On the Existence of Optimal Level of Women's Intelligence in Men's Perception: Evidence from a Speed Dating Experiment

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On the Existence of Optimal Level of Women's Intelligence in Men's Perception: Evidence from a Speed Dating Experiment

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Abstract

We study gender differences in preferences for mate characteristics such as perceived physical attractiveness and intelligence using data from a speed dating experiment. We have observed that women give greater weight to perceived physical attractiveness than intelligence in their mating decisions. Probability of women's positive speed dating decision rises with men's perceived physical attractiveness (in this case we observe increasing marginal effects) and intelligence (with diminishing marginal effects). Marginal rate of substitution of men's perceived physical attractiveness for intelligence is the highest for low levels of men's perceived intelligence and the lowest for high values of men's perceived intelligence. Men also give greater weight to perceived physical attractiveness than intelligence in their mating choices. Probability of men's positive decision rises with women's perceived physical attractiveness (in this case we observe diminishing marginal effects). The relationship between probability of men's positive decision and women's perceived intelligence is non-monotonic. The optimal level of women's intelligence in men's perception exists. This optimal value rises with women's perceived physical attractiveness.

JEL C1, D1

Keywords Gender differences; Mate preferences; Speed dating experiment

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I. INTRODUCTION

Dating in contemporary Western societies is a device for finding a romantic partner. The choice of a romantic partner is, however, a serious decision problem due to individual differences in preferences for mate characteristics (see e.g. Fisman *et al*., 2006). It is difficult to do research on initial romantic attraction, because as in all matching markets, determining individual preferences from equilibrium outcomes is burdened with the risk of coincidence (e.g. the fact that economists choose economists as romantic partners can be explained by preference structures as well as the fact that economists study or work with other economists).

We overcome this coincidence problem by studying the unique experimental data. The data are sourced from the speed dating experiment which was run at the Columbia University in the City of New York (Gelman and Hill, 2007). In the cited speed dating experiment diverse individuals looking for potential romantic partners attended an event where they went on a series of brief dates with other attendees. These dates lasted four minutes within each event. After the event, participants had the opportunity to say ‘‘yes’’ or ‘‘no’’ to each of the other speed daters. If two speed daters said ‘‘yes’’ to one another, they were given the ability to contact each other for a future, probably more traditional date. Speed dating protocols allow for tight experimental control and, what is even more important, reflect the individuals' judgment and decision making in real world settings (Finkel *et al*., 2007). Speed-dating is usually meant to find a long-term partner, although some participants (in particular men) may have different intentions (Asendorpf *et al*., 2011). While long-term mating is usually the preferred tactics for single women, this is less true for men, who in general have a stronger desire to follow short-term mating tactics, i.e. looking for a sexual affair (Buss and Schmitt, 1993; Penke and Denissen, 2008).

Speed dating protocols are especially useful for looking into two fundamental determinants of mate selection, i.e. perceived physical attractiveness and intelligence of a potential partner (Montoya, 2008; Prokosch *et al*., 2009; Sandhya, 2013). Researchers of human mating have observed significant differences between females' and males' preference for mate characteristics, such as physical attractiveness, intelligence or social status (Buss and Barnes, 1986; Buss, 1989a; Fisman *et al*., 2006; Hoyt and Hudson, 1981; Kenrick *et al*., 1993; Landolt *et al*., 1995; Sandhya, 2013). Whereas social status of the other speed dater can be difficult to infer from a brief conversation, physical attractiveness and intelligence of the other speed dater are almost automatically evaluated. Therefore our study concentrates on perceived physical attractiveness and intelligence as key determinants of human mating.

The objective of our paper is to assess the influence of perceived physical attractiveness and intelligence of a potential partner on human mating decisions. We put special emphasis on the relationship between the probability of being chosen in the speed dating experiment and perceived personal traits of participants such as physical attractiveness and intelligence.

In order to solve the above research problem we have built the appropriate logit model on the basis of Columbia speed dating experimental data (see section III). All statistical computing was done in R software.

II. LITERATURE REVIEW

Researchers of human mating have observed significant differences between females' and males' preference for mate characteristics, such as physical attractiveness, intelligence or socio-economic status (Buss and Barnes, 1986; Buss, 1989a; Fisman *et al*., 2006; Hoyt and Hudson, 1981; Kenrick *et al*., 1993; Landolt *et al*., 1995; Sandhya, 2013). The phenomenon of human mating has been studied from both psychological and economic viewpoints.

Psychologists have long studied the determinants of mate selection using survey and field experiment evidence (for reviews, see Buss and Kenrick, 1998; Regan *et al*., 2000). The psychological research (Buss, 1989a; Buss *et al*., 1990; Sepehri and Bagherian, 2013) reveals gender differences in mating strategies. In general, women, significantly more than men, desire qualities that lead to economic resources, such as ambition, industriousness and high social status. Men, significantly more than women, value physical attractiveness and young appearance. Despite these gender differences, most mate preferences of women and men show great similarity. Both sexes are looking for a kind, understanding, healthy and intelligent partner (Buss, 1989b; Geary, 2004). Both sexes equally value similarity and fit in selecting a mate (Kerckhoff and Davis, 1962).

The gender differences in mate selection are most pronounced in partner choices for long-term relationships. In the context of short-term mating the mentioned differences dim. On the one hand, women lay greater emphasis on physical attractiveness of potential partner in the context of short-term than long-term mating (Regan, 1998), on the other hand men lower their standards regarding physical attractiveness significantly in the context of short-term mating (Buss and Schmitt, 1993).

Psychological theories are extremely helpful in explaining gender differences in mate choices for long-term relationships. The evolutionary theory of parental investment (Trivers, 1972) states that the sex that invests more in offspring would be more selective about mates.

The greater parental investment by females (consider costs of gestating, bearing and feeding) makes them more choosy than males. Therefore women engage in careful mate selection in order to find men who can provide valuable economic resources to aid in the upbringing of the children. Thus women focus on men with high resource acquisition ability which usually goes with high social status (Kenrick and Keefe, 1992).

Social psychologists explain gender differences in mate selection by the fact that women and men play different roles in society (Eagly and Wood, 1998). The social structure theory states that selection criteria can be derived from the stereotypical gender role played by the individual in society. Thus women should avoid men who are superior to them on stereotypical female dimensions (e.g. physical attractiveness) and men should avoid women who are superior to them on stereotypical male dimensions (e.g. ambition).

The above psychological theories allow us to explain mate choices for long-term relationships (e.g. choice of a wife or a husband). However, in the context of short-term mating people tend to violate the cited theories. For example, women tend to choose men who are superior to them on physical attractiveness dimension and who do not necessarily have high social status. Therefore there exists an urgent need to identify key determinants of mate choice in the short-term context.

The phenomenon of short-term mating has been studied by experimental economists and game theorists. Economic experiments on short-term mating were based on speed dating protocols (Belot and Francesconi, 2006; Fisman *et al*., 2006; 2008). Under this experimental setup, subjects meet a number of potential mates for few minutes and have the opportunity to either accept or reject each partner (for details, see Fisman *et al*., 2006). Probably the most influential paper is due to Fisman and others (2006). The researchers have observed in particular that women put greater weight on the intelligence and the race of partner, while men respond more to physical attractiveness. Moreover, men do not value women's intelligence when it exceeds their own. Our paper focuses on and extends the latter result.

The speed dating protocol is an experimental device to study two-sided matching. A two-sided matching analysis (Gale and Shapley, 1962; Miller, 1997; Roth and Sotomayor, 1990; Shapley and Shubik, 1972) assumes in this case a certain population of both sexes, where each subject has a defined set of preferences across individuals of the opposite sex. Gale and Shapley (1962) proposed that a matching of women and men is stable only if it left no pair of subjects on opposite sides of the market who were not matched to each other but would both prefer to be. A stable matching is a Nash equilibrium in the short-term mating market.

III. EMPIRICAL METHODOLOGY AND DATA

In our research we used the unique experimental data[1] collected by Andrew Gelman (Department of Statistics, Columbia University, New York). 278 males and 276 females participated in a series of experimental speed dating sessions run from October 2002 to April 2004 at the Columbia University in the City of New York. All participants were students representing different faculties of the Columbia University (participants have been assigned to one of the eighteen fields of study, i.e. (1) Law, (2) Mathematics, (3) Social Science and Psychology, (4) Medical Science, Pharmaceuticals and Biotechnology, (5) Engineering, (6) English, Creative Writing and Journalism, (7) History, Religion and Philosophy, (8) Business, Economics and Finance, (9) Education, (10) Biological Sciences, Chemistry and Physics, (11) Social Work, (12) Undergraduate Students with no Specialization, (13) Political Science and International Affairs, (14) Film, (15) Fine Arts and Arts, (16) Languages, (17) Architecture and (18) Other).

In the speed dating experiment participants attended events where they went on a series of brief dates with other attendees. These dates lasted four minutes within each event. After the date, participants had the opportunity to evaluate (in the 11-point grading scale, from 0 to 10) the physical attractiveness and intelligence of the other dater. After the event, participants had the opportunity to say ‘‘yes’’ or ‘‘no’’ to indicate whether they would like to see each of their dates again. If two speed daters said ‘‘yes’’ to one another, they were given the ability to contact each other for a future, probably more traditional date.

4184 speed dates were organized within period of 19 months of experiment running. In total, 8368 individual decisions were made. Table 1 depicts the number of “yes” and “no” decisions according to participants’ gender.

Table 1: The number of positive and negative decisions according to participants’ gender

	Yes	No
Male	1986 (47.67%)	2198 (52.53%)
Female	1529 (36.54%)	2655 (63.46%)
Both	3515 (42.00%)	4853 (57.99%)

Unfortunately, when filling the values of physical attractiveness and intelligence of their partner, some participants paid less attention and missing data occur. For observations with one missing value, 62% of decisions were negative. If both physical attractiveness and intelligence were left blank, percentage of refusals was even higher and reached 97%. As a

[1] The data are available online: http://www.stat.columbia.edu/~gelman/arm/examples/speed.dating/.

result, for modelling, 8072 observations with full information were used. Figure 1 shows how participants' physical attractiveness and intelligence were rated by their partners. Table 2 summarizes the data.

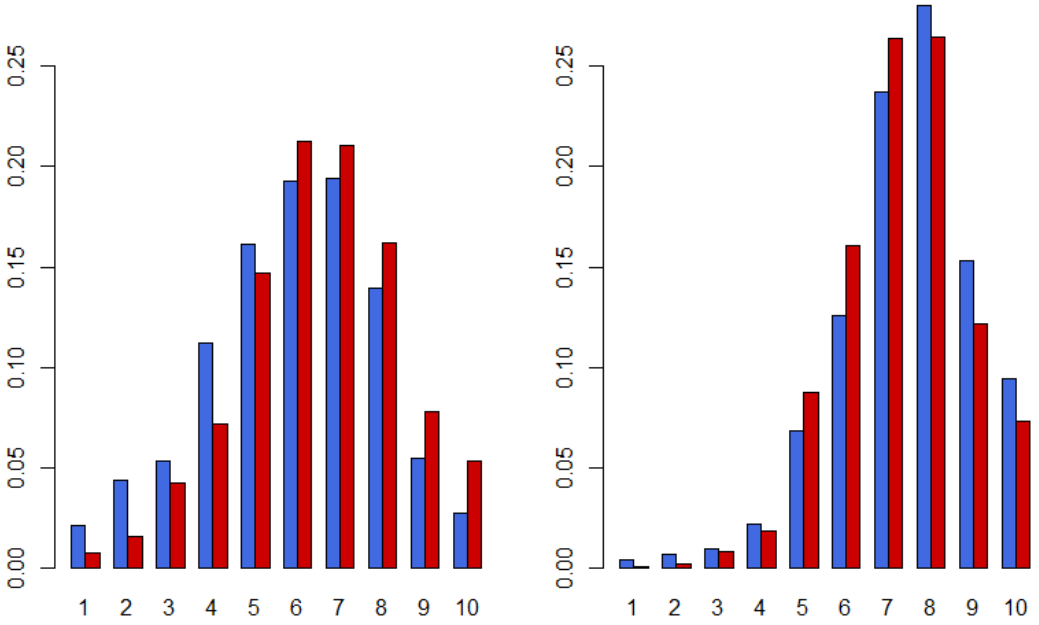

Figure 1. Densities for perceived physical attractiveness (left) and intelligence (right) of men (blue) and women (red)

Table 2: How participants were evaluated by their partners? Descriptive statistics

	Male		Female	
	Attractiveness	Intelligence	Attractiveness	Intelligence
1st Quartile	5	7	5	6
Median	6	8	7	7
3rd Quartile	7	8	8	8
Mean	5.92	7.45	6.47	7.29
Standard Deviation	2.00	1.61	1.86	1.49

To model the relationship between decision and perceived personal traits (perceived physical attractiveness and intelligence) of the daters we will use logistic regression. It is a widely used method for estimating probabilities with which every observation belongs to a certain class (in our case it is a "yes"/"no" decision) (see e.g. Hastie *et al.*, 2001). Due to the use of logit function posterior probabilities always are in the (0,1) interval. Probability that a certain observation will be classified as a certain class Y[2], given the data, is as follows:

$$P(Y = 0|\boldsymbol{X} = \boldsymbol{x}) = \frac{1}{1+exp(\beta_0+\boldsymbol{\beta}^T\boldsymbol{x})} \quad (1)$$

$$P(Y = 1|\boldsymbol{X} = \boldsymbol{x}) = \frac{1}{1+exp(-(\beta_0+\boldsymbol{\beta}^T\boldsymbol{x}))} \quad (2)$$

[2] Y=1 refers to the positive ("yes") decision; Y=0 refers to the negative ("no") decision.

Amid various advantages of logistic regression, an interpretability of a model is one of the most important. A fairly straight-forward interpretation is possible due to formulas of odds and log-odds that are given by:

$$\frac{P(Y=1|\boldsymbol{X}=\boldsymbol{x})}{1-P(Y=1|\boldsymbol{X}=\boldsymbol{x})} = e^{\beta_0+\boldsymbol{\beta}^T\boldsymbol{x}} \tag{3}$$

$$\log\left(\frac{P(Y=1|\boldsymbol{X}=\boldsymbol{x})}{1-P(Y=1|\boldsymbol{X}=\boldsymbol{x})}\right) = \beta_0 + \boldsymbol{\beta}^T\boldsymbol{x} \tag{4}$$

This enables us to interpret estimated coefficients in terms of odds of belonging to a certain class.

IV. RESULTS

Females' choices

While seeking best partners, women do not exclude men who are perceived as less physically attractive. As it is shown in Figure 2, even those men who are not perceived by women as physically attractive may be attractive overall, if only they seem intelligent. Yet, percentage of positive decisions inevitably rises as one moves closer towards right-top corner in the Figure 2. Dots mark positive and negative decisions, gold and violet respectively.

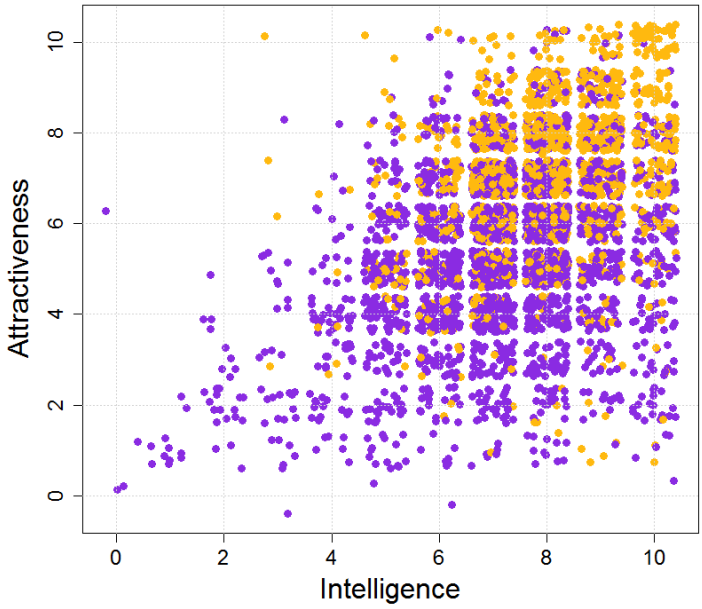

Figure 2. Females' choices on a base of males' perceived physical attractiveness and intelligence

Correlation which exists between physical attractiveness and intelligence makes some variables redundant. Thus, the lowest AIC (Akaike Information Criterion) variable selection effected in excluding interaction variable *"intelligence * attractiveness"*. Other variables are significant at the .1 level ($\alpha = 0.1$).

Estimates for the coefficients are presented in Table 3. Big negative value for intercept means that for men who are perceived as neither physically attractive nor intelligent chances for being chosen are minuscule. Due to the other coefficient values probability does not change rapidly while variables are low. In fact:

$$P(Y = 1|intelligence = 0, attractiveness = 0) = 0.33\%$$
$$P(Y = 1|intelligence = 2, attractiveness = 2) = 1.63\% \quad (5)$$
$$P(Y = 1|intelligence = 4, attractiveness = 4) = 7.57\%$$

Non-negative estimates for both *physical attractiveness* and *physical attractiveness*^{2} ("physical attractiveness squared") indicate positive and increasing marginal effects for this variable. A small increase in perceived physical attractiveness of men boosts odds in favor of positive decision.

Table 3: Estimates of females' choices: logistic regression

	Estimate	Standard Error	z-value	p-value
Intercept	-5.72348	0.8066	-7.096	1.29E-12 ***
Intelligence	0.58269	0.21354	2.729	0.00636 **
Attractiveness	0.23496	0.12503	1.879	0.06022 .
Intelligence^2	-0.02953	0.0142	-2.079	0.03758 *
Attractiveness^2	0.02645	0.01018	2.599	0.00935 **

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Perceived intelligence does not follow the above schema. Although sign on *intelligence* is positive, its quadratic term is slightly below zero. This means that, while men's perceived physical attractiveness is fixed, probability of women's positive decision reaches its maximum, and one may find it for the following value of men's perceived intelligence:

$$intelligence^* = -\frac{\beta_{intelligence}}{2\beta_{intelligence^2}} = \frac{0.58269}{2*0.02953} = 9.87 \quad (6)$$

This value is located at the top of the scale and therefore *intelligence's* increase has a positive impact on women's decisions. However, diminishing marginal effects make exchange between perceived physical attractiveness and intelligence less profitable to those males who benefit mainly from the latter. One may observe the relationship between independent variables and the probability of women's positive decision in Figure 3.

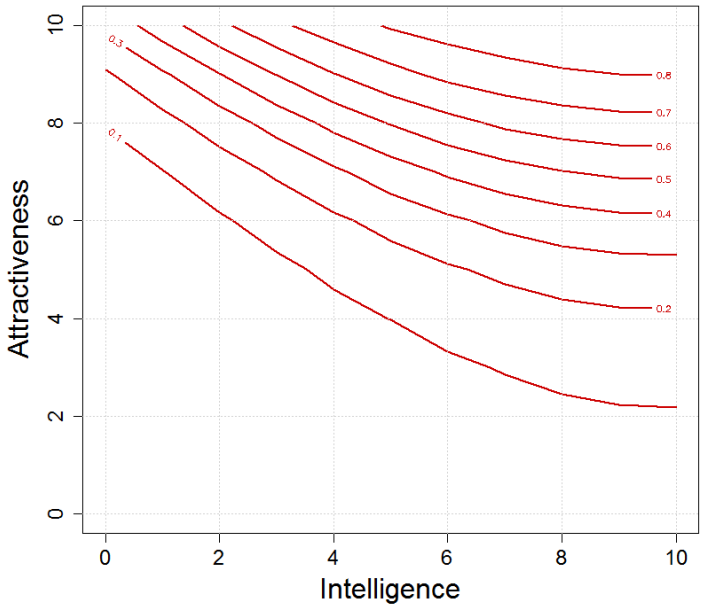

Figure 3. Contour lines for probability of women's positive decision

The marginal effects of both physical attractiveness and intelligence are visible in Figure 3. Additionally, a slope of contour lines informs us about the marginal rate of substitution between perceived physical attractiveness and intelligence. In other words, one may check what is the trade-off between the two variables in women's perception. Diminishing marginal effects for intelligence are especially visible at the right side of the Figure 3 where contour lines are almost flat. The slope of contour lines is the biggest for small values of intelligence and this is a region where differences in intelligence have relatively high impact on women's decisions. Physical attractiveness plays bigger role in final decision, especially for high levels of intelligence. For perceived as smart ones even a small increment in physical attractiveness results in highly rising probability of being chosen by women. Finally, from the Figure 3, one may notice that if someone may choose, then it is better to be perceived as handsome and not necessarily brainy than the opposite. Of course, it is best to be perceived as both smart and physically attractive.

Males' choices

Males have clearly different attitude towards mate selection than females. As one may see from the Figure 4, dispersion of observations is relatively smaller and most of the observations are concentrated on the right side of down-left-top-right diagonal. Moreover, one may find puzzling the relative lack of gold dots on the right edge of the Figure 4. This

suggests that, unlike women, men may perceive as optimal some certain combinations of physical attractiveness and intelligence.

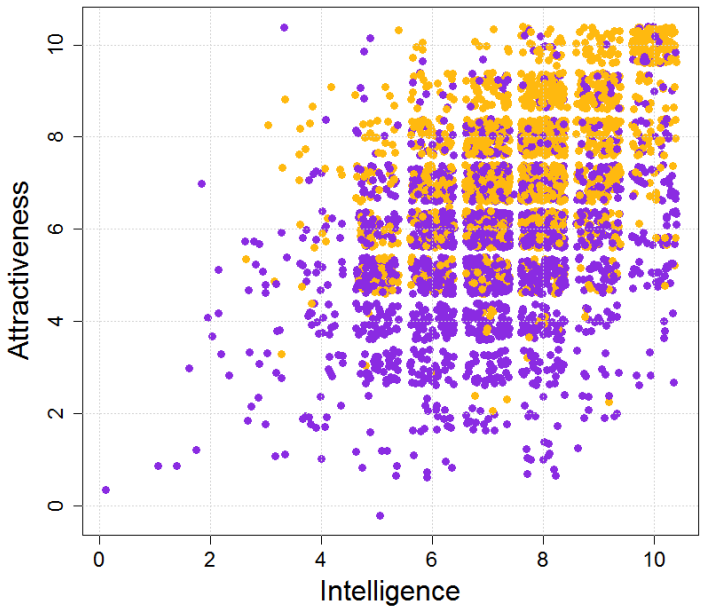

Figure 4. Males' choices on a base of females' perceived physical attractiveness and intelligence

Table 4 presents estimates for logistic regression model of males' choices. This time using the lowest AIC variable selection did not result in exclusion of any variables. All of them are significant at the .1 level ($\alpha = 0.1$).

Table 4: Estimates of males' choices: logistic regression

	Estimate	Standard Error	z-value	p-value
Intercept	-10.2425	1.05467	-9.712	< 2e-16 ***
Intelligence	0.96234	0.23229	4.143	3.43e-05 ***
Attractiveness	1.35146	0.20749	6.513	7.35e-11 ***
Intelligence^2	-0.08912	0.01604	-5.555	2.77e-08 ***
Attractiveness^2	-0.07103	0.01634	-4.347	1.38e-05 ***
(Intelligence * Attractiveness)	0.04988	0.02151	2.319	0.0204 *

Significance codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

The intercept has even lower value than the one from females' choices model. This may suggest that males are even more picky than women. Big negative value for intercept means that for women who are perceived as neither physically attractive nor intelligent chances for being chosen are very low. However, from a scatter plot one may notice that hardly any woman was evaluated with perceived intelligence lower than 5 or physical attractiveness lower than 3. In fact, 95% of observations are equal to or higher than those values.

Signs on both independent variables are positive. However, both quadratic terms are negative, thus maxima exist. Yet, due to the presence of interaction terms, instead of using formula for parabola's optimum, a partial derivative has to be computed. Starting from the intelligence:

$$(7)\frac{\partial y^*}{\partial intelligence} = 2\beta_{intelligence^2} intelligence + \beta_{intelligence*attractiveness} attractiveness + \beta_{intelligence} = 0$$

$$(8) attractiveness^* = \frac{-2\beta_{intelligence^2}}{\beta_{intelligence*attractiveness}} intelligence - \frac{\beta_{intelligence}}{\beta_{intelligence*attractiveness}}$$

$$(9) \qquad attractiveness^* = 3.57 intelligence - 19.29$$

Points that satisfy the equation 9 are the ones which estimate an optimal level of women's perceived intelligence for a given level of women's perceived physical attractiveness. The line which is determined by the equation 9 is shown in Figure 5. It goes through and follows all the maxima traceable from the contour lines. Although a similar line exists for a given level of women's perceived intelligence, it does not cross the 0-10 region. Thus it is uninterpretable. One may notice from the Figure 5 that in the presented region the partial derivative of *attractiveness* is always positive.

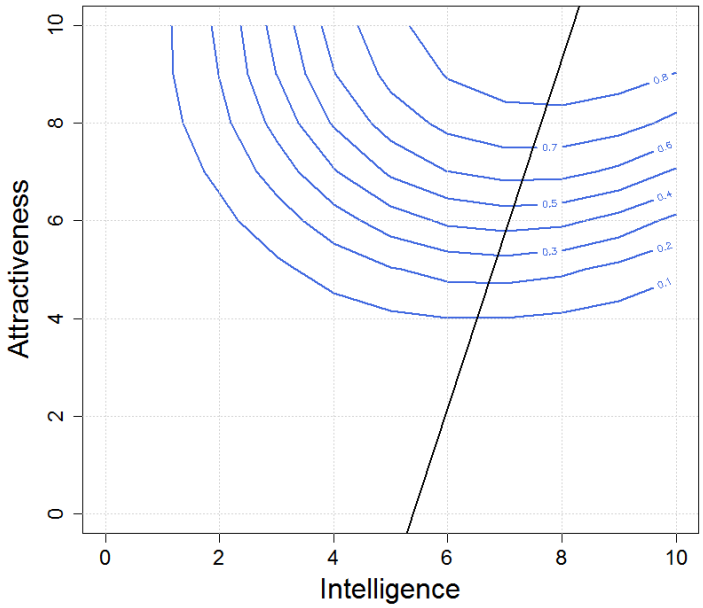

Figure 5. Contour lines for probability of men's positive decision

One may wonder whether the phenomenon of males' pickiness is present due to the males' jealousness. Fisman *et al*. (2006) find that on average men do not value women's intelligence or ambition when it exceeds their own; moreover, a man is less likely to select a woman whom he perceives to be more ambitious than he is. Yet this is not the case in our study (as it is shown in the Table 5). Values are significant at the .001 level ($\alpha = 0.001$).

Table 5: Do men want to date smarter women?

		Does he perceive her to be less intelligent than he believe he is?	
		No	Yes
Decision	No	313	620
	Yes	471	594

We may then say that the existence of women's optimal intelligence levels in men's perception, given women's perceived physical attractiveness, does not come from the fact that men are envy about women's intelligence. On the contrary, women who were evaluated as more intelligent than men were chosen more often.

V. CONCLUSIONS

In this article we have focused on the gender differences in preferences for mate characteristics such as (perceived) physical attractiveness and intelligence. On the basis of an unique experimental data we have observed that women give greater weight to perceived physical attractiveness than intelligence in their mating decisions. Probability of women's positive decision rises with men's perceived physical attractiveness (in this case we observe increasing marginal effects) and intelligence (with diminishing marginal effects). Marginal rate of substitution of men's perceived physical attractiveness for intelligence is the highest for low levels of men's perceived intelligence and the lowest for high values of men's perceived intelligence. For men perceived as highly intelligent even a small increment in physical attractiveness results in fast rising probability of being chosen by women. For men who are perceived as neither physically attractive nor intelligent, chances for being chosen are minuscule.

Men also give greater weight to perceived physical attractiveness than intelligence in their mating choices. Probability of men's positive decision rises with women's perceived physical attractiveness (in this case we observe however diminishing marginal effects). The relationship between probability of men's positive decision and women's perceived

intelligence is non-monotonic. The optimal level of women's intelligence in men's perception exists. This optimal value rises with women's perceived physical attractiveness. This suggests that men, unlike women, may perceive as optimal some certain combinations of partner's perceived physical attractiveness and intelligence.

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