

Love Island Simulator

Final Report

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MSc Artificial Intelligence – Multi-Agent Systems

October 2025

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Abstract. This project introduces a multi-agent simulation inspired by the reality television show Love Island to explore how genuine love interest versus strategic intent for romantic relationships influence winning outcomes, and if being more proactive can outrun physical attractiveness in an isolated group. Each agent in the simulation is defined by static personality traits (Big Five and MBTI), and dynamic emotional states such as attraction, jealousy, confidence, loyalty, and energy. Agents interact through probabilistic social actions—flirting, gossiping, dating, sabotaging, and coupling—governed by bounded island environment’s mechanisms. Relationship formation and maintenance are modeled as non-linear emotional updates constrained by energy budgets and influenced by environmental disturbances such as gossip, jealousy propagation, and periodic voting rounds. Experimental analyses using survival modeling, regression, and permutation tests reveal that traits traditionally viewed as advantageous, such as hotness, energy, and Machiavellianism, become detrimental when expressed at high intensity. Contestants who pursued strategic coupling achieved temporary gain, but were eliminated earlier than those who maintained emotionally balanced and cooperative behavior. The findings demonstrate that sustained success emerges from authentic intent rather than maximized self-interest, suggesting that relational equilibrium and emotional reciprocity are more adaptive than being goal-oriented or sabotaging rivals in socially competitive systems.

1 Introduction

Love Island is a reality television program that was originally aired by ITV2 in the UK in 2015. To continue participating in (‘surviving’) the show, islanders have to form relationships (‘couple up’) with other contestants and be voted to stay in either by fellow islanders or members of the public. Relationships are ideally for love but can be for friendship. Developing relationships is the key tactic to achieving success in the show, and islanders should maintain their relationships to avoid getting voted out. At the start of the show, couples are formed based on first impressions, but these couples may change over time (‘recoupling’). Over the course of the show, couples are gradually eliminated (although new islanders may enter as ‘bombshells’), at the final, the couple with the most votes is awarded a cash prize.

Simulation has the key attributes and rules of the reality TV show, although some parts are changed to fit the purpose of the simulation. The winning condition, for instance is to be the only couple that survive. Because in real Love Island there is public voting which cannot be simulated, we changed it accordingly. Reality dating shows like Love Island offer a perspective on relationships in a contest environment.

A multi-agent simulation allows us to manipulate variables such as personality distributions, jealousy thresholds, or new-contestant timing. This provides a controlled experimental setting that cannot be as easily achievable in reality.

The project establishes this format to develop a testing framework for a multi-agent simulation (MAS). The representation of islanders as agents with personality traits, preferences, and emotional states allows us to study how the intention of coupling affect the outcome of winning, and whether the agents who strategically form couples or ones who couple because of genuine love interest achieve better results. The impact of jealousy, flirting and dating more, having a good physical appearance on winning the competition is also studied. The simulation explore social effects through repeated interactions, which produce emergent patterns that result in gossip, cheating, dating, sabotaging others' relationships and coupling. Our research links to psychological theory and dating literature within the framework of reality TV cultural studies. Porter and Standing [17] explore the ideas of compatibility and relationship education, while Lipowski [12] discusses the options of mechanisms based on personality traits that can emulate social structures and connections. These mechanisms are borrowed in the model, so that we can rely on the extroversion-introversion spectrum, as well as openness, agreeableness, and other attributes that will be discussed in the methodology section. The simulation model combines personality-based behavior with environmental disturbances that include adding new participants to the island, and voting sessions to create a controlled setting for studying how jealousy and relationship factors affect survival .

1.1 Problem

Contemporary research studies concentrate on the selection of partners or emotional transmission separately. The Love Island contestants reveal how their personal traits affect their deliberate decisions when external factors change. The goal is to create agents that can generate complex behaviors such as jealousy, while gossiping and cheating change the stability of the relationships. The simulation combines all these elements into one system which enables us to study how personality characteristics combined with social relationships affect the duration of relationships.

1.2 State of the Art

Multi-agent simulations of social dynamics have been widely explored, but few have combined emotional modeling, personality traits, and competitive dating-show environments. Bourgaïs et al. [4] provide a comprehensive review of emotion modeling in social simulation, outlining key mechanisms such as emotional decay, thresholds for triggering behavioral changes, and emotional contagion. Their work shows how emotions like jealousy can fade over time or escalate when external triggers occur, providing a foundation for representing emotional states in our work.

Barachini and Stary [3] demonstrate that stochastic approaches to modeling emotions can produce realistic fluctuations in mood and cooperation. This is particularly relevant for simulating volatile behaviors such as jealousy and trust in a Love Island-style villa. Similarly, the study by Lipowski et al. [12] explores how preferential partner selection can create cliques and hierarchies, which directly parallels how social influence can shape recoupling choices on the show.

Game design perspectives, such as The Sims compatibility system described by Claudino [6], offer practical insights for implementing attraction scoring and personality matching mechanics. This allows us to connect established entertainment systems with academic research, ensuring our model’s pairing logic feels both realistic and intuitive. Finally, Porter and Standing [17] analyze Love Island’s cultural context, gender norms, and strategic behaviors, highlighting the competitive and performative nature of relationships on the show. Their findings justify modeling both genuine romantic intentions and strategic coupling to “stay in the game.”

Together, these works inform the key elements of our simulation: dynamic emotional states, personality-based attraction, gossip-driven popularity shifts, and external interventions such as new contestants or public voting. By integrating these concepts, our Love Island simulator advances existing work on social simulations while creating a unique framework to study the interplay of personality, emotion, and competition.

1.3 New Idea

Although there is a lot of research on attraction and social dynamics, we still don’t know much about how personality traits and emotions shape relationships in competitive dating settings. Love Island participants must compete for romantic partners while facing social pressure and jealousy. These are favorable conditions to study how attraction and emotions play out in a group.

Research conducted by psychologists and dating scientists shows that personality characteristics serve as the primary factor for successful romantic relationships. The three personality traits of introversion–extroversion, openness, and agreeableness, determine how people find attraction and how satisfied they are in their relationships. Porter and Standing [17] show how Love Island presents contemporary relationship ideas, but the show does not establish a system which accurately depicts these relationship dynamics. The simulation model will combine these results into a single integrated system.

Based on these gaps, the following research questions arise: ‘How do strategic relationships, compared to genuine romantic relationships, influence contestants’ winning outcomes in Love Island?’ and ‘To what extent can energy outperform hotness?’ The multi-agent simulation covers energy, such as having more energy to engage in activities such as dating, flirting, sabotaging and gossiping in a day, versus physical attractiveness and compares the outcomes. Also, it showcases agents who strategically couple for the goal of winning versus ones who couple out of love interests and compares the results.

The multi-agent simulation will assign unique personality traits, strategic approaches, and emotional responses to each participant. Although the Myers–Briggs Type Indicator (MBTI) has been criticized for its limited psychometric reliability [19], it remains a practical tool for generating interpretable behavioral archetypes in agent-based simulations. In contrast, the Big Five framework [14] provides a continuous and empirically validated measurement of personality traits. By combining the categorical structure of MBTI with the dimensional accuracy of the Big Five, our model can distinguish between behavioral types and gradual variations in traits, enabling a wider range of realistic social interactions among agents.

Contestants will pair up and split apart based on their attraction levels, their self-assurance, and their jealousy levels. They can gossip, lose confidence and energy when rejected, or couple strategically to stay in the game. The stability of these pairs can be tested by adding new contestants.

This approach extends past work in three ways. The model introduces a new approach by using personality-based attraction and jealousy mechanisms within a dating show simulation framework which previous emotion-based models did not study before. The system features additional elements which is caused by bringing outside factors by allowing new participants to join and sabotaging other relationships. The method enables to study the impact of third-party attacks in a two-person relationship.

The simulation will explore how gossip affects trust in relationships, while jealousy propagates within the group through gossiping with enemies and friends. The research findings that will rise from the Love Island simulator can help scientists study relationship dynamics, team formation, and social systems that link competition with emotional responses.

2 Method

In order to answer our research question, we developed the Love Island Simulator. In this simulation, we will experiment with coupling and decoupling, based on similarity or complementary traits, we will create multiple contestants with various personality traits. Moreover, these agents will exist in an environment where they can enter relationships, they can choose to stay or not stay loyal to their partners, they can gossip, sabotage, and they can also end relationships. However, they are all bounded by a mutual goal, namely, winning the game (being the last couple that does not get eliminated).

2.1 Simulation Model

We chose an object oriented approach, using Python, to shape the characteristics and behaviors of the agents. Using .json files, we will load different agents with various personality traits into the simulation. This way, we have the flexibility to create any personality combination that we desire, we can leave it random, and we can also adjust the number of agents and the number of rounds.

This way, testing and debugging can be done more rigorously, given the control that de.json files provide.

Each agent has core attributes, such as the name, the gender and whether they prefer people with similar, or complementary personality traits. On top of that, they dispose of the 16 Personality Traits, as well as the Big 5. Moreover, they have the capability to be more or less prone to jealousy, to act more strategic, they also have different loyalty degrees, as well as confidence and gossipness. The above traits are static, but the agents also have dynamic traits, such as the current loyalty towards their partner, their current jealousy towards other agents, as well as a list of friends, a list of crushes, and their current confidence, that can increase if they are successfully flirting with another agent. These dynamic traits are in accordance to Cathexis Emotion Models Theory. As described by Bourgaïs et al. (2018) [4], these models allow agents to “simulate continuous emotional updates and decay”, providing a more realistic reflection of human behavior.

In the simulation, the agents are going to be able to gossip and agree or disagree with other’s opinions. Based on the theory of Emotional Contagion explained in Emotional Contagion by Elaine Hatfield, John T. Cacioppo, and Richard L. Rapson [9], “people tend to automatically mimic and synchronize expressions, vocalizations, postures, and movements with those of another person, and consequently converge emotionally.” While gossiping, agents will modify their perspective in regards to other agents based on the beliefs of the agent that they are gossiping with. If the contestant is friends with their gossiping partner, their opinions will align, while the opposite happens when they are enemies.

Flirting in the simulation can be successful or unsuccessful, based on the attraction, that can be physical and emotional. The personality traits and hotness of two possible matches will be compared and then a compatibility score will be calculated. If the score is above a certain threshold, then attraction increases, and the opposite happens if the score is not high enough. Moreover, the initial attraction is only based on hotness, because physic appearance is the first impression. Later on, personality traits will play a bigger role in attraction. As a result, coupling and breaking up will occur based on the attraction, with some exceptions. For example, break-ups can happen when cheating is involved or if levels of jealousy exceed a certain score.

2.2 Implementation

2.2.1 Contestant: The contestant class has name, gender, personality traits, hotness, preferences for their partner, energy, partner, a list of previous partners and a list of previous dates as attributes. Core attributes are name, gender, preference for in a partner and hotness which are also static variables. An extensive list with all the attributes and explanations can be seen in Table 1

To simulate the personality of an agent we used 16 personalities Myers-Briggs Type Indicator (MBTI)[2] alongside Big-Five Personality Trait Model[15]. In 16 Personality Framework, traits are presented in a matrix, also in our simulation personality traits are represented as floats from 0 to 1, such as a contestant with

Table 1. Core contestant parameters and their descriptions.

Parameter	Type / Range	Description
Static Core Attributes		
Name	String	Unique contestant identifier
Gender	{male, female}	Biological or presented gender
Preference_for	{similar, complementary}	Attraction style preference
Hotness	[0–1] Continuous	Physical attractiveness rating
Prone_to_jealousy	[0–1] Static	Baseline jealousy tendency
Gossipness	[0–1] Static	Likelihood of spreading social information
Base_loyalty	[0–1] Static	Default commitment level to partners
Base_confidence	[0–1] Static	Default self-assurance or social confidence
Machiavellianism	[0–1] Static	Manipulativeness and social strategy
Max_energy	[0–2] Static	Maximum social energy per cycle
Personality Traits		
Extroversion	[0–1] Static	Sociability and outgoingness
Openness	[0–1] Static	Creativity and receptiveness to experience
Conscientiousness	[0–1] Static	Organization and self-discipline
Agreeableness	[0–1] Static	Compassion and cooperativeness
Neuroticism	[0–1] Static	Emotional instability or anxiety proneness
Intuition	[0–1] Static	Preference for abstract vs. concrete information
Thinking	[0–1] Static	Rational vs. empathetic decision-making
Judging	[0–1] Static	Structured vs. spontaneous lifestyle orientation
Dynamic State Variables		
Current_energy	[0–2] Dynamic	Available social energy for actions
Current_loyalty	[0–1] Dynamic	Relationship commitment over time
Current_confidence	[0–1] Dynamic	Confidence updated by social outcomes
Current_jealousy	Dict[String, float]	Jealousy toward each contestant
Current_attraction	Dict[String, float]	Attraction levels toward others (opposite gender)
Current_friendship	Dict[String, float]	Friendship strength (same gender)
Partner	String / None	Current romantic partner name
History	List[String]	Past partners' names
Past_dates	List[String]	Previously dated contestants
Action System		
Action_coefficients	Dict[String, float]	Modifier weights for available actions
Available_actions	Derived	Computed per cycle based on energy and context

extroversion value 1 being very extroverted and extroversion value 0 being very introverted. Other static traits are being prone to jealousy, machiavellianism, base loyalty, base confidence and gossipness. Dynamic traits are current loyalty, current confidence, current jealousy. Current attraction list, current friendship list and energy of the contestant also change dynamically according to contestant's behavior and events that take place. Partner and history list stores the relationship state and previous partners.

2.2.2 Flirting: The `flirt()` function defines one of the fundamental social interactions between agents in the Love Island simulation by calculating the compatibility of the contestant that initiates flirting and target contestant. It measuring the distance of two arrays and whether the preference of initiator aligns with the compatibility score. "The reinforcement-affect model of interpersonal attraction is based on a classical conditioning paradigm in which affect plays a central role: stimuli that evoke positive affect are liked while stimuli that evoke negative affect are disliked." [5]. This score reflects how compatible the two agents are in terms of personality.

The final compatibility value depends on the target's stated preference for attribute: if they prefer "similar" partners, higher similarity increases compatibility; otherwise, dissimilarity becomes attractive. "The model is based on a vector representation of each agent. The components of the vector are the key continuous "attributes" that determine the social behavior of the agent.[...] It assumes that the force between two agents is proportional to the "similarity of attributes."" [13] Success is defined as a product of compatibility, target's attraction towards the initiator and a noise to mimic the unpredictability of the nature of love relationship dynamics. If the product is bigger than 0.5, success is obtained.

The parameters k_{up} , k_{down} , p , and q control the rate of change and ensure emotional responses are non-linear, allowing strong or weak attraction to evolve differently over time and not reach 1 or escalate down to 0 very fast. Confidence levels are also adjusted: successful flirtations boost both partners' confidence slightly, while failures reduce the initiator's confidence. All values are bounded between 0 and 1 via a clamping function to prevent numerical instability. Delta is how much the attraction will change and the equation for delta is:

$$\Delta A = \begin{cases} k_{up}(1 - A)^p, & \text{if success,} \\ -k_{down}A^q, & \text{if failure.} \end{cases} \quad (1)$$

After, we add some noise to delta. The confidence of target increases regardless of success, but if it is a successful flirtation increase rate is higher. If success is not obtained, initiator's confidence decreases by 0.02.

A key parameter is reciprocity. If the reciprocate flag is set to True and the flirtation succeeds, the target automatically flirts with the initiator. This mutual feedback allows attraction to grow symmetrically between agents, enabling mutually escalating attraction over multiple iterations.

2.2.3 Coupling: Coupling function first checks whether contestants have opposite gender and they are single. There are three possibilities of two contestants forming a couple: if one is strategic and the other likes the contestant, if both like each other and if both are strategic. For the first situation, contestant's machiavellianism value should be above a threshold, which is a personality trait that is characterized by one's cynicism and selfishness[11]. In the case where

Table 2. Main parameters controlling flirtation behavior.

Parameter	Symbol	Description
Attraction increase rate	k_{up}	How fast attraction grows on success
Attraction decay rate	k_{down}	How fast attraction drops on failure
Non-linearity factor (success)	p	Controls curvature for strong bonds
Non-linearity factor (failure)	q	Controls curvature for breakups
Confidence increment	c_1	Boost after successful flirting
Noise scale	σ	Random variability for realism

both agents like each other, meaning that both attraction scores are above a certain threshold, it is safe to say that the coupling will be organic and 'sincere'. Lastly, if both parties have a high machiavellianism scores, they will strategically couple up to avoid being eliminated. After 2 contestants couple up, their past dates lists get emptied, so that we can easily track cheating within the current relationship.

2.2.4 Breakup: In the simulation, there are three reasons for a breakup: if one of the parties lose interest and their partner is not in top 3 in their attraction list, if one of the partners' jealousy level passes a threshold, or if one of the partners cheat. To realistically simulate finding out about cheating, we take a random date from the past dates list. If it does not match the current partner, they break up.

2.2.5 Gossip: Gossiping is occurring when two interacting agents have a certain amount of gossipness. We are simulating this in a natural and spontaneous way by storing a random number between 0 and 1, and if the average of the gossipness attributes of the agents is above that number, the function is entered. "A positive force causes the attributes of the agents to become more similar and the corresponding vectors to become more nearly parallel." [13] The gossip function operates on emotional contagion and social influence. When two agents gossip, their emotional vectors (jealousy, attraction, friendship) are adjusted based on gender and perceived relational status. This aligns with Bourgeois' paper [4], who notes that "emotions can spread between agents through direct interaction or communication," and with Flache's [7], who emphasize that agents tend to adjust their states toward those of similar others (homophily). Furthermore, as Giardini and Wittek describe [8], gossip serves as a regulatory mechanism for social cohesion and rivalry. With all of these in mind, the gossip algorithm is simplistic yet accurate. Based on the `current_jealousy` of the agents, we establish whether they are friends or enemies. If they are friends, and they have the same gender, their `current_jealousy` vectors will become more similar, using the `similar()` helper function, meaning that they will tend to like/dislike the same people. The rest of the fluctuations of the vectors can be seen in Table 3. This enables gossip to act as both a bonding and divisive force within the simulated population.

Table 3. Influence of Gossip on Emotional Vectors

Contestants	Jealousy	Attraction	Friendship
friends & same gender	+	-	+
friends & opposite gender	+	+	+
enemies & same gender	-	+	-
enemies & opposite gender	-	-	-

2.2.6 Date: Dating occurs between two contestants of opposite gender. Generally speaking, dating is calling the flirt function from both sides, so they are both flirting with each other. In addition, the flirt function has an additional functionality: if flirting is successful, the target will also initiate flirting back to the initiator, meaning that if the flirt function will be called at least two times or at most four times within the dating function. Another functionality that the dating function has is that

2.2.7 Agent Memory: Current loyalty and current confidence are the dynamic traits of the contestant. At the beginning of the simulation, they are equal to the base loyalty and base confidence values. After going through various events, these values get modified accordingly. For instance, when a contestant flirts and the target does not like them back their current confidence decreases. Current jealousy is a dictionary consisting of names of contestants and the score of how much the contestant is jealous of them. Contestants from any gender can be jealous of each other. Current attraction list is sorted in a way that the first indexes are occupied by contestants that the agent finds most attractive. At the beginning of simulation, this list is only based on hotness values, so everyone with the same gender has the same list. After they flirt, this list gets modified based on the success or failure of flirtations. Current friendship list contains the names of contestant’s friends. Friends can only be from the same gender in Love Island. Partner is the current partner, it starts as none and if the contestant couples up with another contestant, it becomes the name of that contestant. History stores previous partners’ names. The name gets added after a break up. Past dates stores names of contestant’s previous dates. If a contestant is in an official relationship, some entries of this list might become available to their partner, in order to simulate catching a potential cheater. This is feasible, because contestants have the option to go on dates with other people while they are in a relationship with someone else.

2.2.8 Agent Strategy

- **Sabotage:** It occurs when the agent has high machiavellianism and gossipness, so this activity is more occurring with attackers that are more focused on strategy and they are trying to win the game at any cost, spreading false information. The attacker will try and sabotage someone’s relationship. So, the target’s attraction to their partner will decrease, and if they are currently

single, the person that they are most attracted to. Their confidence will also decrease, while the jealousy towards the attacker will increase. Sabotaging is a powerful action that changes the game dramatically and it efficiently simulates real life scenarios, playing a big part in the strategy of the players.

– **Voting:**

Voting is a simple concept, but the simulation has additional rules in its regard so that we can efficiently establish winners. The main principle of voting is that every contestant chooses the person that is on top of their jealousy vectors. However, we added some ground rules. If there is only one male or one female left on the island, they are granted immunity, because the rule of Love Island is that the winners are going to be a couple, so there is a need to facilitate that contestants from both genders are permanently present in the simulation. Moreover, we made sure that the contestants cannot vote their partners out. The person with the most votes is eliminated from the island.

2.2.9 Theories Used In Research The simulation’s theoretical framework is built on multiple pillars designed to model complex and realistic social behavior:

Emotional Contagion:

The emotional layer of the simulation draws from the theory of *Emotional Contagion* [10], which posits that emotions spread between individuals through automatic mimicry and synchronization of expressions, tone, and behavior. Within the simulation, gossip and daily interactions act as transmission channels where emotional states-particularly jealousy, attraction, and friendship-mutually adjust among agents. When contestants gossip or form friendships, their emotional vectors (jealousy and attraction) gradually converge if they are friends or diverge if they are enemies. This dynamic reflects the real-world feedback loop of empathy and social resonance in group environments, leading to emergent phenomena such as group polarization or collective mood alignment.

Game Theory/Bounded Rationality:

Social decision-making in the simulation is modeled through the lens of bounded rationality [18] and game theory, where agents do not behave as perfectly rational optimizers but rather as probabilistic strategists constrained by limited information and emotional biases. Each contestant acts within a decision space defined by energy, confidence, and social context, selecting actions such as flirting, gossiping, or sabotaging according to probabilistic weights. These decisions are influenced by short-term survival incentives (remaining coupled) and long-term strategic goals (winning). The combination of stochastic decision-making and adaptive feedback mechanisms captures the essence of strategic interaction observed in real competitive social environments, where behavior often balances emotion, self-interest, and uncertainty.

Personality-Based Modeling:

To prevent agents from being similar and predictable, each contestant is initialized with a unique set of static personality traits. "Utilizing the Five-Factor

Model (FFM) of personality traits, agents varying in openness, conscientiousness, neuroticism, extraversion, and agreeableness were modeled to form both heterogeneous and homogeneous teams." [16] These traits serve as the "source code" for each agent's baseline, personality, uniqueness, randomisation and bias. The **Contestant** class directly implements traits from two major psychological models:

- **Myers-Briggs Type Indicator (MBTI):**
 - extroversion (vs. introversion)
 - intuition (vs. sensing)
 - thinking (vs. feeling)
 - judging (vs. perceiving)
- **The "Big Five" (OCEAN) Model:**
 - openness
 - conscientiousness
 - extroversion (shared with MBTI)
 - agreeableness
 - neuroticism

These are supplemented by other traits that are crucial for the simulation's context, such as machiavellianism, gossipness, base loyalty, prone_to_jealousy, and hotness, so that we can more easily compute necessary methods to simulate human behavior.

OCC / Cathexis Emotion Models

The simulation is an emotional model that took inspiration from the OCC cognitive theory of emotion. Instead of modeling discrete affective labels such as anger and happiness, we focus more on the dynamic state variables that showcase the agent's emotional changes, or, better said cathexis. These variables are maintained within the **Contestant** class.

Each agent maintains the following emotional state variables:

- **current_attraction:** a dictionary showing romantic intensity toward every other agent.
- **current_friendship:** a dictionary representing platonic connection.
- **current_jealousy:** a dictionary capturing negative emotion, aligned with OCC constructs such as distress and resentment, or competitiveness.
- **current_confidence:** a vector encoding self-appraisal, highly sensitive to social feedback.
- **current_energy:** a scalar modeling action capacity, that is decreasing through interactions and restored daily.

All social interactions in `island.py` trigger emotional updates. Each event implements an OCC-style appraisal:

- **Flirt:** If the target evaluates the flirt as success, both agents gain confidence and the target's attraction increases; otherwise, attraction decreases and the initiator's confidence drops.

- **Gossip:** A relational context based on existing friendship or jealousy attributes. Gossip modifies all three relational maps (**attraction**, **friendship**, **jealousy**) using similarity or opposition transforms.
- **Sabotage:** A hostile event that increases the target’s jealousy toward the attacker, reduces their attraction to their partner (or biggest crush), and decreases confidence and energy for both parties.

Regulation and Decay: Emotional states are continuously regulated. Each night, agents recover full energy and receive a small confidence rebound. A confidence floor, computed from each agent’s **base_confidence**, prevents unbounded decline. This slowly recovers emotional states back to static personality traits.

" Rather than seeing emotions as purely biological or automatic reactions, Lazarus proposed that emotions arise from our cognitive appraisals—our mental evaluations of situations and their implications for our well-being. This means that how we interpret a particular event is key to understanding how we feel about it. " [1]

2.3 Experiment Design

The Love Island Simulator is evaluated through the execution of many-worlds experiments in a controlled, reproducible setup. The core simulator (agents, actions, daily ticks) is treated as a black box; the experimentation layer varies inputs (traits, action propensities, population composition) and aggregates outcomes for statistical analysis.

World Dynamics and Schedule. It is evident that each world is initiated with a balanced cast of male and female contestants. The simulation progresses in discrete daily ticks. On a daily basis, agents are assigned a predetermined social energy budget and select actions (e.g. flirting, gossiping, sabotaging, or dating) probabilistically based on their action coefficients and the energy available to them. Every few days, the villa triggers *voting* events; periodically, *bombshells* (newcomers) enter and perturb existing relationships. The run terminates early if the population converges to a final pair, or at a pre-specified horizon.

Independent Variables. We manipulate (i) *personality distributions* (e.g., Big Five and MBTI-inspired scalars), (ii) *strategic dispositions* (machievellianism, baseline loyalty/confidence, jealousy proneness), (iii) *physical attractiveness* (hotness), (iv) *action coefficients* (compositional weights over flirt/gossip/sabotage/date), (v) *energy budgets* (max energy), and (vi) *environmental pacing* (frequency of voting and bombshell injections).

Outcome Variables. We record: survival time (days survived), final status (win vs. elimination), pair-formation latency, relationship duration per pair, number of re-couplings, jealousy incidents discovered, sabotage attempts, and daily aggregates (mean confidence, attraction assortativity). For pair-level metrics we compute per-pair Kaplan–Meier curves and median time-to-breakup.

Experimental Arms and Replication. For each base cast, we generate newcomer profiles and run paired arms where a newcomer replaces either a male or a female in the baseline roster, keeping the population size constant. Each (*cast* $\times$ *newcomer* $\times$ *arm*) condition is replicated under multiple random seeds to decouple stochastic dynamics from structural effects. Seeds are deterministically derived from hierarchical identifiers to ensure reproducibility across runs.

Action Selection and Energy Costs. At each tick, an agent samples one action from the set $\{\textit{flirt}, \textit{gossip}, \textit{sabotage}, \textit{date}\}$ using its normalized action coefficients as probabilities, subject to energy feasibility. Actions consume energy according to fixed costs; agents with insufficient energy skip until their next daily recovery. Confidence floors and nightly rebound rules prevent degenerate collapse (e.g., confidence never falls below a global minimum and partially recovers overnight).

Internal Mechanics (Analysis-Relevant). Attraction updates follow a bounded, non-linear rule: successful interactions increase attraction by $k_{\text{up}}(1-A)^p$ and failures decrease by $k_{\text{down}}A^q$, with small multiplicative noise; updates are clamped to $[0, 1]$. Confidence is co-updated on successes and penalized on failed attempts. Jealousy is actor-target specific and can be amplified or reduced via gossip, depending on homophily (same-gender friends) or rivalry relations. Cheating discovery is stochastic; upon discovery the pair breaks up. Voting prunes low-popularity/low-stability pairs, and bombshells temporarily re-rank attraction lists.

Data Processing and Statistical Modelling. We export per-run, per-agent, and per-pair summaries to a tabular dataset. Analyses include: (i) OLS models for days survived, (ii) logistic regression for winning odds, and (iii) non-parametric tests for gender-matched arms. Because action coefficients form a composition, we apply isometric log-ratio (ILR) transforms before regression. Where non-linearities are suspected, we additionally fit GAMs with smooth terms over ILR-transformed coefficients and hotness. Significance is assessed with cluster-robust (by seed/cast) standard errors; permutation tests validate key effects (e.g., whether extroversion or openness accelerates pair formation).

Hypotheses. H1: Higher extroversion shortens time-to-pair but increases re-coupling events. H2: Greater openness increases cross-type coupling and reduces jealousy-triggered breakups. H3: Strategic weighting toward *sabotage* boosts short-term survival only when confidence floors are high; otherwise it backfires via retaliation and c.

2.4 Contestant Design

Contestants are instantiated from JSON descriptors into `Contestant` objects with static traits, dynamic states, and an action policy. This section summarizes the agent state and how code-level rules operationalize psychological constructs.

Table 4. Experimental Schedule and Event Dynamics in the Love Island Simulation

Event	Frequency	Description
Daily Loop	8 ticks per day	Agents perform one social action per tick (<i>flirt</i> , <i>gossip</i> , <i>date</i> , or <i>sabotage</i>) depending on their energy and action coefficients.
Voting Round	Every 5 days	Low-stability or unpopular couples are eliminated based on trust, loyalty, and attraction metrics.
Bombshell Entry	Every 20 days	New contestant joins the villa and reshuffles attraction networks, testing the resilience of existing couples.
Energy Recovery	Nightly	Agents restore social energy and partially recover confidence for the next day.
Termination	Until convergence or time limit	Simulation ends when only one stable couple remains or after a fixed horizon of days.

Static Traits. Each agent has: name, gender, hotness (0–1), preference style (*similar* vs. *complementary*), jealousy proneness, gossipness, machiavellianism, baseline loyalty/confidence, and personality scalars (Big Five: extroversion, openness, conscientiousness, agreeableness, neuroticism; MBTI-inspired axes: intuition, thinking, judging). A per-agent *max energy* controls the daily action budget. An *action coefficients* dictionary assigns propensities over $\{\textit{flirt}, \textit{gossip}, \textit{sabotage}, \textit{date}\}$; coefficients are normalized at runtime for sampling.

Dynamic State. During simulation, agents maintain: current energy, current loyalty/confidence, partner (or None), relationship history, past dates, and three maps over other contestants: (i) attraction, (ii) jealousy, and (iii) friendship (same-gender affinity). Confidence is lower-bounded by a *global floor* and subject to a nightly rebound; this prevents irreversible spirals. Attraction lists are initialized from hotness (first-impression heuristic) and subsequently reshaped by interaction outcomes.

Action Semantics. **Flirt:** Computes a compatibility score from personality similarity/complementarity and current attraction; if successful, attraction updates follow the non-linear rule with parameters $(k_{\text{up}}, k_{\text{down}}, p, q)$ and bounded noise. Confidence increases for both sides on success; failed initiations reduce the initiator’s confidence. **Date:** Symmetric exchange that triggers bilateral flirt attempts within one interaction budget; successful chains accelerate mutual attraction. **Gossip:** Implements emotional contagion and social influence: friends of the same gender move their jealousy vectors closer; rival dyads push them apart. Attraction and friendship can also be nudged depending on relation type (bonding vs. divisive effects). **Sabotage:** Available to high-machiavellianism agents

with sufficient energy; attempts to depress rivals’ attraction or induce jealousy spikes, trading off large energy costs against short-term strategic gains.

Coupling, Breakup, and Cheating. Two singles of opposite gender couple either (i) organically (mutual attraction above threshold), (ii) strategically (both highly machiavellian), or (iii) asymmetrically (one strategic, one sufficiently attracted). Breakups occur when (a) a partner falls out of the other’s top-attraction set, (b) jealousy surpasses a threshold, or (c) cheating is stochastically discovered. Upon coupling, past-date buffers reset to enable subsequent cheating detection.

Environmental Interventions. *Voting* periodically eliminates unstable or unpopular pairs based on aggregated social signals (attraction, loyalty, recent conflicts). *Bombshells* (newcomers) are injected at fixed intervals; they are generated with realistic trait ranges and balanced action coefficients, and replace the gender minority to keep roster size constant. Both interventions re-order attraction rankings and test pair robustness.

Initialization and Reproducibility. Agent populations are loaded from JSON (including archetypal Season-inspired profiles) and optionally augmented by programmatically generated newcomers. All stochastic components (daily order, action sampling, success noise, discovery events) are driven by hierarchical seeds to enable exact replication of any run.

Measurement Hooks. Each action returns a structured event record (actor, target, success, deltas), enabling transparent logging. Per-day summaries compute means and dispersions over attraction, confidence, and jealousy, as well as pair-level counters (dates, successful flirts, sabotage attempts). These hooks feed directly into the analysis pipeline described in Section 2.3.

2.5 Evaluation Metrics and Observables

To bridge the agent-level design and the population-level results, this section defines the quantitative indicators extracted from each simulation run. These metrics transform raw interaction logs into interpretable measures of social and emotional dynamics. Each observable corresponds to either an individual trait trajectory, a relationship-level outcome, or an overall system property.

Agent-Level Metrics. For every contestant, we monitor changes in attraction, jealousy, confidence, and energy at each tick. The primary measure of persistence is *days_survived*—the number of simulated days before elimination. Additional features include:

- **Mean confidence:** Average daily confidence level across the simulation.
- **Jealousy frequency:** Proportion of ticks in which jealousy surpasses a predefined threshold.
- **Action counts:** Total number of flirt, gossip, sabotage, and date actions performed.

Together, these quantities describe each agent’s behavioral style and emotional stability.

Relationship-Level Metrics. For every couple formed during the simulation, we record the start and end day of the relationship to compute its duration. Additional pairwise statistics include:

- **Pair stability:** Ratio of total days in relationship to total days active in the simulation.
- **Attraction assortativity:** Correlation between partners’ attraction scores at formation time.
- **Jealousy incidents:** Number of jealousy spikes or cheating discoveries during the relationship.

These metrics capture how personality alignment and emotional regulation influence relationship resilience.

Population-Level Metrics. At the collective scale, the simulation yields global indicators of social organization:

- **Couple count:** Number of concurrent couples at each day.
- **Voting survival rate:** Proportion of contestants surviving each elimination round.
- **Network clustering:** Degree of friendship and attraction clustering in the social graph.

Population-level measures reveal emergent structures such as alliance formation, popularity polarization, and oscillations in group cohesion.

Analytical Use. All metrics are exported as structured CSV files, enabling regression, correlation, and survival analyses. Relationship-level durations feed into Kaplan–Meier survival curves, while agent-level data support OLS and logistic regression models described in Section 2.3. These observables thus form the empirical foundation for the findings reported in the following section.

3 Results

The results revealed a consistent pattern across both the linear (OLS) and non-linear (GAM) analyses. Traits that might intuitively confer social advantage, such as physical attractiveness, energy, and strategic intelligence, became liabilities when expressed at high intensity. Rather than maximizing success, exaggerated expressions of these traits were systematically associated with shorter survival within the simulated *Love Island* environment. Contestants who were too attractive, too energetic, or too manipulative were eliminated more quickly than those with moderate, balanced profiles.

Table 5. Summary of Key Evaluation Metrics

Metric Category	Metric Name	Description
3*Agent-Level	Days Survived	Number of days before elimination.
	Mean Confidence	Average confidence across simulation time.
	Jealousy Frequency	Fraction of ticks where jealousy exceeds threshold.
3*Relationship-Level	Relationship Duration	Length of active pairing in days.
	Pair Stability	Ratio of days in relationship to total active days.
	Jealousy Incidents	Count of jealousy or cheating events.
3*Population-Level	Couple Count	Total active couples per day.
	Voting Survival Rate	Percentage of contestants surviving each voting round.
	Network Clustering	Average clustering coefficient of attraction network.

3.1 Core Traits and Survival Dynamics

The OLS model identified three major predictors of survival time: hotness, energy, and Machiavellianism. All three showed strong negative coefficients, with *hotness* exerting the largest individual effect ($\beta = -4.73$, $p \approx 10^{-126}$), followed by *Machiavellianism* ($\beta = -4.55$, $p \approx 0$) and *energy* ($\beta = -4.26$, $p \approx 0$). When normalized for magnitude, the three traits contributed almost equally to the overall prediction (35%, 34%, and 31%, respectively). These findings indicate that excessively high levels of attractiveness, drive, or strategic behavior were equally detrimental to contestants’ ability to remain in the simulation. The GAM analysis confirmed these relationships and revealed that their effects were strongly nonlinear. Survival probability declined sharply at extreme values of any trait, while moderate expressions of the same characteristics were associated with improved longevity. The pattern suggests an optimal “zone of balance” rather than a simple linear advantage.

3.2 Interaction Between Hotness and Energy

A positive interaction between hotness and energy ($\beta = +0.68$, $p \approx 5 \times 10^{-18}$) indicated that these two traits jointly influenced survival in a compensatory way. Contestants with moderate levels of both attractiveness and vitality tended to offset the negative effects of each trait in isolation. In contrast, an imbalance, such as high attractiveness without sufficient energy or high energy without charm, predicted earlier elimination. The interaction implies that the social ecosystem rewarded coordinated combinations of traits rather than extremes along any single dimension. The GAM smooths supported this interpretation, showing curved

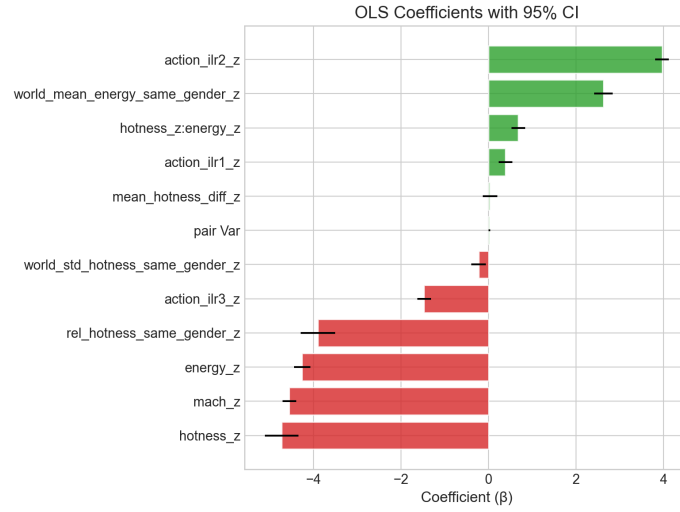


Fig. 1. Standardized coefficients from the OLS model showing direction and magnitude of each predictor. Negative coefficients indicate traits associated with shorter survival time.

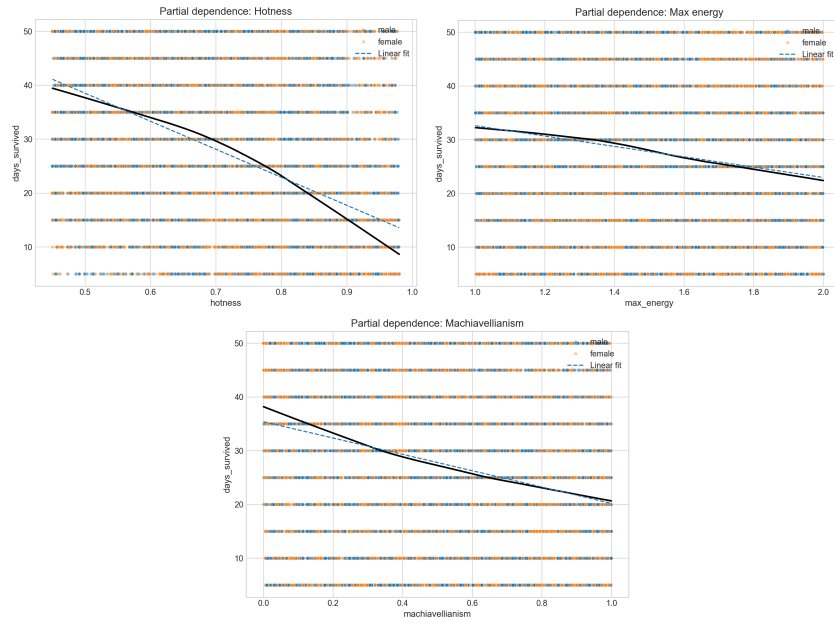


Fig. 2. Partial dependence plots for (a) hotness, (b) energy, and (c) Machiavellianism. Each curve illustrates how increasing each trait affects survival time, showing a steep decline at high trait levels.

response surfaces where balanced mid-range profiles yielded the most stable survival outcomes.

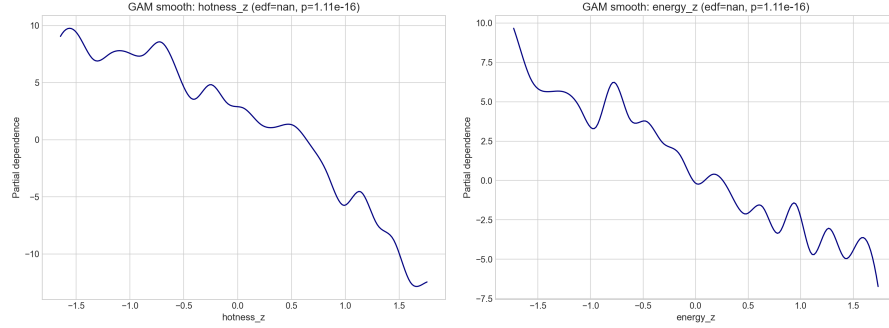


Fig. 3. GAM smooths illustrating the nonlinear relationship between hotness and energy with survival. Both traits show diminishing returns at high levels, supporting the idea that moderate expression yields maximal stability.

3.3 Strategic Relationships and Machiavellian Behavior

Machiavellianism, interpreted as a measure of strategic or manipulative social behavior, consistently reduced survival time across both models. Higher values on this dimension predicted shorter stays, even when controlling for attractiveness, energy, and contextual variables. The GAM curve showed no reversal or plateau, indicating a monotonically negative effect. This result suggests that strategic or instrumental relationship approaches eroded long-term stability within the simulated social environment. While manipulative agents could achieve short-term gains, such as securing partnerships or influencing votes, these advantages decayed rapidly as trust deteriorated. The model therefore supports the hypothesis that strategic relationships were less durable than genuine, emotionally engaged ones.

3.4 Contextual and Environmental Factors

The social environment further moderated survival outcomes. A contestant's attractiveness relative to others of the same gender was one of the strongest contextual predictors ($\beta = -3.90$, $p \approx 10^{-83}$), with higher relative hotness reducing survival time. This finding suggests that standing out within one's peer group intensified rivalry and instability, leading to faster turnover. Conversely, a higher average energy level across the entire simulated world ($\beta = +2.63$, $p \approx 10^{-129}$) increased survival, indicating that contestants thrived in collectively active, prosocial contexts. The combination of individual and environmental effects implies that success depended not only on personal attributes but also on their fit within the broader social equilibrium.

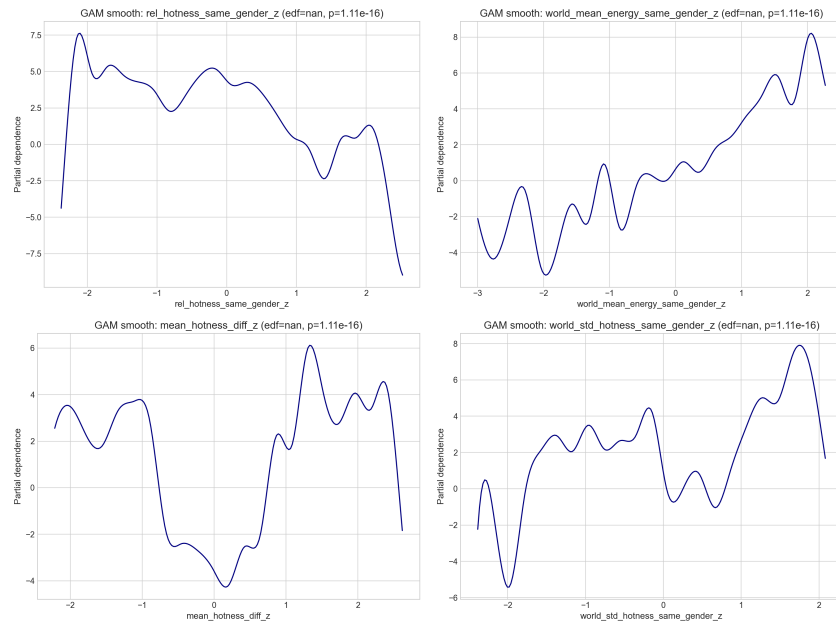


Fig. 4. Contextual GAM smooths depicting environmental effects. High relative hotness within same-gender groups reduced survival, whereas higher world energy increased it, indicating that social balance and collective engagement fostered stability.

3.5 Model Performance and Convergence

The OLS model explained approximately 56% of the variance in survival time ($R^2 \approx 0.56$), with nearly all predictors remaining significant after false-discovery-rate correction. The GAM achieved comparable explanatory power, reinforcing the robustness of the observed relationships. Both models converged on the same qualitative structure: survival decreased when individual traits exceeded socially sustainable levels, and moderate, well-calibrated profiles were most adaptive.

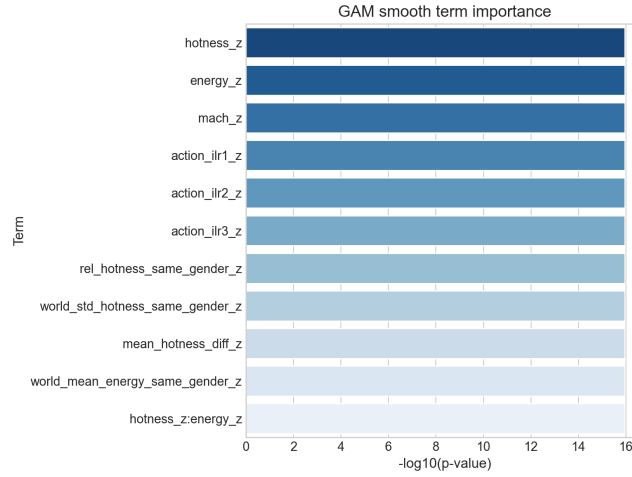


Fig. 5. Relative term importance from the GAM model showing predictors contributing most to explained deviance. The dominance of hotness, energy, and Machiavellianism reflects strong nonlinear effects on survival.

3.6 Emergent Social Equilibrium

Taken together, these results describe a self-regulating social system that penalized excess and rewarded balance. Contestants with extreme levels of attractiveness, energy, or manipulative intent destabilized their relationships and were more likely to be eliminated early. In contrast, those who maintained moderate vitality, authenticity, and emotional reciprocity achieved the longest survival. Energy modestly outperformed hotness as a long-term predictor once interaction effects were considered, suggesting that sustained relational engagement outweighed surface-level appeal. The simulated environment therefore favored agents who invested in consistent, cooperative behavior over those who pursued dominance or manipulation.

The overall pattern can be summarized as an emergent principle of social equilibrium. Genuine, balanced engagement supported endurance, whereas at-

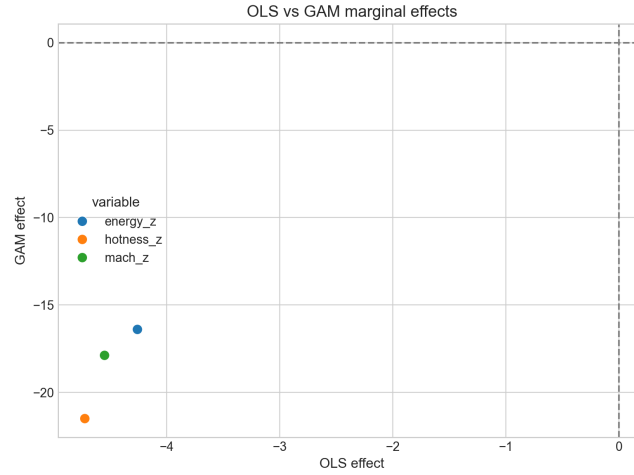


Fig. 6. Comparison of trait effect directions and magnitudes across OLS and GAM models, showing consistent negative impacts of core traits on survival.

tempts to maximize individual advantage through excessive attractiveness, activity, or strategy produced instability and decline. In this artificial yet behaviorally coherent system, relational success was not achieved through optimization but through harmony with collective dynamics.

4 Conclusion

The simulation results demonstrate that social success in complex, interdependent environments cannot be engineered through the maximization of individual advantages. Traits traditionally perceived as beneficial, such as attractiveness, energy, and strategic intelligence, became counterproductive when amplified beyond moderate levels. Rather than rewarding dominance or manipulation, the simulated *Love Island* ecosystem selected for behavioral balance and relational authenticity. Contestants who embodied moderate engagement and cooperative energy consistently outperformed those who relied on physical appeal or strategic calculation.

This emergent equilibrium reflects the self-correcting logic of social systems in which reputation, reciprocity, and emotional stability determine long-term viability. Agents who pursued purely instrumental relationships disrupted the social fabric and were removed from the population earlier, while those who invested in genuine connection contributed to collective stability and benefited from it. The findings therefore suggest that sustainable social strategies depend not on maximizing any single trait but on aligning one’s behavior with the ambient norms and energy of the surrounding community.

From a broader perspective, the study provides a computational illustration of how cooperation and balance can emerge spontaneously in competitive social

simulations. It supports the hypothesis that relational authenticity, rather than strategic optimization, is the adaptive response in environments governed by reputation and feedback. In the context of multi-agent modeling, this outcome underscores that the most enduring agents are not those who manipulate others most effectively, but those who maintain equilibrium between self-interest and social harmony.

References

1. (Oct 2025), <https://psychology.town/motivation-emotion/lazarus-cognitive-theory-emotions-appraisals/>
2. 16Personalities: Our framework: Neris personality theory. <https://www.16personalities.com/articles/our-theory> (2025), accessed: 2025-10-10
3. Barachini, F., Stary, C.: Agent-based stochastic simulation of emotions. In: From Digital Twins to Digital Selves and Beyond. pp. 63–74. Springer (2022)
4. Bourgaïs, M., Taillandier, P., Vercoeur, L., Adam, C.: Emotion modeling in social simulation: A survey. *Journal of Artificial Societies and Social Simulation* **21**(2), 5 (2018). <https://doi.org/10.18564/jasss.3681>, <http://jasss.soc.surrey.ac.uk/21/2/5.html>
5. Byrne, D., Neuman, J.H.: https://www.researchgate.net/publication/229221146_Chapter_2_The_Implications_of_Attraction_Research_for_Organizational_Issues
6. Claudino, M.: The sims 4 full compatibility guide. <https://gamerant.com/the-sims-4-full-compatibility-guide/> (2023), accessed: 2025-09-16
7. Flache, A., Mäs, M., Feliciani, T., Chattoe-Brown, E., Deffuant, G., Huet, S., Lorenz, J.: Models of social influence: Towards the next frontiers. *Journal of Artificial Societies and Social Simulation* **20**(4), 2 (2017). <https://doi.org/10.18564/jasss.3521>, <http://jasss.soc.surrey.ac.uk/20/4/2.html>
8. Giardini, F., Wittek, R.P.M.: Silence is golden. six reasons inhibiting the spread of third-party gossip. *Frontiers in Psychology* **Volume 10 - 2019** (2019). <https://doi.org/10.3389/fpsyg.2019.01120>, <https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2019.01120>
9. Hatfield, E., Cacioppo, J.T., Rapson, R.L.: Emotional contagion. *Current Directions in Psychological Science* **2**(3), 96–100 (1993). <https://doi.org/10.1111/1467-8721.ep10770953>, <https://doi.org/10.1111/1467-8721.ep10770953>
10. Hatfield, E., Cacioppo, J.T., Rapson, R.L.: Emotional Contagion. Cambridge University Press (1993)
11. Hodson, G., Hogg, S.M., MacInnis, C.C.: The role of “dark personalities” (narcissism, machiavellianism, psychopathy), big five personality factors, and ideology in explaining prejudice. *Journal of Research in Personality* **43**(4), 686–690 (2009). <https://doi.org/10.1016/j.jrp.2009.02.005>
12. Lipowski, A., Lipowska, D., Ferreira, A.L.: Emergence of social structures via preferential selection. *Scientific Reports* **13**, 14492 (2023)
13. Maclay, G.J., Ahmad, M.: An agent based force vector model of social influence that predicts strong polarization in a connected world (Nov 2021), <https://pmc.ncbi.nlm.nih.gov/articles/PMC8594851/>
14. McCrae, R.R., John, O.P.: An introduction to the five-factor model and its applications. *Journal of Personality* **60**(2), 175–215 (1992)

15. McCrae, R.R., John, O.P.: An introduction to the five-factor model and its applications. *Journal of Personality* **60**(2), 175–215 (1992)
16. Pena, I., Chen, H.: Exploring team dynamics and performance in extended space missions using agent-based modeling, <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0332496>
17. Porter, A., Standing, K.: Love island and relationship education. *Frontiers in Sociology* **5**, 58 (2020)
18. Simon, H.A.: *Models of Man: Social and Rational*. Wiley (1957)
19. Stein, R., Swan, A.B.: Evaluating the validity of myers–briggs type indicator theory: A teaching tool and window into intuitive psychology. *Social and Personality Psychology Compass* **13**(2), e12434 (2019)