A Model of Human Mate Choice With Courtship that Predicts Population Patterns

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Abstract. We present a new model of human mate choice incorporating non-negligible courtship time. The courtship period is used by individuals to strategically swap to better partners when they become available. Our model relies on realistic assumptions about human psychological constraints and the specifics of the human social environment to make predictions about population level patterns that are supported by empirical data from the social sciences.

1 Introduction

Human mate choice, when you're immersed in it, seems like a long and complicated affair. Vast amounts of time and energy are spent thinking about who to attract, how to attract them, and how to keep them attracted (or how to terminate the attraction and escape) once a relationship is underway. Yet attempts to understand the process of mate choice through formal models typically throw away most of this complexity, reducing everything to a simple sequence of decisions about whom to mate with. How realistic can such models be if the heart of the romantic process—courtship—has been removed?

Typical assumptions of models of mutual mate choice are that individuals search and encounter mates sequentially (usually without the ability to go back to, or "recall," earlier mates), and that individuals make their mating choices as a single, *irreversible* decision whether to mate an individual or not [4, 8, 6, 5, 3]. This conflicts with the fact that humans use extensive courtship periods to establish long-term sexual/romantic relationships, and that this allows individuals to engage in relationships in tentative ways—possibly switching to better alternatives if they become available in the future [2]. Many of these models also make the unrealistic assumption that complete and accurate information is available to all individuals [1, 6, 5, 3]. This includes information about the distribution of qualities of potential partners, about the searching individual's own quality,

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and sometimes even about the preferences of other individuals [1]. Given that such information is often not available in the real world, it is not surprising that most of these models are of limited empirical validity.

In this paper, we present an individual-based model of human mate choice based on an evolutionary functional analysis. Our model relies on more realistic assumptions about human psychological constraints and the specifics of the human social environment. In particular, we assume that individuals build networks of acquaintances gradually instead of having complete information about all potential alternative partners instantaneously, and we consider the strategic impact of long courtship and investment on mate switching decisions. We argue that individuals can make simple, efficient, and robust mate decisions by exploiting the specifics of the adaptive problem domain rather than attempting to perform complex optimizations, thus constituting an example of *ecological rationality* [7].

2 A Model Built Around Courtship

To model the mate search process, we begin with a population of constant size $2 * P$ with a fixed sex ratio of 50% (so P is the number of males or females). Individuals of both sexes have a one dimensional quality q, randomly generated from a normal distribution with mean μ and variance σ^2 ($0 < Q_{min} \leq q \leq Q_{max}$). When two individuals mate, they are removed from the population and replaced by two new individuals of random quality (one of each sex). Time is modeled as a sequence of discrete steps. Pairs of males and females meet at a certain stochastic rate: in each time step each individual has a probability Y of meeting a new individual of the opposite sex. Each individual maintains a list of the potential mates already met (the *alternatives list*).

Within the alternatives list, one member can have the "special status" of being the individual's current *date*. This happens when both individuals previously agreed to date and have not changed partners in the mean time (see below). It is also possible for an individual not to be dating anybody (i.e., in the beginning of its "life", or when it gets "dumped"). The length of time that two individuals are dating is regarded as the courtship or dating time c_t. If a pair of individuals remain dating for a period of K time steps (i.e., when $c_t > K$), they are deemed to mate and are removed from the population (and replaced). Every individual has a maximum lifetime of $L(> K)$ time steps. If individuals are unable to mate during that period they are removed from the population (they "die"). To replace the dead individual, a new one is created with the same sex.

In each time step, individuals decide whether to continue to date the same partner or to try to date another individual that they know, that is, someone from their list of alternatives. To make this decision, several pieces of information are used: the quality of each alternative q_a (all alternatives are considered independently), the quality of the current date q_d, the current courtship time c_t, the age of the individual t, the age of each alternative t_a, and the age of the date t_d. If an individual is not dating someone else, q_d and c_t are set to 0. A binary output function S with these input variables is used to make courtship decisions, returning 1 iff a dating proposal is to be made.

We assign mated individuals a fitness value $f = q_d^{Q_S} * (L - t)$, where q_d is the quality of the individual's partner, Q_S is a scaling factor that relates quality values to effective mating potential, and t is the individual's age at mating. Thus we reward a preference for high quality, and introduce time pressure to motivate individuals to mate early (in addition to the limited life-time). Given this fitness function, agents can use the following reasonable (although not optimal) strategic decision rule for deciding whether to try to switch from the current date of quality q_d to another alternative of quality q_a (with this switch only happening if the alternative individual decides to switch from their current date as well):

$$\mathbf{S}(q_a, q_d, c_t, t, t_a, t_d) = \begin{cases} q_d = 0 & \longrightarrow 1 \\ t + K > L & \longrightarrow 0 \\ t_a + K > L & \longrightarrow 0 \\ q_a^{Q_S} * [L - (t + K)] > & \\ q_d^{Q_S} * [L - (t + K - c_t)] & \longrightarrow 1 \\ \text{otherwise} & \longrightarrow 0 \end{cases} \quad (1)$$

2.1 Simulation results

We evaluated the performance of this model by seeing if it could produce realistic mating patterns matching those observed in human populations. Specifically, we looked for high rates of assortative mating (i.e., roughly equally attractive individuals mating with each other, as reflected by within-pair attractiveness correlations of around 0.6 in many human studies [4]) achieved with relatively little search. We set population size $2 * P = 100$, lifetime $L = 200$, and scaling factor $Q_S = 0.75$. The (quasi) normal quality distribution was set with $\mu = 10$, $\sigma^2 = 4$, $Q_{min} = 0.001$, and $Q_{max} = 20$. Each simulation run consisted of $10 * L = 2000$ steps. We varied two parameters likely to have a wide range of values across different real settings: the rate-of-meeting Y and courtship time K. Figure 1a depicts the linear correlation between the qualities of individuals in mated pairs as a function of Y and K, while Fig. 1b shows the mean number of alternatives met before settling with the last date (both averaged across 5 runs). The reasonably high correlation coefficients observed (mostly between .5 and .6) suggest that individuals are making good use of their mating potential even though they have no direct knowledge of their own mate value or the distribution of qualities in the population. This is also achieved by most individuals with rather little search: for example, with $K = 15$ and $Y = .2$, we obtained a correlation of qualities of .53, and observed that 87% of the individuals in the population were able to mate, even though they only met a small number of alternatives (6.9 before settling with the last date and 10.0 before mating), and only entered into 2.0 dates on average (including the very last one). This realistic combination of statistics was never obtained in previous models of human mate choice [4, 8].

3 Conclusions

In this paper, we have briefly demonstrated the use of an individual-based artificial life modeling approach to gain insights into the processes underlying human sexual/romantic relationships. In particular, by building extended courtship processes into our model of the mating game, we have accounted for existing data in ways unattained by earlier models. This work is part of a larger project to build realistic models of human mating systems that explain individual-level behavior and predict population-level patterns. We hope that our work will motivate researchers in the fields of artificial life and evolutionary psychology to begin courting each other to build explicit computational models of the mechanisms guiding human social behavior.

References

[1] C. Bergstrom and L. Real. Towards a theory of mutual mate choice: Lessons from two-sided matching. *Evolutionary Ecology Research*, 2(4):493–508, 2000.

[2] D. Buss. *The Evolution of Desire*. Basic Books, 1994.

[3] R. Johnstone. The tactics of mutual mate choice and competitive search. *Behavioral Ecology and Sociobiology*, 40(1):51–59, 1997.

[4] S. M. Kalick and T. E. Hamilton. The matching hypothesis reexamined. *Journal of Personality and Social Psychology*, 51(4):673–682, 1986.

[5] J. McNamara and E. Collins. The job search problem as an employer candidate game. *Journal of Applied Probability*, 27(4):815–827, 1990.

[6] G. A. Parker. Mate quality and mating decisions. In P. Bateson, editor, *Mate Choice*, pages 141–166. Cambridge University Press, 1983.

[7] P. M. Todd, L. Fiddick, and S. Krauss. Ecological rationality and its contents. *Thinking and Reasoning*, 6(4):375–384, 2000.

[8] P. M. Todd and G. F. Miller. From pride and prejudice to persuasion: Satisficing in mate search. In *Simple Heuristics that Make Us Smart*, pages 287–308. Oxford University Press, 1999.

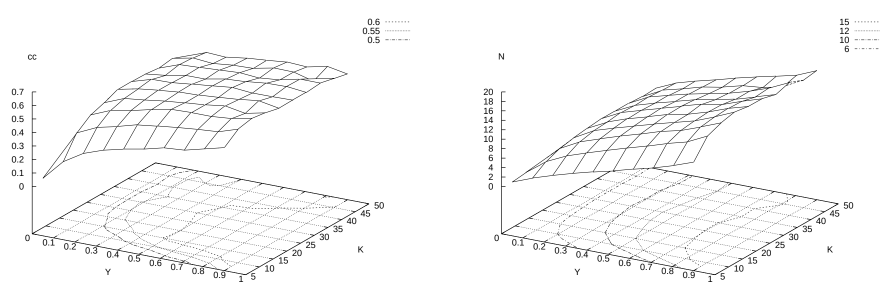

Fig. 1. a) Mean correlation of qualities in mated pairs. **b)** Mean number of alternatives seen before settling with the last date.