amount of 'underchoosing' when it fell below one. Factor values close to one suggest a random choice behaviour with regard to education.

On average, more than one third (35 per cent) of an average user's contacts fell into the same educational class, and about the same proportion (36.7 per cent) was found for reciprocal contacts. We observed a higher overall homophily factor for women. When looking at contacts characterized by dissimilarity in education, women showed strong underchoosing of educationally downward contacts (18.5 per cent for first contacts) and marginal overchoosing of upward contacts (40.7 per cent). Men, in contrast, though behaving by and large as expected, slightly

Table 3 Distribution of educational levels in the active user population (column percentages)

Educational class	Men	Women	Total
Basic secondary school	6.4	6.1	6.3
Vocational secondary school	34.6	40.2	36.9
University entrance	23.8	25.5	24.5
University degree	35.2	28.2	32.4
Total	100.0	100.0	100.0
N	6,199	4,249	10,448

Source: Database dump of a German dating site, first half-year of 2007; own calculations.

Table 4 Observed and expected proportion (in percent) of educational patterns in first and reciprocal contacts averaged by user

Educational constellation	Male initiators and female receivers		Female initiators and male receivers	
	First contacts	Reciprocal contacts	First contacts	Reciprocal contacts
$i = r$: 'Similarity'				
Observed	35.0	36.7	40.9	40.4
Expected[a]	30.4	30.4	30.2	30.4
Factor	1.15	1.21	1.35	1.33
$i > r$: 'Downwards'				
Observed	35.8	36.6	18.5	20.9
Expected[a]	38.1	40.2	31.4	32.8
Factor	0.94	0.91	0.59	0.64
$i < r$: 'Upwards'				
Observed	29.2	26.6	40.7	38.8
Expected[a]	31.6	29.4	38.4	36.8
Factor	0.92	0.91	1.06	1.05

Source: Database dump of a German dating site, first half-year of 2007; own calculations.
[a]The proportion of contacts of a certain constellation a user would be expected to achieve under the conditions of a model of independence.

underchose dissimilarity contacts in terms of education. In absolute terms, contacting upwards was the rarest case for men and contacting downwards the rarest case for women.

To gain a more detailed picture of educational homophily, we used multivariate logistic regressions to estimate the probability of same-education contacts. Table 5 reports the results of the probability estimation of educational homophily in contact relations for first contacts and their replies. Models 1a–3a estimated the probability that a user would initiate a contact with somebody having the same educational level. Models 1b–3b estimated the probability of an educationally similar constellation within the set of reciprocal contacts, that is, first contacts that have been replied to by the receiver. To test our hypotheses, gender, educational attainment level, age, the interactions between educational level and gender, and between age and gender were entered stepwise as explanatory covariates. Furthermore, Models 2 and 3 included an additional variable labelled 'structural chance' that resembled the independence model. This captured the expectation of educational equality in contacts derived from the gender-specific distribution of education in the users' population (that could be

extracted from Table 3). A varying degree of homophily over educational levels might simply be the result of varying distributional chances. Hence, it was crucial to control for this structurally induced homophily in order to ascertain the amount of homophily originating from intentional rather than random choice.

Models 1a and 1b combined the structural and the individual parts of the explanation. Models 2a, 3a, 2b and 3b then virtually adjusted the coefficients of the structural effects by holding them constant. Thus, it is important to note the changing interpretation of effects of 'Educational level' and 'Man × Educational level' after controlling for distributional chances. Being able to account for the actual opportunity sets of users with regard to education is a major strength of our dataset compared to other available studies of mate choice.

The first three models in Table 5 reveal that, on average, men contacted women with similar education with a higher probability than women did when everything else was held constant. In addition, a higher educational level seemed to increase this probability, but, as the interaction term shows, only for women and not for men. When controlling for distributional chances, the educational effect appeared

Table 5 Educational homophily—probability estimation of educational similarity in initial and reciprocal contacts

|	Educational homophily in first contacts[a]			Educational homophily in reciprocal contacts[a]		
	Model 1a	Model 2a	Model 3a	Model 1b	Model 2b	Model 3b
Attributes of initiator						
Gender (Man = 1)	1.40***	0.80***	0.48*	1.30***	0.49	0.41
Educational level	0.59***	0.51***	0.52***	0.51***	0.40***	0.41***
Structural chance[b]		0.05***	0.05***		0.06***	0.06***
Age			−0.01**			−0.00
Interaction terms						
Man × Educational level	−0.59***	−0.38***	−0.39***	−0.51***	−0.23**	−0.23**
Man × Age			0.01*			0.00
Intercept	−2.04***	−3.38***	−3.07***	−1.84***	−3.42***	−3.36***
Log-likelihood	−5,278.71	−5,151.52	−5,147.56	−2,638.66	−2,564.13	−2,564.05
McFadden's R^2	0.02	0.04	0.05	0.02	0.04	0.04
Observations[c]	8,179	8,179	8,179	4,033	4,033	4,033

Source: Database dump of a German dating site, first half-year of 2007; observations weighted to individual user's mean, own calculations, logit coefficients and levels of significance are reported.

[a]*The dependent variable was binary: 1 = both users having the same educational level; 0 = users having different levels of education.*

[b]*Expectation—specific to gender and education—of realizing an educationally homogenous contact (model of independence).*

[c]*User-weighted observations. For model class a, observations were first contacts sent by initiators; for class b, first contacts that were also replied to by the receiver. Both types of observation were weighted to the individual user's mean.*

*Significance: *$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$.*
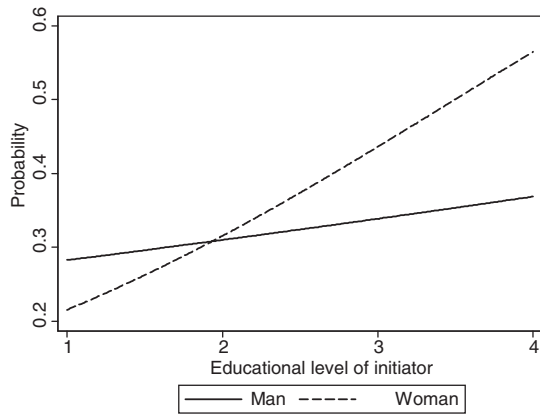
Figure 1 Predicted probability of choosing a contact partner with same educational level by own educational level (age constant at 30 years, distributional chance fixed at 0.3).

for men as well, although it was somewhat smaller due to the still significant and negative interaction term. Not surprisingly, the coefficient of structural chance was highly significant in a positive direction: the higher the chances of getting in contact with somebody of similar education, the higher the probability for realizing such a constellation. Things did not change when we controlled for age as well as for the interaction of age and gender. Increasing age reduced educational homophily for women, whereas it seemed to stay more or less constant over age for men. Given the structural conditions, education had a positive effect on educational homophily as a result of intentional choice—as anticipated theoretically. Moreover, this effect was stronger for women. To illustrate the effect of education on homophily for men and women, we plotted the probability of educational similarity varying with the initiator's educational level on the basis of Model 3a, holding age constant at 30 and distributional chances at 30 per cent (see Figure 1). This showed clearly that the higher factor of homophily for women in Table 3 was a result of over-choosing behaviour in better educated women.

The other three models in Table 5 (labelled 'b') report the results of estimates when the sample was restricted to those first contacts that received a reply. Here, we went beyond just one-sided contacting and explicitly took two-sided consensuality outcomes into account. We wanted to know whether users succeeded in establishing contacts with similarly educated others more often than structural conditions would lead us to expect. Put briefly, the effects of the theoretically important education variables on the probability of realizing a two-sided contact with equally educated partners were just the same as in the models for first contacts (labelled 'a'). Thus, first contact patterns were reinforced by the replies, strengthening our interpretation that homophily is the main mechanism of mate selection in online dating.

Conclusions

Searching for intimate relationships on the internet has become a mass phenomenon in recent years (e.g. Geser, 2007; Schulz et al., 2008). More and more individuals seem to be taking advantage of the new possibilities of mate selection offered by online dating platforms. From the perspective of social stratification research, this leads to the following question: who is meeting whom in online dating, and, thus, which couples have a chance to transform a virtual relationship into one in the offline world?

The goal of this article was to study the relevance of education for contact behaviour on the digital marriage market. Therefore, we analysed education-specific contact and reply patterns during the early phases of getting to know each other on an online dating platform. These platforms can be described as marriage markets on which men and women meet to exchange resources. When doing so, actors can reduce the large number of alternatives to a manageable set of tangible options.

Our empirical analyses are based on data from a German online dating company. This non-reactive data enable us to exactly reconstruct initial contacts and the replies to these contact offers by looking at the users' messaging behaviour. Thus, the actors' choices in the process of searching for partners can be observed more directly than with traditional (survey) methods. Additionally, it is possible to control for the actors' opportunity structure in order to systematically assess the intentional aspects of mate selection for men and women. As our analyses show, rational individual propensities indeed play an important role in the formation of the observable coupled educational patterns. Hence, mere structural explanations of these patterns omit actors and their purposive choice, and thereby finally draw an incomplete picture of the social mechanisms at work in mate selection.

Alongside these theoretical and methodological implications, our main result is the importance of homophily for the formation of intimate relationships. In line with a growing number of studies for other marriage markets (see, for recent reviews, e.g.,

Kalmijn, 1998; Blossfeld, 2009), assortative mating along similar characteristics proves to be the dominant mechanism in the online dating environment as well. It is symmetrical and operates for both men and women. A similar educational level not only encourages initial contacts, but also supports the formation of relationships. What makes this finding so special is the fact that online dating is hardly as institutionally structured as the marriage markets of everyday life. This makes it possible to interpret the contact and reply behaviour of actors as an indicator of individual preferences and purposive choice (see also Hitsch et al., 2009, in press; Lee, 2008). On the Internet, any person can basically contact any other person at any time. Nonetheless, our results show that the social structures and normative rules of mate selection from everyday life continue to affect people's choices even in such an open setting. Insofar, our results support the hypothesis of a closing social structure in the process of modern mate selection (see Blossfeld and Timm, 2003).

Moreover, when estimating homophily from contact relations defined as the probability of sending a first contact to another user with the same educational level while controlling for distributional effects (being inherent in the platform's sociodemographic structure of users), we find that homophily increases significantly with level of education. This relationship is symmetrical because it can be found for both male and female users. However, it is significantly stronger for women as a result of the large extent of educational closure that these highly educated women reveal in their contact decisions.

In the less frequent cases of deviation from homophily, we find rather strong evidence for the asymmetric mechanisms of mate selection associated with the traditional bourgeois family model. For women, overcoming the traditional patterns seems to be rather difficult because of the continued persistence of female gender stereotypes in society.

Taken together, our results are pretty much in line with the few earlier studies from the United States and Korea (Fiore and Donath, 2005; Hitsch et al., 2009, in press; Lee, 2008) that also particularly underline the importance of homophily for relationship formation on the Internet. As the basic patterns are already apparent for initial contacts, that is, the very first time two online daters get together, our analysis of replies to these initial contacts yields an even stronger indicator for the sorting mechanisms on the digital marriage market. To begin with, initial contacts are only one-sided choices that prestructure the marriage market, although they still have to be accepted by receivers. From the moment a receiver replies, we can speak of a two-sided choice (see Todd and Miller, 1999), meaning that receivers reveal similar perceptions of preferred couple constellations as initiators. This makes it possible to measure and model the relevance of education more appropriately as a distinctive criterion for the intentional actions of rational actors in the early phase of the mate selection process.

Of special importance for research on mate selection is the fact that observed educational patterns are almost identical for initial contacts and replies. Replies strongly reinforce the tendencies present in first contacts. Consequently, the early decisions in the process of union formation may well be rather good predictors for eventual marriage patterns. This conclusion is supported by Lee (2008) who found the same relation in her Korean dataset containing both early online dates and actual marriage choices. This suggests that the high similarity of spouses in terms of education (as studied by, e.g., Kalmijn, 1998; Blossfeld and Timm, 2003) is not the result of some kind of converging process over the course of marriage. Instead, individuals show educational homophily from the very beginning of mate selection. Thus, studying individual strategies will expand our understanding of assortative mating beyond bare macro-structural explanations.

Acknowledgements

Notes

1. While the term *homophily* (etymologically from greek; *homoios*: equal, similar; *philia*: friendship, love, affection) alludes to an individual and intentional propensity to associate with similar others (Lazarsfeld and Merton, 1954), the term *homogamy* (greek *gamos*: marriage) refers to an

outcome, namely that two people who are similar to each other in some way do marry or are married (e.g. Kalmijn, 1994).

2. One example is the institutional filtering logic of educational systems as marriage markets and their tendency to homogenize men and women in terms of age, education, and several other characteristics (see Blossfeld and Timm, 2003).

3. It is perfectly clear that neither first contacts nor replies are eventual partner choices. However, without these two events, there would not be any couples at all.

4. Because the opportunities provided by online dating research are so self-evident, some limitations may be less obvious. However, we shall note at least two aspects that future research must address in order to challenge our results and improve understanding. First, it is not clear whether the specific online context alters the process of mate selection. However, it is just as unclear how other social settings in which people can meet (e.g. discotheques, bars, lecture rooms) affect how they make their choices. Second, the external validity of our results will suffer if online daters prove to be a selective sample. People may use online dating simply because they have special preferences that have led them to be unsuccessful in other modes of search. However, to the best of our knowledge, there is no empirical support for this premise. Indeed, nowadays, online dating is used regularly by millions of people in Germany (Schulz et al., 2008), making it indefensible to label these users as an unrepresentative pool of awkward people.

5. Like every other research methodology, non-reactive data from online dating has major advantages but also shortcomings. Since we rely on observational data, it is important to note that we do not have any information regarding the subjective meaning of events, and thus we have to make this assumption here. We are perfectly aware that not every first contact or each reply has to be an expression of willingness to engage in our sense. For example, a receiver could express an unwillingness to engage by replying with a polite rejection. However, because reading and composing messages demand time and therefore costs, and online dating is not a face-to-face context but

a highly anonymous environment, the easiest way to say no is simply not to reply. Thus, interactions based on mere politeness should be much less frequent online compared to offline. This is also supported empirically by the low proportion of replies to first contacts (see also Hitsch et al., 2009, in press).

6. Since we rely on self-reported information of user profiles, this could probably harm our analysis if users were lying systematically. However, existing empirical evidence shows that, with regard to self-reported data on age, weight and height, though deception occurs, its magnitude is usually small (Hancock et al. 2007).

7. These are translations of the German school types and qualifications *Hauptschule* (providing the most basic secondary education), *Realschule* (providing a more advanced vocationally and technically oriented education), *Lehre* (apprenticeship), *Abitur* (university entrance certificate) and *Hochschule* (tertiary education).

8. Using a set of dummy variables instead of a metric for educational level did not change our conclusions.

9. See Global Database on Body-Mass-Index, World Health Organization (WHO): http://apps.who.int/bmi/index.jsp?introPage=intro_3.html [accessed 17 January 2010].

10. In a sense, the word 'normal' already implies a certain socially constructed and normative idea of a positive percept of physical appearance, whereas the terms 'over' and 'under'—to say nothing of 'obese'—indicate a rather less desirable deviation from 'normal.'

11. We look at users trying to initiate contacts (initiators). Thus, the question may occur if that is a selective subsample of our sample of users. To put it briefly, people are likely to send first contacts when they do not receive contacts from others. As we found out in another analysis (Skopek, 2010), the rate of incoming contact offers depends on education, age, physical appearance, and an interaction of those categories with gender. Of course, we are dealing here with interdependent processes (sending and receiving contact offers). Generally, men initiate contacts more often than women. This implies that initiators are indeed a selective subsample of the

whole sample of active users. However, this selectivity is not a result of a systematic methodological bias, but the consequence of the natural and dynamic flow of events in the field under study. A study of this kind of social dynamics of interaction patterns in partner markets would fill a separate paper.

12. As the control variables do not change our main results about educational homophily, we kept this discussion short. For a detailed look on these issues see Schulz, 2009; Skopek, 2010.

13. We also calculated the following regression models by using unweighted data and robust standard error estimation. Coefficients were then even more strongly significant and had almost the same effect size. Therefore, our approach can also be considered to be a rather conservative analysis of users' homophily.

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