Rapid Biography In A Society Of Evolutionary Lovers

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Premise

We developed an evolutionary-ecological simulator for a scientific research in order to seek the origin of beauty from a viewpoint of evolutionary psychology, which simulates a large number of human lives for longer than some tens of centuries for some thousands of individuals as the population size. It generates a lot of biographies rapidly, and it becomes effective for the viewers when each individual is given its own name as same as humans, and summary of each life is read loud by the computer. We extended the system so that it picks up a number of sample individuals from the population, displays their life events, and reads some of those sentences and summaries as many as possible utilizing a speech synthesis by the computer, under our intention to turn it to a piece for automatic generative art. The ratio of homosexual couples is 50% in the early phase because there is no clear correspondence between appearance and gender. However, the appearances and the preferences are gradually getting separated between male and female thanks to the advantage of heterosexual mating for reproduction, supported by the genetic encoding as sex-influenced hereditary traits. We are hoping this piece provides an occasion to audience to rethink their lives typically on the human relation and gender diversity among lovers and families.

1. Introduction

Love and sex are popular topics of humans' interests widely common in any period in the history and at any place on the earth. These words have been employed for the subjects of various forms of artistic activities such as poetry, novel, play, movie, painting, sculpture, music, and so on. Love itself is made up of relation between persons attracted each other. As you can see from the fact that the word "beauty" is typically applied to women, it can be assumed that attractiveness is one of the origins of aesthetics from a viewpoint of evolutionary psychology [1, 2].

For a scientific research to seek the origin of beauty, we developed an agent-based simulator of society of evolutionary lovers. A population of thousands of agents lives in a two-dimensional virtual world where they are roaming around. Each agent has its own physical appearance and psychological preference as the sex-influenced hereditary traits. An agent approaches another one whose appearance matches its

preference. If two agents are attracted each other and stay together in enough time, the female agent may bear a child if the partner is a male. Since the correspondence between gender and appearance is not clearly assigned a priori, half of the couples are homosexual in the initial population. However, the appearance and preference are evolved toward sexual dimorphism, separation of the traits between male and female, thanks to the advantage of heterosexual mating for successful reproduction. To make mating easier, we allow an agent to propose its lover to receive the response of acceptance or refusal. The other traits are also introduced such as activeness, fickleness, tolerance, compromise, and so on.

The simulator is useful not only for a scientific research but also a form of generative art that presents huge number of biographies of agents rapidly. Each biography is a series of life events described by simple sentences with individual names randomly assigned from the list of English first and family names. Though it has no rhetoric for impressive representation, it sounds interesting that inspires a type of sympathy to the life of agent.

In the installation, the two-dimensional view of the virtual world and the texts of life events are dynamically displayed on the screen, and some of the texts are read loud using speech synthesis by the computer.

In the following sections, some details of visualization and speech synthesis are described after a design overview of the simulator.

2. Overview of the Simulator

As similarly as the pioneering works of evolutionary ecological simulation in the field of artificial life, such as PolyWorld [3], the environment is a square shape of two-dimensional Euclidean space with continuous Cartesian coordinates surrounded by four walls. Some hundreds of still objects are randomly placed, and some thousands of agents are roaming around inside of this virtual world. Each agent has its own state of position and age. It gets older by a constant portion of month for each simulation step. The maximum life span is 120 years and it is divided into three periods of child, adult, and elderly ages, where the boundaries are 16 and 50 years old for example. Each agent may be killed in a probability in each step that is predefined following the population statistics issued by Japanese government [4]. The characteristics of individual agent are specified by its own genetic codes inherited from its parents which includes appearance, preference, and other parameters for action selection. The following sections describe overviews of movement, mating between agents, genetics, and control. The detail specifications including the mathematical model and embedded tools for statistical analysis will be available in another literature [5].

2.1 Movement

Each agent has a vector of the velocity to be modified in each step by adding a force vector synthesized from factors of both attraction and repulsion. It is discounted by a friction at the same time. It is always affected by repulsion forces from walls, objects, and the other agents in order to avoid the collision, but attraction forces are different

depending on the age. When the agent is a child, it intends to follow its mother, but it starts approaching another attractive agent when it became adult. It just intends to keep staying together with its mutual lover if exists, after it became elderly. The position of the agent is revised in each step using a simple Euler method by adding the velocity vector to the current value of the position. Because the attraction forces are inversely proportional to the distance to the target agent, mother or lover, and the repulsion forces are inversely proportional to the square of the distance to the obstacle, an agent usually moves towards its target agent but soon escapes from a nearby obstacle when the distance becomes short.

The degree of attractiveness is measured basically as a similarity between the agent's preference and the target's appearance, but the physical distance is also an important factor to select which agent is the best. It is often better to choose an acceptable one nearby than the best beauty in a distance. An adult agent always tries to find the best target in the observable area, within a constant distance from the agent. Measuring the attractiveness as a weighted geometric mean between the matching degree and the physical closeness. The weight is a hereditary trait encoded on the gene as described in the section 2.3.

2.2 Mating and Reproduction

If two agents mutually select each other as the best target to love, or if the target agent accepted a proposal, the relation between two agents is established. If the relation continues for enough time and the genders of the agents are different, the female agent may become pregnant under the predefined probability depending on the age. The probability is high until the middle of adult period, but it decreases toward zero at the boundary of elderly age. The highest value is depending on the population density on local area around the agent to avoid the population explosion and extinction. A baby agent is born after ten months passed at the adjacent location with the mother.

The attractiveness is not affected by gender, but to avoid incest, an agent ignores its parents, brothers, and sisters as a candidate to love. An agent sometimes gets to love an object since the still objects placed in the world are also potential candidates by the appearance of their color.

The probability to propose the best one depends on the activeness, and the probability to accept the proposal is proportional to the tolerance. If the receiver of the proposal already has a mutual lover, it might accept it if the fickleness is high. It also depends on the fickleness whether the agent proposes an attractive target even when it has a mutual lover. If the proposal was refused and the proposer is graceful enough, it memorize the target agent to prevent from proposing it again until it is forgotten. These parameters of characteristics are encoded on the genes as described in the next subsection.

2.3 Genetics

Each individual agent has its own genome including five elements on appearance and preference for each and eight elements affecting the behavior. Each element is represented in a real number within a range from 0 to 1. Three out of five elements

for appearance and preference are the color components of red, green and blue. The others are plumpness and aging in the look. For a female agent, the plumpness is temporary changed when it is pregnant. If the value of aging is high, the agent looks older than it is. If the value is low, it looks younger. The aging value for preference indicates how old target the agent prefers in observation. The elements on behavior include love-hate threshold, fickleness, duration necessary to deepen the relation, distance bias for compromise, activeness of proposal, tolerance to accept proposal, gracefulness to give up retrial of proposing, and maximum speed of movement.

A genome consists of double of these genes as they are sex-influenced, that is, one side manifests when it is male, and the other side manifests when it is female. When a new genome for a child is organized, the element for each locus is a mutant of the gene randomly selected from the same locus in the genome of either mother or father. The mutation is made by adding or subtracting a small random number to or from the original value.

2.4 Control

The simulation software is equipped not only with graphical user interface for manual control by the user, but also with a software interface that enables another application software to send a command to the simulator and to receive data as the response if necessary. This functionality is useful to conduct a large number of trials automatically with a variety of parameter settings and different random number sequences. For a scientific research, it is important to conduct such simulation in an enough number of times to induce statistically feasible consequences. At the same time, it is also useful for a purpose of installation as an automatic art. We developed a control application to realize the iteration of initialization of the parameter settings, periodical changes of display, and restart after tens of minutes passed, as described in later section 5. It also accepts an interruption by the user for emergency stop. As the application software runs on macOS, the communication between the applications is implemented utilizing Apple events. Therefore, it is relatively easy to develop a controlling software in the scripting language, AppleScript.

3. Visualization

Visualization is important in general for any types of computer simulation to show what happens in the process. As an automatic art using the computer, this piece shows who is doing what in the virtual world especially concerning the love and mating. Figure 1 shows a typical example of screen image where the left side is the two-dimensional distribution and movement of objects and agents, the trend graph and density distribution of statistical indexes are displayed at the right bottom, and the sentences describing the life events of six sampled agents are printed at the middle right part of the screen. The sentences are shown not only as scrolling texts at the right side, but also displayed in the balloons attached to the agents in the distribution part at the left side. The background color of the balloon is same with the title bar of scrolling area. The top part of the right side is also a scrolling text of summaries of individual lives that is added when a monitored agent passed away. The arrangement is designed suitable for an ordinal full HD screen of 16 by 9 as the aspect ratio.

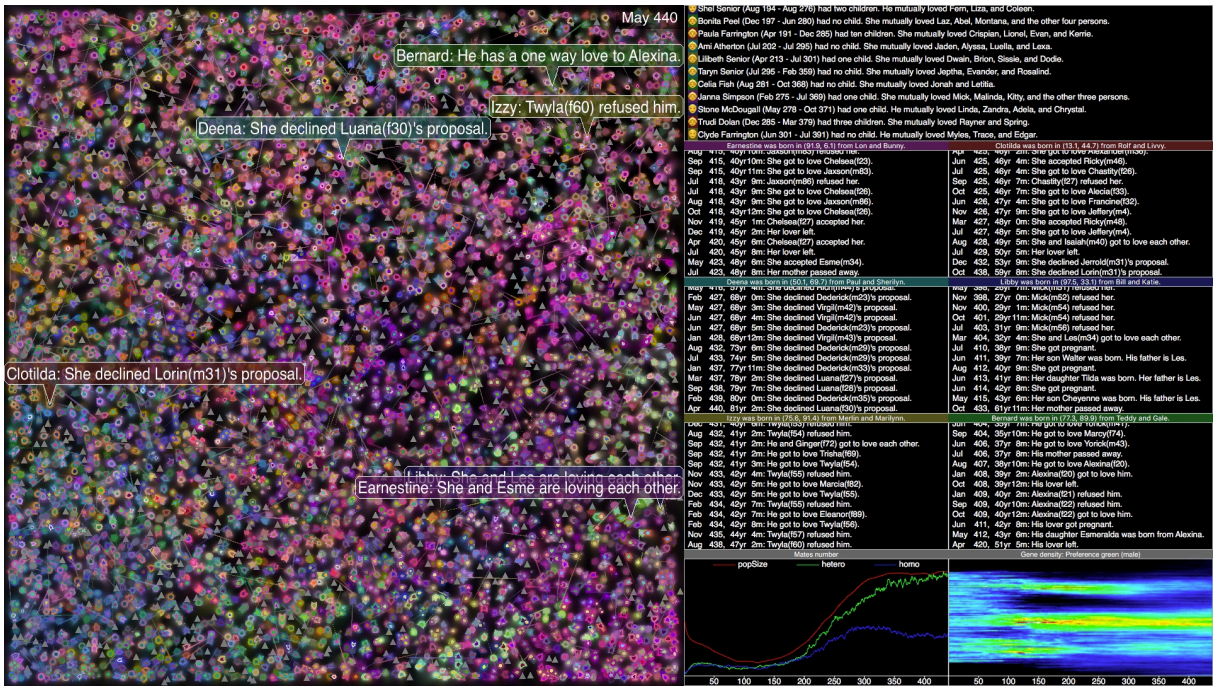

Figure 1. *A typical example of a view of the screen.*

The following part of this section describes the detail of each part of the screen, and the design of extra monitor that allows the visitors to browse the individual biography using a tablet terminal connected via Wi-Fi.

3.1 Agents

Each individual agent is rendered on the screen as a shape with two colors, the outer color is the appearance and the inner color is the preference, as shown in Figure 2. A male agent is drawn in a shape of arrow head, and the female agent is in a round shape. The aspect ratio is determined from the plumpness. It is drawn in a small size when it is a child, and gradually grows up until it reaches the age of adult. The color becomes gradually darker after it enters the elderly age. It rotates following the moving direction if it has no lover, but are facing the lover if exists regardless of the movement direction.

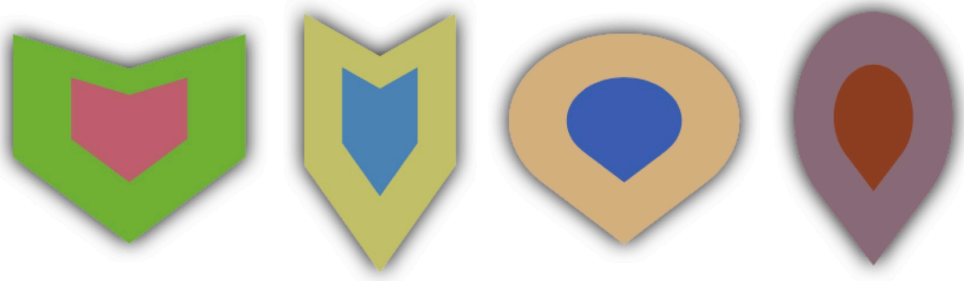

Figure 2. *Examples of agent figures in visualization. The two shapes in left side are male agents, and the two in right side are female agents.*

If an agent has a lover, it expands the right arm toward the target. The edge of the arm is shaped sharply as it points the target when it is a one-way love. If they are loving each other, the edge becomes round and it looks as if they are hugging. The color of an arm is a gradation of the appearance color at the shoulder and the preference color at the fingers with half transparency. Figure 3 shows another example of a screen shot where the view of the distribution is zoomed.

Figure 3. *A sample screen shot with zoomed display.*

3.2 Monitoring the Life Events

The life events to be described in the monitor are concerning birth, love, being loved, proposing, being proposed, acceptance, refusal, separation, birth of its child, and death. If the name is Tom, the sentence of his birth is “Tom was born from John and Mary,” for example. The events of an individual is shown in a separated scrolling text area from the others as shown in Figure 1 and 3. The sentence of its birth is drawn in the title bar of the area with unique background color in order to make it easy for a viewer to identify the agent displayed in the left side. A summary sentence is added when a monitored individual passed away in the area of top right part of the screen is “Tommy Smith (Jan 1023 - Sep 1102) had two children. He mutually loved Mary, Jane, and Kathy,” for example.

The name for each agent is randomly assigned from the list of English boy and girl names gathered from the internet [6]. The family name for the summary is also chosen from a similar list [7], but it is randomly assigned only for the initial population, and it is inherited to the children from the mother or the father. The mother’s family name is always inherited if the father has left or gone when the child is born. Because the number of girl names we gathered is larger than boys’, the names common in both boys and girls, such as Alex and Chris, were omitted from the list of girl names. To prevent from occasional overlaps between first and last names, the

overlapped names, such as Bennett and Lee, were also omitted from the first names lists. In the current implementation, the system contains 921 boy names, 1,377 girl names, and 1,199 family names.

3.3 Browsing the Individual Biographies

The biographies generated through out the simulation process provide interesting narratives for the visitors. To allow them to appreciate these life stories, we added a functionality to save the life events in a separated file of HTML format for each individual. The list including the links to individual profiles is also organized and revised when a monitored individual has gone. By storing these files in a directory for the contents of web server running on the same machine that the simulator is running, the visitors can browse the biographies by operating the separated tablet terminals through Wi-Fi connection. Figure 4 is a sample screen image on the tablet terminal. When the visitor touch a name in the list shown in the left side, its biography is displayed at the right side with the background color same with the color shown in the simulator. The image of agent's shape is also shown in the background. A emoji face is attached to each item in the list to make it easy for visitors to recognize the death age and gender. Since this is a web application viewable from modern web browsers, it is also possible to enjoy it using a user's smart phone and a web browser on user's PC.

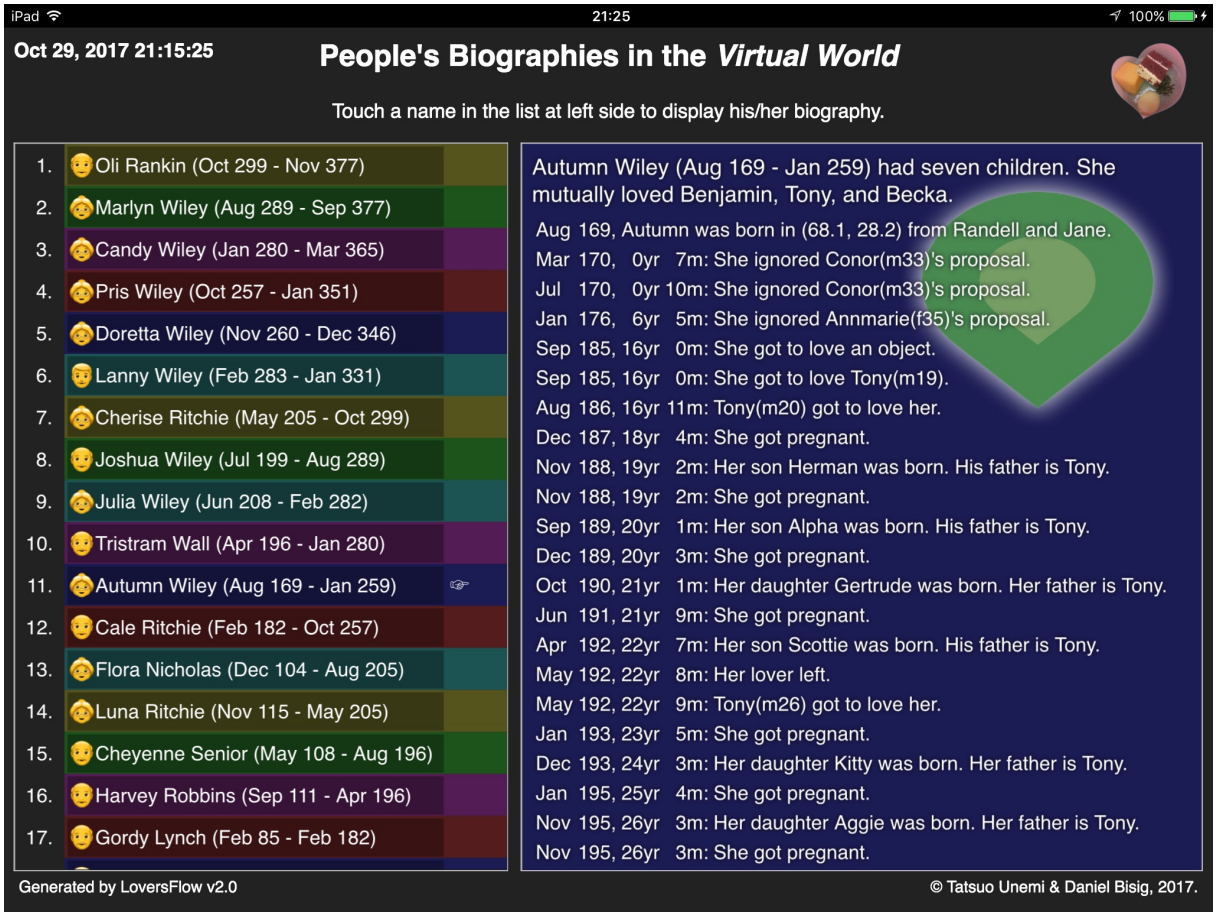

Figure 4. *A sample screen image of the biography browser on a tablet terminal.*

4. Sound Effects and Speech

The system synthesizes sound effects and speeches similarly to the visuals. Three types of sounds start when the corresponding events occur in the displayed part of the virtual world. The events include birth, proposal, and death. These events correspond to the sounds of a baby cry, a human voice telling “I love you,” and a funeral bell, respectively. The adult and elderly agents probabilistically express their emotion by happy laughters when they have mutual lovers, and by sad sighs when they are alone. The human voices are selected depending on the gender. We employed license-free sound samples available from the internet. The sounds are modulated in various playback speeds, and are played back mixed all together. It sounds a noise when the whole of the world is displayed, but it becomes clearly recognizable when the display is zoomed. The balance between two audio channels, left and right, is also helpful to identify who are making the sounds.

The system also produces sounds of speech that reads the sentences loud. The displayed events are generated too fast to read them all, some of them are chosen to be spoken by referring the importance. Birth and death are recognized more important than proposals in the current settings. Behind the spoken events happened on the six sampled agents, approximately sixty stories of individual lives are produced for each second, since it has an ability to simulate one year of virtual world in a second of throughput time for some thousands of agents under the settings where three simulation steps are interpreted as one month.

The summary sentences are also read loud in another audio stream in louder voice. It is usually possible to speak them in time, and sometimes it needs wait for the next sentence. During the summary is being read, the speech volume of life events is suppressed in half.

The speech synthesis is realized using a programming framework embedded in the operating system on the computer. In macOS 10.12, a number of high quality voices for a variety of English accents in both male and female are available for speech synthesis. The voice is changed for each 30 seconds in turn. To give a time for the voice of events to be recognizable, a 5 seconds pause is inserted before a next voice for summaries begins. The pitch of the voice is modulated higher when it reads happy events, such as birth of child and a start of loving each other, and modulated lower when a sad event happened, such as refusal of proposal and death of agent.

5. Exhibition Scenario

The simulation process itself has no limit of continuation for arbitrary number of steps. However, because it is interesting to watch the dynamical transition in the early phase from a random population to a relatively stable distribution, it is better to exhibit a reputation of limited length of simulations each of which uses different random number sequence. As Figure 5 illustrates, the population size rapidly decreases just after beginning, since most of individuals with random genome has no ability of successful reproduction. Some are trapped by an object as a target of their love. Some are hating all of the other agents even if they are proposed. But usually, some of the others find their partner and produce their children successfully. It is not

always because the population might not include any agents that would succeed. In such a case of extinction, the simulation process stops and restarts again with a newly initialized population. We limited a single simulation process to 72,000 steps. It is possible to run faster but we allocated 30 steps per second in order to make the animation smooth. It means that a single simulation takes 72,000 / 30 / 60 = 40 minutes. This duration corresponds to 2,000 years in the virtual world. The average life span of an individual agent is approximately 85 years and the number of sampled agents is six, therefore the total number of sampled biographies is about 2,000 / 85 × 6 ≒ 141, listed in the browser described in section 3.3 at each end of a single simulation process.

To show the spacial distribution and movement of agents both globally and locally, the display iteratively changes the visible area from the whole to a local part. The cycle time is 40 seconds or so. When it zooms up, the area is selected so that a sampled agent is placed at the center of the frame if possible. If the focused agent moved toward the edge by which the frame edge violates the border of the world, the frame stops shifting from the boundary. When the focused agent died, the youngest sampled agent replaces it as a subject to be traced. The scale of zooming magnification is determined so that the sound effects generated by the visible agents are clearly recognizable for viewers, referring to the local agents density.

All of these transition including zooming in and out is controlled by a script code as described in section 2.4.

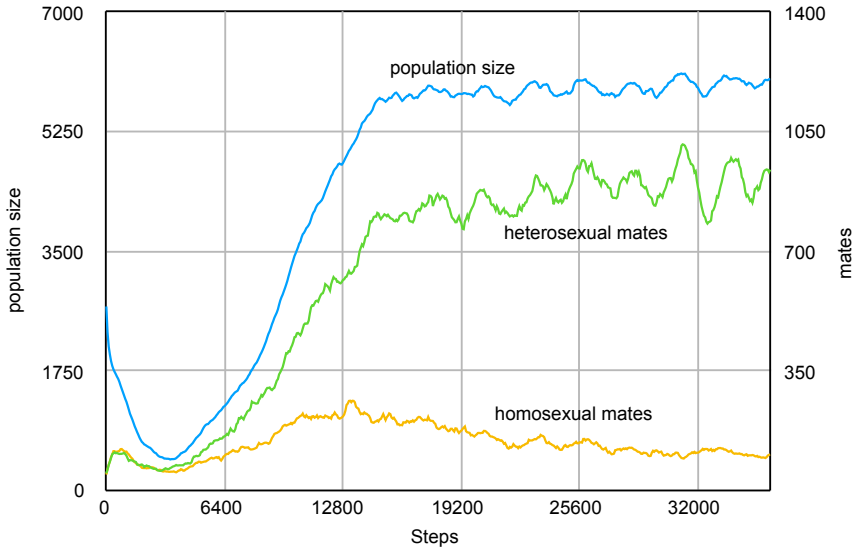

Figure 5. *A sample of time evolution in population size and the number of mates.*

6. Concluding Remarks

We developed an individual-based evolutionary simulator that imitates a long term human evolution focusing on a mating strategy by introducing a genetic mechanism of sex-influenced traits concerning appearance and preference. And we extended it so that it produces a huge number of individual biographies rapidly. By the graphical visualization of agents' distribution, movement, and relations; and by letting the

system read the sampled life events loudly using a speech synthesis; it became possible to provide the viewer an occasion to enjoy a lot of unique narratives. It sounds sometimes hilarious and sometimes impressive. Human life is a series of happiness and sadness. You may be moved by such stories even though the computer generates them automatically.

Of course, there are many aspects to be added to the current model in order to fill the gap toward reality. As several researches related to the mating strategy of humans have been conducted in the field of anthropology, cultural studies, human evolution, and psychology, such as [8], the other interesting features to be considered include resource gathering, possession, protection, investment, and fighting to solve a conflict between individuals. Social aspects are also important for humans, such as cooperation, group conflict, ethics, social norms, and so on. From a viewpoint of gender studies, it must be interesting to add some features that lead asymmetrical relation between male and female. It will be possible to produce more interesting biographies when some of these features are implemented in the simulator.

We are hoping this research and development will provide a path toward our scientific understanding on aesthetics, gender diversity, and mutual understanding among different cultures, in near future.

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