Compatibility in Mate Selection

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***Abstract*—Mating is important for evolution. Since mating requires agreement of both parties, although men and women have different preferences in partner selection, there should be compatibility in these preferences. How compatible are the preferences of male and female in a given property such as age, height, education and income?**

We have investigated the mating preferences of females and males on a large online dating site. We use the most restricted definition of mating in our data which reduces the population size with N = 44,253. We confirm that females and males have different mating preferences. Females prefer taller and older males with better education and higher income. Males prefer just the opposite. Our findings indicate that these differences complement each other in such a way that majority of the partners are happy with their mates.

***Index Terms*—Mating, mate selection, mating preferences, parental investment, gender compatibility, evolution, online dating.**

I. Introduction

[gender differences] THERE has been a long debate on how different male and female are [1]–[12]. *Gender difference hypothesis* claims that males and females are very different in their personalities, abilities, interests, attitudes and behavioral tendencies [2]–[10]. Some recent findings support this hypothesis. Men and women are different in many ways including sexual contacts [5], in brain imaging studies [7], performance in Mathematics [8], or chess [10], even online games [9]. On the other hand, some investigations support the *gender similarity hypothesis* which claims that the difference is not as big as one expects [11], [12].

[hunter-gatherer theory] One possible evolutionary explanation of the gender difference is the *hunter-gatherer theory of spatial sex differences* proposed by Silverman and Earl [13]. It claims that there has been division of labor between men and women as early as the time of hunter-gatherers. Males are primarily hunters and females primarily foraged. This affects the cognitive development since " tracking and killing animals entail different kinds of spatial problems than does foraging for edible plants; thus, adaptation would have favored diverse spatial skills between sexes throughout much of their evolutionary history ". Hence, it calls for different spatial skills such as mental rotations, map reading, maze learning for male. and ability to learn, recognize, remember spatial configurations of objects, and their spatial relationships for female.

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A. Mating and Parental Investment

[mating and parental investment theory] Mating is important for evolution. In many species, it has been observed that male and female have different strategies in mate selection.

We need an evolutionary theory to explain differences in mating strategies. One such theory is Trivers' *parental investment theory* which is based on parental investment [14]. Offsprings, having support from parents, have better chance to survive, hence to reproduce. Therefore, evolution calls for parental support. He carefully defines *parental investment* as " any investment by the parent in an individual offspring that increases the offspring's chance of surviving (and hence reproductive success) at the cost of the parent's ability to invest in other offspring ".

[mating strategies] Parental investment is quite uneven between male and female in many species [14]. Therefore both genders evolutionarily developed mating strategies which are clearly different [3], [15]–[17]. [female strategy] In female mammal, hence human female, is forced to select quality, since she cannot choose quantity. Human female makes mandatory high investment in offspring compared to male, if one considers nine months of gestation, childbirth, lactation, nurturing. Therefore, she looks for supporting male in her mate selection. She prefers a male who not only have the resources to support her but also willing to commit these resources to her. That explains female preference for *long-term* commitment. [female strategy] On the other hand, human male can choose quantity. He is reluctant to long-term commitment. He has a tendency for *short-term* relations which increase his chances to reproduce offsprings. This quality versus quantity paradigm is clearly a conflict that has to be resolved. Female, who invest more in offspring, should be more choosy selecting mate (*intersexual attraction*) and male, who invest less, should compete to access the opposite sex (*intrasexual competition*) [14].

B. Properties in Mate Selection

[mating properties] Properties, that increase the chance of mating, become crucial in this respect [3], [13]–[21]. [age] In terms of evolution, (a) *fertility*, i.e., immidiate probability of conception, and (b) *reproductive value* i.e., future reproductive potential, are the top two properties for both gender [17]. They are age related. Clearly, health is also very important. So young healthy mate should be the choice in all species. Human male just does that. But human female has other issues therefore being young is not enough. She is looking for male that will provide parental support for her offspring, that is, he should (a) have the resources and (b) willingness to commit these resources to her offspring. In order to collect resources

he needs time. Therefore he may not be that young after all. [physical] While female is busy providing parental investment to her offspring, she expects male to provide food and shelter. He is also expected to protect her and her offspring. So physically masculine male should be preferred. [expect] So we expect that younger female and "superior" male partners.

Empirical evidences support these deductions [3], [6], [13], [15], [18]–[21]. Investigations on partners has revealed that [age] male is older [18], [physical] taller [19]–[21] than female. This is a universal pattern across cultures [6], [15].

[Compatibility of Preferences] Since mating requires agreement of both parties, although men and women have different preferences in mate selection, there should be compatibility in these preferences. We can ask the following question. How compatible are the preferences of two genders in a given property?

We will use the data obtained from an online dating site. First we carefully define mating in our data set. Then we aggregate the properties of partners that an individual selects as mate. Finally we search for patterns in the properties for mating behavior.

II. Method

A. Data Set

[online dating data] We investigate the data of a large Turkish online dating site for compatibility of mating preferences [22]. There are 4,500,000 registered users in total. More than 3,000 new users register daily. A user stay in the system for 3 months, on the average. Many of them come back, later; sometimes as a new user. The daily activity is also quite large such as 50,000 user logins, 500,000 massage transactions, 5,000 photo uploads, and 20,000 votes.

B. Definition of Mating

[online dating] A typical online dating system enables its user to find partner that best matches one's desires. Each user defines his user profile. An initiator, predominantly male, selects a potential partner by examining her profile and sends her a message. If there is a positive response from the receiver, then more messages are exchanged which hopefully leads to a face-to-face meeting.

[partner criteria] When do we say that male and female are mating? Online dating site has lots of information about the virtual world, but there is usually no information whether the male and the female really make a mating partner in the physical world. Any action in an online dating site is clearly an attempt for mating but is it sufficient to be considered as mating? For example, just sending a message, getting a message in response, or some more exchange of messages should not be enough in the world of online dating which is full of these.

Therefore we select the most restricted criteria of mutual interest, that is available in our data set, which is virtual gifts [22]. Receiving a *virtual gift*, which is usually a picture of a flower, is considered a "value" in this virtual society. We have even observed that some user sent virtual gifts to themselves. This value is probably due to (i) the virtual gifts one receives is visible to all, (ii) they are not free, i.e., one has to purchase virtual gifts in order to sent, and (iii) only qualified users can sent virtual gifts. Since unpaid male members are not qualified to sent gifts, able to sent gifts may be considered as an indication of wealth.

There are 276, 210 male and 483, 963 female users that are qualified to send virtual gift in the system. Among those, only 29, 274 male and 14, 981 female, in total $N = 44, 253$, users reciprocally exchange virtual gifts. Hence we define a pair as (mating) *partners* if they not only exchange messages, but also send at least one gift to, and receive at least one gift from each other.

Note that this definition is based on actual behaviors of users in the online dating site. We have the "actual" partners, that is, they mutually agree to "mate" as far as we can trace in our online dating site, rather than a "theoretical" partner one wishes to have as he answers the questions of a survey as in the case of ref [15]. We have such theoretical data in user profiles, too. Users specify what properties, such as the age, height, they look for in their potential partners. This data is noisy. Users are not consistent. They claim something and does something else. For example, someone claims that he prefers women taller than 170 cm but does not hesitate to be partner with a 160 cm. Such behavior is clearly difficult to register in questionaries. In this respect our actual data deserves special attention.

C. Properties of the Mate

[properties of the mate] Once we have identified the partners, we investigate the properties of the mate. As expected, user i becomes partner with many others as time goes. Each partner of i may have different value for property p. The average of the properties of the partners of i is given as

$$\overline{p_i} = \frac{1}{|C_i|} \sum_{j \in C_i} p_j$$

where p_j denotes the property p as it is defined in user j's profile and C_i is the set of users that i partnered with. We interpret this as user i has a tendency to select partners having value of $\overline{p_i}$ in property p . Hence, we call $\overline{p_i}$ as the *preferred value* for i. Instead of using the preferred value directly, we compare one's own value to the preferred value that one looks in his partners. The *preferred difference* of i, in property p, is defined as

$$\Delta p_i = p_i - \overline{p_i}.$$

Note that Δp_i can be negative or positive. If Δp_i is around 0 then the user prefers partners with similar properties with him, i.e. homophily [23], [24]. For example, if the property is height and if user i has a tendency for taller partner in her selection, then Δp_i would be negative.

D. Distribution of Preferred Differences

[property distribution] We can extend these concepts from individual i to a group of people. Then, frequency of people with the same preferred difference makes a probability distribution, which we call *preferred difference distribution*. Having all

women as one group, and all men as another group, we obtain two preferred difference distributions $f(x)$ and $m(x)$ of females and males, respectively.

III. Results

[findings] The statistical parameters of the preferred differences in age, height, education and income are given in Table I. Columns μ_m, μ_f, and σ_m, σ_f are the averages and standard deviations of males and females, respectively. The distributions of the preferred differences are given in Fig. 1. We first focus on the averages, and leave the discussion of distributions and their compatibility, the last column of Table I, later.

A. Average of Preferred Differences

In all four properties in Table I, there is a distinct pattern. The averaged preferred differences for males, μ_m, are all negative and that of females are all positive. This observation indicates that in all four properties, whatever the metric is used to measure the property, males prefer "inferior" females and females prefer "superior" males compared to themselves.

[age] **Age.** According to evolutionary theories, we expect to see younger female and older male in partners. Our findings confirms that. We observe that, on the average, males mate with females 2.90 years younger than themselves, and females mate with males 2.74 years older. Our findings are in agreement with males prefer 2.66 years younger, females prefer 3.42 years older mate than themselves reported by Buss [15].

[difference in partner selection] **Height.** Our findings on preferred difference in height, given in Fig. 1a, agree with the previous work. People usually interact with people who have similar characteristics [23], [24]. For example no drastic height differences between partners are observed. That is, tall male partners with tall female, and short with short [19], [21]. Although there are males prefer females 30 cm shorter or 10 cm taller in Fig. 1a, they are rare. Majority are accumulated around the average which is a manifestation of homophily in height.

Yet, there are distinct differences between the preferences of male and female when it comes to partner selection, such as height [19]–[21]. Male is usually taller then female in partners, which is called *male-taller norm* [19]. The averages in Table I agree with the male-taller norm. On the average, male prefers female 11.12 cm shorter. Similarly, on the average females prefer male 11.37 cm taller.

Income and Education. We observe similar pattern in income and education, too, namely, males prefer negative and females prefer positive differences. Here the numbers cannot be compared with other works directly since users are asked to select one bin out of many bins which are organized in a consistent but an arbitrary way. They are consistent in the sense that the larger the bin number, the more educated or higher income. The bins in education are related to the number of schooling years such as graduate of primary school, or of college. The bins in income field represent monthly income such as bin 2: $500 < x < 1000$, bin 3: $1000 < x < 2000$.

TABLE I
Comparison of Male and Female Distributions

Property	Averages		Standard Deviations		Compatibility
	μ_m	μ_f	σ_m	σ_f	ρ
Height (cm)	-11.12	11.37	6.76	7.09	0.90
Education (bin)	-0.36	0.34	1.35	1.40	0.92
Age (year)	-2.90	2.74	5.06	5.23	0.94
Income (bin)	-0.93	0.99	1.28	1.32	0.95

B. Distributions of Preferred Differences

Note that the average preferred differences of males and females are very close to each other in Table I. The standard deviations are also very close to each other. If we assume that the male and female distributions are gaussian distributions, the distributions should be very similar as if female distribution is obtained by shifting the male distribution. This cannot be a coincidence and deserves further study. It seems males and females complement each other in the preferred differences. Since we have not only the averages and standard deviations, but also the distributions, we can further investigate the distributions for compatibility.

Distributions of preferred differences in age, education, and salary are given in Fig. 1b, Fig. 1c, and Fig. 1d, respectively. As we have deducted from Table I, for all properties in Fig. 1, the bell-shaped curves of male and female are also resemble to each other. One notices that male curves are left-shifted, and female curves are right-shifted with respect to the y-axis.

[compatible] In order to get better understanding, consider a simplified example given in Fig. 2. Note that females that prefer $\Delta p = x$ matches with males that prefers $\Delta p = -x$. Therefore, we should not compare the distribution $f(x)$ of females not with $m(x)$ of males as we previously thought. We should compare $f(x)$ with $m(-x)$, the symmetric graph with respect to the y-axis. We make a reasonable assumption that there are equal number of men and women. Then $\min\{f(x), m(-x)\}$ of the women who prefer $\Delta p = x$ are matched. Then, the *compatibility* of two distributions can be measured by means of the ratio of matched women given as

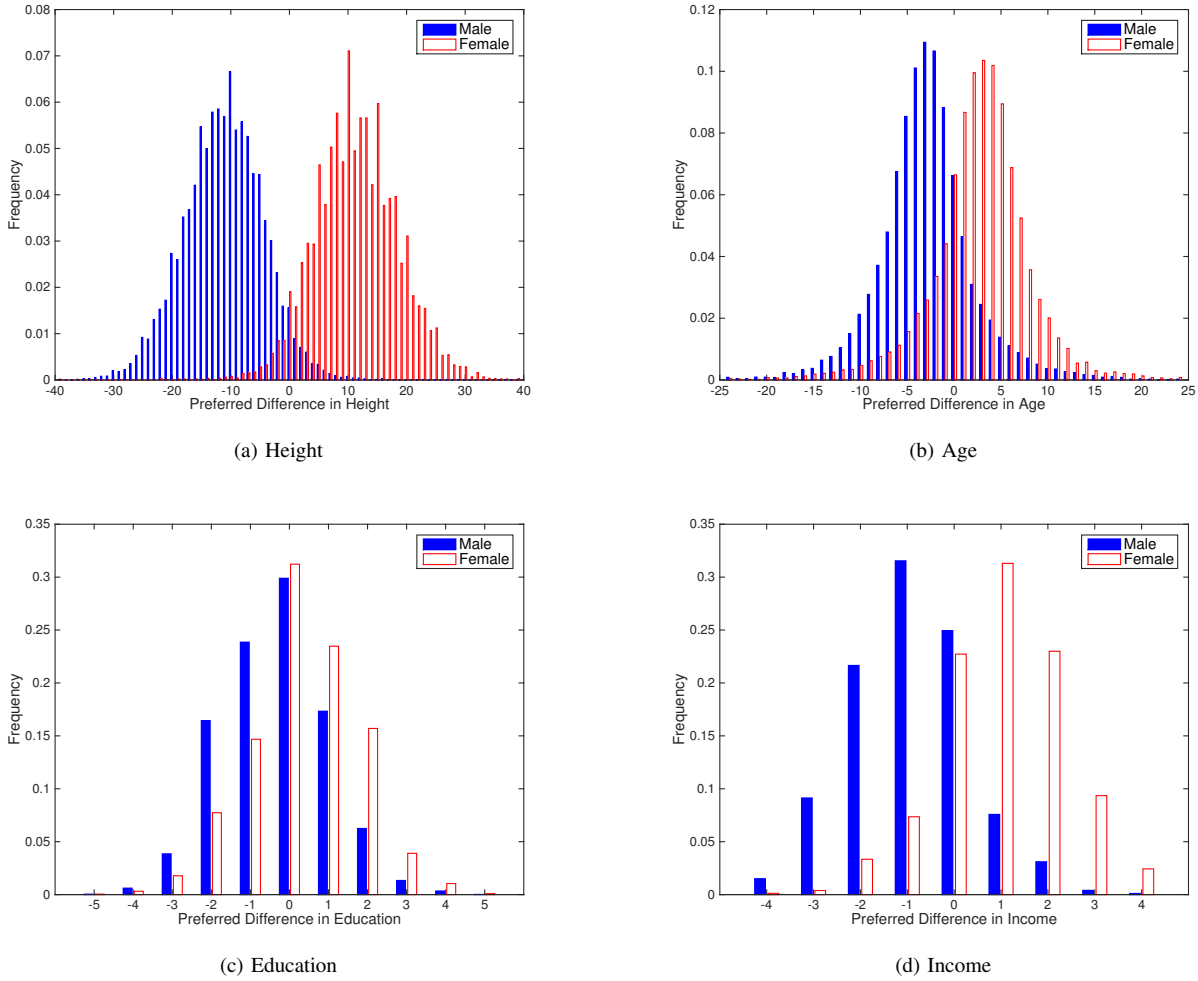
$$\rho = \sum_x \min\{f(x), m(-x)\}$$

where summation is taken over all possible values of x. This is a well-defined metric since the ratio of matched women is equal to that of men.

In Table I, the properties are listed in ascending order in compatibility. Height is the property with the lowest compatibility. Even for this case, 90 % of the population can find a satisfying partner. Interestingly, income has the highest compatibility and age comes next.

IV. Discussion

[discussion] In real life, men and women behave differently. Our findings show that the virtual world of online dating is another manifestation of this difference. (i) While male prefers women with lower qualifications in every property that we have investigated, women just do the opposite. (ii) Interestingly, the preferences of men and women match to each other



(a) Height (b) Age

(c) Education (d) Income

Fig. 1. Preferred difference distributions in height, age, education, and income.

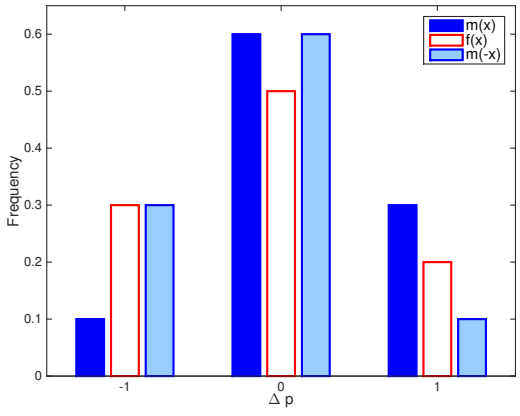


Fig. 2. Distribution of difference in a dummy property p. We assume that male female populations are the same. (i) 50% of women and 60% of men prefer no differences in p. Hence 50% matches for $\Delta p = 0$. (ii) 20% of women who prefer difference of $\Delta p = 1$ are to match with 10% of men who prefer differences of $\Delta p = -1$. Only 10% matches for $\Delta p = 1$. (iii) 30% of women who prefer difference of $\Delta p = -1$ are exactly match with 30% of men who prefer differences of $\Delta p = 1$. That is, 30% matches for $\Delta p = 1$. In total 90% of women are match. Hence male female compatibility is $\rho = 0.90$.

so that the number of dissatisfied is minimized. Due to lack of space, we do not report here but we have also observed similar findings in body mass index and body type, too [22].

We can explain this evolutionary dynamic. Suppose we start with individual with uniform one individual prefers difference far away from the We are not in that position but it would be nice if we could provide explanations for these findings. It may be possible to find some evolutionary explanation [13], [18], [20].

[warnings] One needs to be careful on a number of issues in a study like that. (i) One has to keep in mind that the findings could be culture dependent. (ii) The profile is based on user's claim, that is, it may be misleading. On the other hand, stretching the properties too far would not be a good strategy since unfaithful declaration, such as declared as slim while being obese, would be an obstacle to further the relationship when the time comes to meet face-to-face [25], [26]. So we assume that users are closed to what they claim to be. (iii) Privacy is the most important issue for such an investigation. In this study no data left the company. All the data processing is done at their site. No individual personal information is used. Only statistical data such as given in Fig. 1

is shared with us.

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V. CONCLUSION

The conclusion goes here.

APPENDIX A
PROOF OF THE FIRST ZONKLAR EQUATION

Appendix one text goes here.

APPENDIX B
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[large data] Investigation of mating preferences on larger population in traditional ways, such as one-to-one interviews, becomes prohibitively difficult. Thanks to Internet, very interesting data sets [9], [27]–[30] have become available including data on online dating [22], [25], [26], [31], [32]. Compared to $N = 10,047$ of ref [15] and $N = 17,637$ of ref [6], which are very big numbers, we will investigate mating patterns of a population of $N = 44,253$ based on the data of an online dating site.

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