A Study on Evolutionary Dynamics of Mating: Appearance and Distance

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Abstract

Mating is an essential behavior for animals including humans who rely on sexual reproduction. Here we present the design and some results of our multi-agent-based simulation targeting an evolutionary process of appearance, preference, and mating strategies, as a model of human life. A person's evaluation for neighbors to find the best partner does not always depend on the matching degree between the subject's appearance and the observer's preference. We introduce two kinds of interpersonal attractiveness, which stand for "distance" and "appearance" in our simulation. Our simulation result showed that, in mating, we should not stick to how close to the candidates of our partner and how good appearance they have.

Introduction

There has been much discussion in recent years about evolutionary psychology, such as human's sex differences and mating strategies. Darwin's work has had a huge influence on various fields, specifically in animal's instinct characters. Individual differences in psychology are also traits inherited from their ancestors through the evolutionary process (Darwin, 1871). Additionally, attractiveness of appearance is an important evaluation criteria in human sexual selection (Walster and Berscheid, 1969). However, there is no clear explanations how the human's appearance is involved with interpersonal attraction, and how the appearance is important compared to other factors.

We tried to make an artificial society using multi-agent system to investigate population dynamics on mating and reproduction, which is often used to simulate a complex evolutionary ecological system. A person's evaluation for neighbors to find the best candidate of partner does not always depend only on the matching degree between the subject's appearance and the observer's preference, but an acceptable neighbor is often better than the best look far away. We make a comparison between visual attractiveness and distance attractiveness, and considered which attractiveness we should take priority.

Agent Model

The system we designed here includes a collection of hundreds of individual agents that moves in the world of squire shape interacting each other. Each agent has its own life span, and has a chance of reproduction. The following subsections describe the specification of individual agent.

Agent's parameter

In this simulation, agent's appearance and preference are specified by RGB color. Agents have parameters of

- gender
- age
- appearance color (f_R, f_G, f_B)
- preference color (p_R, p_G, p_B).

Appearance and preference inherit the descendants.

Mating

Every agent of the age between 15 and 50 years tries to make a proposal to the best candidate as a partner every step if it has no partner. To choose the best, each agent calculates two kinds of attractiveness for each candidate of the opposite gender positioned within a given visible range S. First one is l_{fm} standing for agent's appearance, and second attractiveness standing for agent's appearancel_{fm}. Second one is d_{fm} standing for intersexual distance, defined as

$$l_{fm} = 1 - (|f_R - p_R| + |f_G - p_G| + |f_B - p_B|) \quad (1)$$

$$d_{fm} = 1 - \frac{D_{fm}}{S}, \quad (2)$$

where D_{fm} is the distance to the candidate. The comprehensive interpersonal attractiveness L_{fm} weighted summation between these two values by using a weighting coefficient "appearance bias" α. If the proposal is accepted, the proposer and the acceptor make a child together. The child agent's appearance and preference are inherited from its parents. Each component of RGB color data is randomly inherited from mother or father with crossover and mutation in a given probability.

Move

Each agent is subjected to the force $\overrightarrow{F_f}$ from neighbors depending on matching degree. $\overrightarrow{F_f}$ is defined as

$$\overrightarrow{F_f} = \sum_m (L_{fm} - C_{fm}) \cdot \frac{\overrightarrow{a_f a_m}}{|\overrightarrow{a_f a_m}|}, \quad (3)$$

where C_{fm} is a variable that works to prevent agents from overlapping each other.

Simulation

We conducted ten simulation processes with different random number sequences for each value of appearance bias α from 0 to 1 stepping by 0.1, that is 1,100 processes in total. The other parameter settings are:

1. The number of agents is at most 1000.
2. Agent's life is fixed at 1000 steps (10 steps = 1 year).
3. There are two distinct genders, which are chosen randomly at birth with equal probability.
4. Every female can give a birth to one child per step.
5. Agents accept proposals from others if their evaluation value of proposer's comprehensive attractiveness is over 0.7.

Figure 1 shows how the simulation goes. Round shapes stand for females, and square shapes stand for males. Small ones are 0 to 20 years old. The inside color of each agent is its preference, and the outside is its appearance.

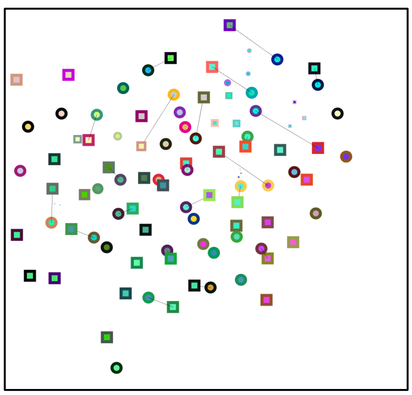

Figure 1: Simulating window

Figure 2 shows the number of married agents ratio to population which is averaged in each value of α. When α is 0.6, the ratio of married agents reaches the maximum except the case α is 1.0. In the case α is 1.0, the acceptance ratio becomes higher because the average of population is smaller than other cases.

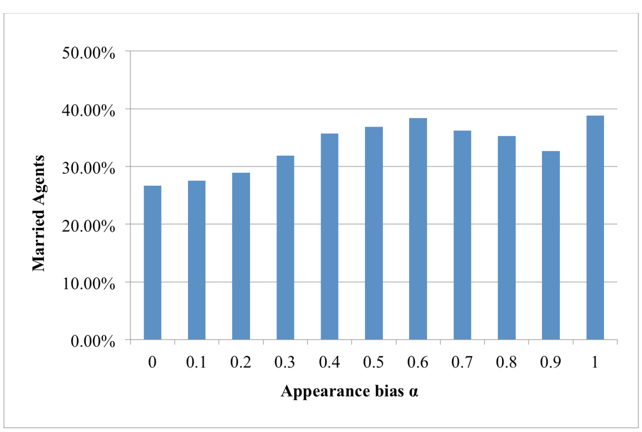

Figure 2: The averaged number of married agents ratio to population in each value of α.

Conclusion

We confirmed evolutional dynamics of agent's appearance and preference in different strategies of mating. The simulation results indicate that sticking to the degree of matching in appearance or distance decreases the possibility of mating. Under the environment that every agent chooses their partner depending on physical distance ($\alpha = 0$), agents cannot easily get their partner, and as the value of appearance bias increases, the number of married agents ratio to population increased as well. However, if the value gets over 0.6 except the case it is 1.0, the number of married agents ratio begins to decline. This is because, we assume that, as observers evaluate matching degree depending on subject's appearance, accepter's preference does not match proposer's appearance often. This phenomenon looks close to reality. We predicted before this experiments that, as the value of α increases, the number of married agents ratio also decreases. It is because the degree of distance attractiveness is often larger than appearance attractiveness. Contrary to our expectations, however, the number of married agents ratio increases as the α increases in the cases α is 0 to 0.6. The reasons we discussed are as follows.

- Many couples divorce by the approach of a third agent.
- Many proposes are refused because of triangular relationships.

These results suggest that in reality, we should not stick to how close to the candidates of our partner and how good appearance they have. To simplify the simulation, this paper has only defined two criteria so that agents can select the best candidate of partner. In reality, of course, there are many more than two factors, for example, degree of similarity to observer's family, observer's past experiences. Actually, in this paper, female agents can give a birth to over 10 children. That is an example of unreal setting, so we need to restrict the number of children that an female agent can give a birth in its life. Our future task is to review the simulation settings and make it close to real human society model.

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