Conspiracy of silence effects on Axelrod's metanorms

Stefano Romanazzi

stefan.romanazzi@gmail.com
student ID: 819445

Department of Computer Science
University of Bologna, Italy

Abstract. The conspiracy of silence brings out many negative effects in a society, creating an atmosphere of fear and diminishing the probability of punishment for a criminal, that can usually commit crimes undisturbed. Both the evolutionary mechanisms and the metanorm rule try to teach individuals how to react in a defecting society in order to defeat the most fearful criminals. Evolutionary mechanisms allow the individuals to learn from punishments, thus replicating in the next generations only if their strategy was successful. The metanorm rule enforces punishments also towards individuals that turn a blind eye when observing a crime. The experiments performed on the model try to establish whether these components can successfully work together producing a significant outcome.

Keywords: conspiracy of silence, game theory, Netlogo, Axelrod, metanorms

1 Introduction

A social dilemma is a situation where the interest of the individual conflicts with the preference of the collective [2]. Individuals entangled in a social dilemma have rational arguments to follow a behavior that, in the aggregate, leads to unfavorable outcomes for the collective. In fact, some individuals choose not to risk or spend energies trying to reach the ideal situation for the collectivity, gaining personal advantages and aggravating the collective situation instead. The ideal outcome of a social dilemma would be the one in which every individual cooperates in order to improve the society. As an example, economic social dilemmas include problems associated with the provision of public goods such as national security, public health and environmental protection, where individuals can make investments into a common pool to provide a costly, non-excludable asset that benefits all regardless of how much they contribute to creating it. In this project, the society is modeled by following Axelrod's metanorms game as a guideline. The society consists of individuals who can choose whether to commit a crime, leading to a small personal gain and a general worsening of the rest of

the society, or not to commit it but to cooperate instead in order to improve the society. This model has been used as a base to reproduce the code of silence mechanism, known as omertà. Omertà is a code of honor that places importance on silence: it originated and remains common in southern Italy, where criminal organizations have a strong influence. It creates a fearful situation for individuals who want to punish a criminal. In fact, the criminal may be involved in a criminal organization capable of reacting violently to any form of punishment towards one of their members. In this scenario, the majority of agents decide not to react to the observed crimes, leaving criminals unpunished [1].
Hence, the purpose of this paper is to simulate a society disturbed by the effects of omertà and to test its adequateness during the interaction of omertà with other society mechanisms, such as the capability of individuals to learn from their errors and to reproduce only if they are the most successful part of the society.

2 Preliminaries

The simple model that the project is based on is Axelrod's metanorms game. The primary modeled component is a simple society in which individuals can decide whether to commit a crime based on the probability of being seen. In brief, the metanorms try to implement a mechanism that promotes cooperation in a social dilemma. Social dilemmas are usually modeled as games in which every actor can follow different strategies. The first requirement in social dilemmas is the presence of at least one deficient equilibrium, which is an equilibrium where individuals are not inclined to change behavior, but at the same time there exists another possible configuration that each individual prefers to the current one. Eventually, the best strategy for the collectivity is the cooperation: cooperation brings advantages to the group at some cost, whilst every individual is tempted not to bear the collective cost, taking better advantages all by himself and without providing advantages for the society [2]. The standard Axelrod's game has been mainly implemented on global interaction networks, where every individual can potentially interact with everyone else. A lot of topologies have been used with metanorms, proving that the global interaction network is not always the most realistic network structure [4]. As emerged from this project, alternative network structures are not well suited for the implemented extensions, since most of individuals tend to die, being replaced by new ones: this rips off any network structure, highlighting the necessity of a global interaction network.
After the analysis of the main aspects of this article, it is of great importance to understand the basic Axelrod's metanorms rules. Every individual is characterized by a boldness and a vengefulness factor. The boldness defines the probability to defect and it's compared with a randomly generated value which defines the probability of being seen during the crime. The vengefulness defines the probability of punishing a spotted criminal [3]. The game is organized in rounds: in each round, every agent decides what to do going through three stages [2]:

1. Agents individually decide whether to cooperate or defect. If the agent cooperates, no one's payoff is altered. If the agent defects, he obtains a Temptation payoff (T = 3), inflicting on each of the remaining agents a Hurt payoff (H = -1). In this case, the defecting agent proceeds to stage 2.
2. Agents who observed another agent committing a crime decide whether to punish the criminal or not, but punishment is costly: the punisher pays an Enforcement cost (E = -2), in order to impose a punishment cost (P = -9) on the defector.
3. The third stage includes the metanorms rule. Agents who don't punish criminals can be punished in turn. The probability of being seen not punishing the criminal is equal to the probability of observing his defection. A meta-punisher pays a Meta-Enforcement cost (ME = -2) in order to inflict a Meta-Punishment cost (MP = -9).

Axelrod was also interested in exploring strategies applied to an evolutionary context. The intent was to improve the quality of the individuals, replacing the actual generation with a brand new one, formed by the offspring of the most promising individuals of the previous generation. More specifically, the natural selection strategy was implemented in the following way [5]:

- Players in the old generation with a payoff exceeding the population average by at least one standard deviation are replicated twice.
- Players who are at least one standard deviation below the population average are eliminated without being replicated.
- The rest of the players are replicated once.
- The total number of players is kept constant, but Axelrod does not specify exactly how.

This strategy has been implemented in the related project, with few variations applied in order to balance the negative effects introduced by the conspiracy of silence. All implementation details are specified in the section 3.1. Another addition to the model provided by Axelrod was a mutation operator, used to generate new strategies. Since in the standard Axelrod model the boldness and the vengefulness take eight possible values (from 0 to 7), they can be represented by three bits that are mutated by flipping one of them, when an agent is reproduced, with a 1% chance of a mutation occurring [6]. As for the natural selection, the mutation operator has also been adequately adapted to the implemented model.

3 Extending the model

Axelrod's metanorms game has been modified and extended in order to test new social interactions. The first immediate difference is in the structure of the created network. Generally, these networks are set up to simulate real society connections, representing ties among individuals. In this model, the network is set to the same structure of the complete graph, thus potentially allowing every individual to interact with every other. This choice has been made in order to simulate a small-town-like society (a society similar to a small town), where individuals can all potentially interact with each other, regardless of their acquaintances. For the same reason, the number of individuals in the society has been incremented to 100. The other relevant change to Axelrod's model concerns the punishment mechanism which now depends also on a random factor that may help the defector to escape the punishment. This random factor has been introduced with the idea of simulating casual events and actions that may cause the criminal to avoid the punishment or the punisher to be merciful.

3.1 Evolutionary mechanisms

The first important addition to the model consists of two evolutionary mechanisms, which try to simulate the evolution of the individuals through learning process and natural selection, allowing for an improvement in the society and providing realistic changes at the same time. The learning process has been designed in a way to simulate how different individuals may react to punishments:

- If the punished individual has a number of points that is less than the population average, his vengefulness is increased by 40% and by a learning factor which depends on the individual. The criminal, in fact, bursts with rage increasing his vengefulness towards other individuals, since he got punished being also one of the weaker individuals in the society.
- If the punished individual has a number of points that is more than the population average, his boldness is decreased by a factor of 20% and by the learning factor, since he learns that committing a crime brings disadvantages (the punishment) and avoids repeating the same error in the future.

The natural selection allows only the most successful individuals of the society to replicate. The selection is performed by choosing the best individuals in accordance with their scores:

- The most promising individuals are those who have more points than the mean and the standard deviation of points added together. These individuals generate three offspring with their same characteristics.
- The average individuals of the society have lower scores than the previous ones, but nevertheless higher than the mean of points minus the standard deviation. These are the most common individuals in the society with average success in the game, so they generate just one offspring.

– The remaining population is not very successful and does not replicate, therefore dying at the end of the round.

If the population exceeds the initial number, the oldest individuals are killed, in order to keep the number of individuals in the simulation constant.

3.2 Mutations

This extension has been implemented with the goal of randomly perturbing the features of the individuals. Without mutations, the mean values of the features that appear in the experiments show a flat trend, that does not look like a realistic scenario. The mutation process is applied only to the individuals who survive the round. Because of its simplicity, this property is implicitly activated during the execution of all the performed experiments in the section 4.

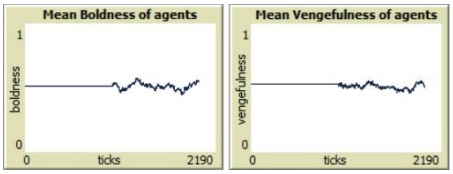

Fig. 1. Effects of mutations on individuals' features. In the second half of the experiment mutations are set to 0.01 and enabled.

3.3 Modeling the conspiracy of silence

The last and the most relevant extension of the Axelrod's metanorms game, the core of this project, is the conspiracy of silence. This addition has the only purpose of extending the metanorms model with another negative mechanism that induces dangerous criminals to kill their punishers. Along with the danger, a courage feature has also been added: this allows potential punishers who are braver than others to punish a criminal even if he is dangerous. Both danger and courage are defined within a range from 0 to 1. These two features help to create a new trade-off between punishers and criminals defined by the following inequality:

$$vengefulness * courage > random * danger.$$

Vengefulness and courage are punisher's related features, whilst random and danger are criminal's related features. The random value has been explained in the section 3. The danger feature is also used to select criminals who actually are capable of killing their punishers. The minimum threshold for this selection is 0.8 and a random probability defines if the murder is successful. The condition to be satisfied for the death of the punisher is the following:

$$danger > 0.8 \wedge random < danger.$$

The higher is the danger the more are the probabilities to succeed in the murder. The conspiracy of silence also interacts with the learning process:

- The danger of the punished individuals having scores under the population average increases by 20%, making them not only more vengeful, but also more aggressive. This is a spontaneous reaction when the agent badly reacts to a punishment.
- The courage of the punished individuals having better scores than the average increases by 20%. These individuals become more loyal and increase their courage in order to fight dangerous criminals in the next rounds.

The conspiracy of silence introduces a new metric, which is applied to the whole model: the appreciation. This metric shows how much an individual is appreciated in the society. Whilst the points evaluate the payoffs (hurt, temptation, enforcement, punishment), the appreciation grows depending on the goodness of actions performed by the individual:

- If he commits a crime, his appreciation is decreased by 9 for every punishment.
- If he chooses to punish a criminal, his appreciation is increased by 5.
- If he is seen not punishing a criminal, his appreciation is decreased by 3 for every individual who spots him.
- If he punishes an agent that turned a blind eye, his appreciation rises by 3.
- At the end of each round the appreciation of each agent is also modified by the following formula:

  $$appreciation = appreciation + courage - danger$$

  In this way, the courage and the danger associated with the individual in the last round influence other agents' opinion of him.

4 Experiments

This section discusses the main results obtained from various simulations, based on specific hypothesis formulated to fit the execution of the experiment. Most of the experiments consist of observing the main changes in the model due to the activation of a specific extension.
As a matter of fact, the dynamics of agent-based models are so complex that it is often not easy to understand in exhaustive detail how they operate. Not knowing exactly what to expect makes it impossible to tell whether any unanticipated results derive exclusively from what the researcher believes are the crucial assumptions in the model, or whether they are just artifacts created during its design, its implementation, or in the running process.
The metanorm extension, designed by Axelrod, tries to model a more severe society. It is based on the assumption that punishing agents who don't punish criminals indirectly reduces criminality, therefore increasing the well-being in the society.
The conspiracy of silence is the key extension designed and implemented in this project. It is interesting to see how other mechanisms of society can react to the increase of defections and a general worsening of the well-being, due to the fear of punishing a dangerous criminal.
Most of these mechanisms are designed to simulate real life situations: as an example, a natural selection process has been implemented, replicating only the most successful individuals of the society while discarding the worst ones.
The interactions of these mechanisms can produce very complex behaviors, inducing several, sometimes unexpected, effects.

4.1 The metanorm

The metanorm extension aims to increase the vengefulness, allowing agents to punish individuals who turned a blind eye. This should work as an incentive to augment the punishment rate towards criminals. In reality, multiple observations conducted on this extension also suggest some undesirable effects:

- The average of points and appreciation unavoidably decreased.
- The vengefulness, expected to grow, remained stable.
- Defections and boldness did not rise or fall either.

This behavior is due to the absence of mechanisms that allow the individuals to improve during time. In fact, in the given model, the oldest individuals die in order to make room for the new ones. This mechanism helps to keep the population stable, but inhibits improvement. To solve this problem two different evolutionary mechanisms have been implemented:

- The learning process implements reactions of the criminals to the punishments they receive.
- Natural selection operates in the following way: the worst individuals of the society are killed, average agents are replicated once and very promising agents are replicated three times.

In the next subsection this experiment is repeated to enforce the evolutionary mechanisms and to prove that the activation of at least one of them is essential in order to observe changes in the society.

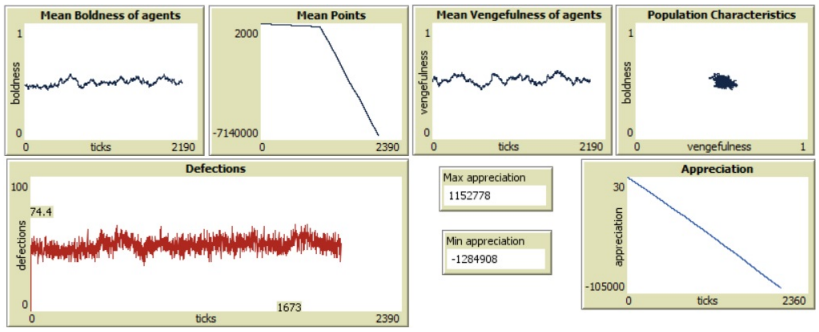

Fig. 2. This experiment consisted of two executions of 1000 rounds each, first execution without the metanorm extension and the second execution with the metanorm rule on. In both of them the evolutionary mechanisms were disabled.

4.2 Learning process and natural selection

The evolutionary processes are essential for the improvement of the society, since on every update the oldest individuals die and are replaced by the newly born ones. This feature doesn't allow for the replication of the characteristics that each individual acquires during his life and at each round new agents are created without considering the experiences of their ancestors.
The experiment from the previous section is therefore repeated, but this time with the natural selection mechanism activated. The experiment is divided into two parts and both of them have a duration of 1000 rounds:

1. In the first part the natural selection mechanism is activated and the metanorm is deactivated.
2. In the second part both of them are activated.

The purpose of this experiment is to point out the importance of an active evolutionary mechanism.

It is possible to observe how in this experiment the activation of the metanorm rule produced the expected effects. First off, the vengefulness remarkably grew as a consequence of the metanorm rule, as did the boldness and, consequently, the defections increased. This suggests that, even if the metanorm rule tries to improve the society by building a more severe model, this approach may also bring undesirable side effects, increasing de facto the violence. Furthermore, the mean points of the individuals initially decreased, though remaining stable

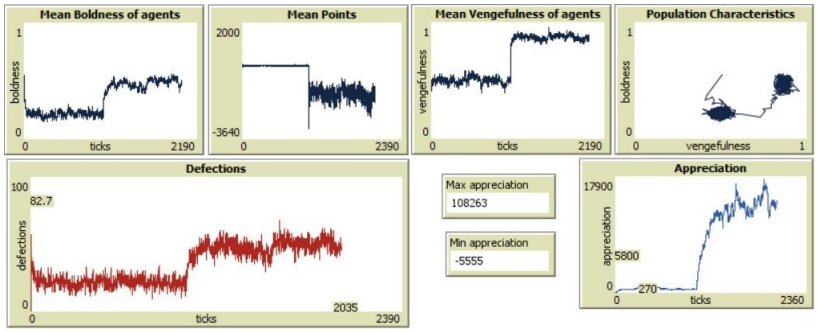

Fig. 3. Repetition of the previous experiment with natural selection mechanism activated. The whole experiment lasted 2000 rounds.

throughout: this is caused by the growth of the total number of vengeances. Lastly, the average appreciation grew since the least appreciated individuals are also the ones with the lowest scores, which are usually killed by natural selection.

The same experiment can be carried out using the learning process instead of the natural selection. In this way, it is possible to compare the two mechanisms and see what happens when they are combined together. The activation of the learning process should induce the individuals to do some self-teaching: individuals may become either more vengeful or less inclined to commit crimes depending on their score compared to other individuals.
As shown in the figure 4, the experiment with the learning process gave the expected results. In addition, it is possible to point out few additional details that allow us to compare the two evolutionary mechanisms:

- Differently from the natural selection, the learning process reduced the boldness and the number of defections, while leaving very high vengefulness values, that increased even more than in the previous experiment since both metanorm and learning process were active.
- As a side effect, the learning process does not have any feature capable of reproducing only the most promising individuals, thus not being capable of keeping the appreciation and the score of the individuals at stable values. In fact, both points and appreciation quickly decline. Points decline even more because of the metanorm rule.

After the first two experiments and the comparison between the two evolutionary mechanisms, it is easy to state that these two mechanisms, if combined together, should bring optimal results in the society, thus reducing criminality and increasing vengefulness, without having a large drop in points and appreciation, which have to remain stable or even grow in an ideal society.
As shown in the figure 5, these hypotheses are confirmed by the performed experiment which exhibits as the only side effect a slight decrease in points when the metanorm rule is enabled (in the second half of the experiment).

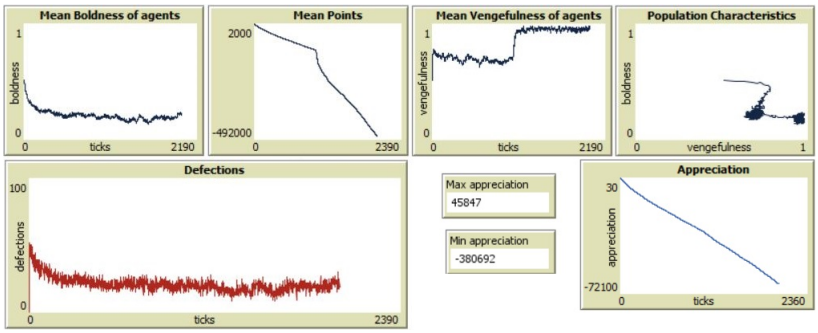

Fig. 4. Repetition of the previous experiment with the learning process activated instead of the natural selection. During the first 1000 rounds the learning process was active without the metanorm rule; during the following 1000 rounds, both the learning process and the metanorm rule were active.

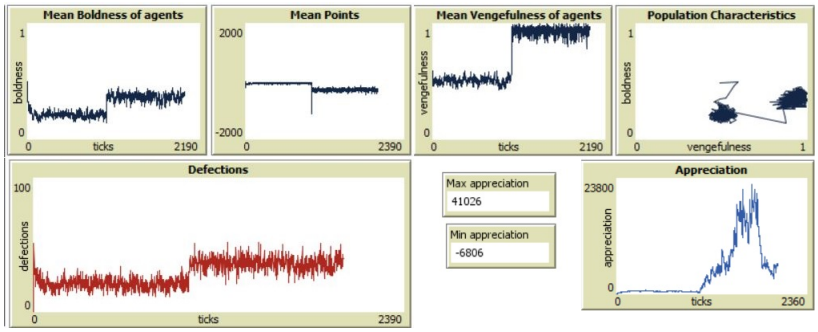

Fig. 5. Final experiment, with both evolutionary mechanisms enabled.

4.3 Conspiracy of silence

The main addition to the created model is the *conspiracy of silence* extension, which has been specially designed and implemented in order to simulate the behaviors that usually occur in a society when individuals are afraid to denounce or punish criminals, since they may take vengeance in violent ways. Without describing the extension once again, whose design choices have been explained in the preliminaries, the current section tests whether the aforementioned extension shows expected results or not. Another key thing to test is if the implemented evolutionary mechanisms are able to counterbalance the negative effects introduced by the conspiracy of silence.
The conspiracy of silence introduces two additional features (courage and danger), associated to each agent and used to determine whether an agent is going to punish a dangerous criminal. A fearful individual will be prone to ignoring a dangerous criminal, since he knows that he will probably get killed. On the contrary, a brave individual will tend to punish more easily a dangerous criminal, putting the society needs first.

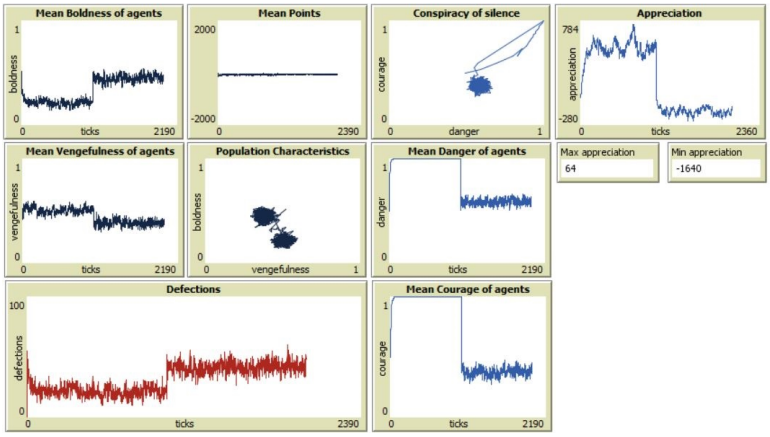

Fig. 6. Effects of the conspiracy of silence on the society. The natural selection mechanism has been enabled since it is required in order to prove the persistence of the criminals in the society.

The influence of these two additional factors should certainly decrease the general vengefulness in the society, allowing more criminals to survive the natural selection. This results in a higher general boldness of the society and, as a consequence, more defections.
Figure 6 shows that all hypotheses are confirmed after the execution of the experiment, also showing a sudden decrease in the appreciation after the activation of the conspiracy of silence.

It is useful to take the last experiment and procedurally enrich it, adding the learning mechanism and eventually the metanorm rule. The purpose is to observe the evolution of the society step by step and, lastly, to evaluate its final status. The addition of the learning process is meant to provoke a desirable growth in the general vengefulness and a decrease in the general boldness and in the number of defections. This should bring more stability to the society counterbalancing a bit more the negative effects introduced by the conspiracy of silence.

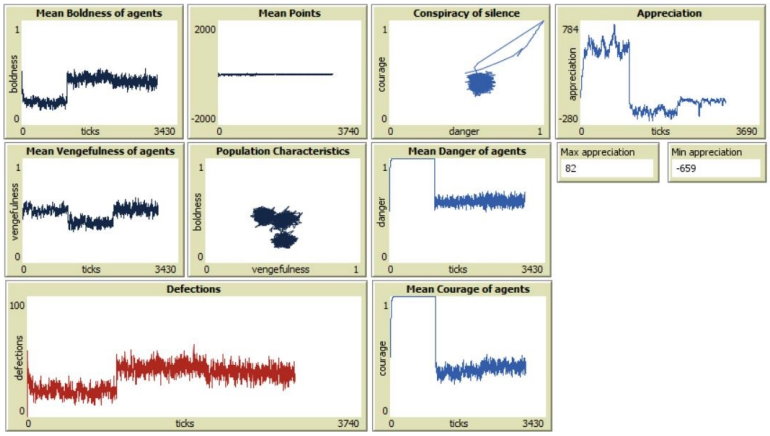

Fig. 7. Previous experiment with the addition of 1000 rounds during which the learning process has been enabled.

Figure 7, containing the output of the experiment, confirms the forecasts made, but aside from the vengefulness, which has been restored to the original values, the general boldness and the defections have shown only a slight decrease. In addition to this, there's a slight increase in the courage and in the appreciation of individuals, which however helps in improving the society. The increase in the courage is provoked by the simultaneous activation of the conspiracy of silence and of the learning mechanism, which makes the repented criminals change sides, growing a desire to improve the society. The slight increase in the appreciation is just a side effect due to the growth in the general courage of individuals.

In the final experiment, it is necessary to observe the changes in the society if the metanorm rule is enabled. The metanorm rule, as always, should induce an increase in the general vengefulness and a decrease in the general boldness. In addition, the points should fall slightly due to the rise in the number of punishments. The effects obtained after the simulation, which can be observed in figure 8, confirm the forecasts, but it's necessary to point out some crucial details:

– The standard effects of the metanorm can be easily determined by observing the result of the experiment, but it is also clear that those effects are

weakened. This is due to the other implemented mechanisms which already contribute to improving the society, making the effects of the metanorm rule less evident.
– The courage has remarkably grown and the danger has slightly fallen. This observation leads to a conclusion: even if the metanorm rule does not interfere directly with danger and courage, it is clear that its interaction with the natural selection mechanism resulted in the death of the most dangerous criminals and the most fearful individuals, giving more stability to the society.
– The general appreciation hasn't grown much, but has gained stability: in fact, as it can be noticed from the figure, there are less evident peaks in the last 1000 rounds.

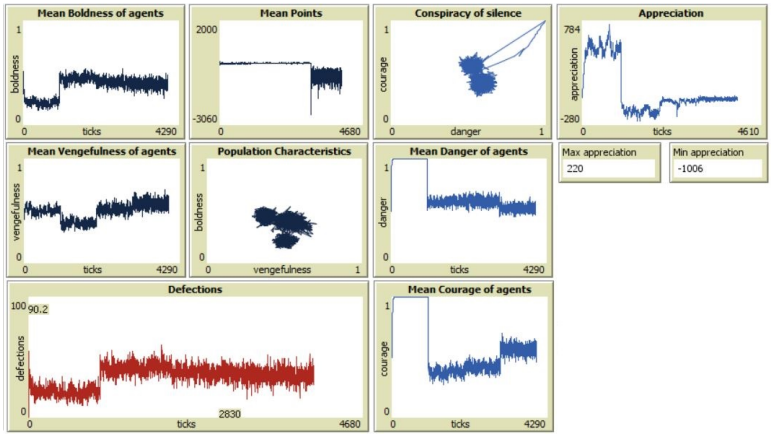

Fig. 8. Final experiment that adds to the previous one 1000 rounds during which the metanorm rule has been enabled.

4.4 Additional observations

After analyzing the implemented extensions and all their relevant interactions, some additional observations can be made with regard to the conspiracy of silence. In particular, it is interesting to monitor the number of murders in the population and correlate it with the death of the most appreciated people in the society. In this way it is possible to point out under which circumstances less murders are committed and less loyal individuals are killed. In these experiments the natural selection mechanism and the conspiracy of silence are implicitly assumed to be active.
In the first experiment, shown in figure 9, the learning process has been activated in the second half of the execution. It is immediately visible that the risk

of being killed grew as a consequence of the rise in the vengefulness that also increased the probability of a lawful individual being killed.

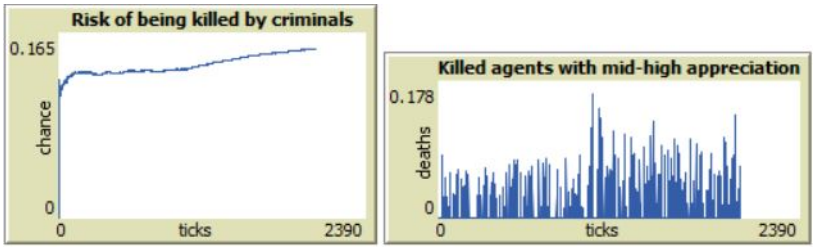

Fig. 9. Influence on murders with the learning mechanism activated.

In the second experiment instead, the simulation proceeds with the activation of the metanorm rule.Figure 10 highlights the differences between the two experiments, showing a slight decrease in the risk of being killed, along with a significant rise in the probability of an appreciated individual being killed.

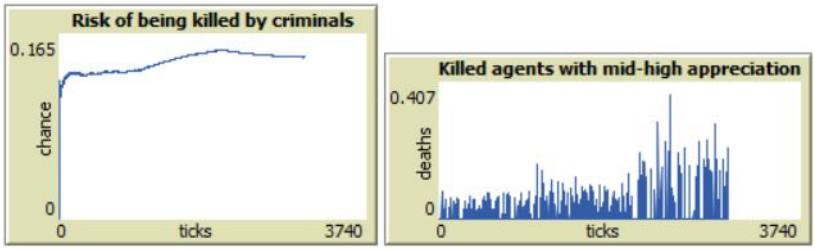

Fig. 10. Influence on murders with the metanorm rule activated.

In conclusion, as demonstrated in previous sections, both the learning process and the metanorm improve the stability of the society, but they also make criminals either generally more aggressive or more vengeful against their punishers.

5 Conclusions

At the end of this work it is possible to state the effectiveness of the implemented mechanisms. In fact, the tensions introduced by the conspiracy of silence into the society have been successfully counterbalanced by the evolutionary mechanisms and the metanorms. The activation of the positive mechanisms had expected and balanced outcomes in the society, without producing extreme changes of the observed features. The experiments have been conducted in a specific sequence, allowing to gradually improve the society after the activation of the conspiracy of silence and, in the meantime, observing step by step the effects of every mechanism in a realistic scenario. In the final experiment the observations reached an acceptable equilibrium:

- The boldness and the total number of defections have globally increased, but the positive mechanisms have anyway gradually counterbalanced the increase provoked by the conspiracy of silence.
- The vengefulness has gradually increased at each step, reaching higher values than in the initial experiment.
- The courage has suddenly increased in the final phase, reaching mid-high levels.
- The danger has slightly decreased, highlighting a positive change in the society, which now has less dangerous individuals.
- Appreciation and mean points stabilized showing acceptable values: in the first case slightly positive, in the second case slightly negative.

Considering the current state of this work, two future directions could be taken into account in order to extend, perhaps validating, the implemented model:

1. Other real mechanisms observed in a society could be modeled and tested in order to be added to the current work, based on the assumption that these mechanisms should regard a crime-based scenario, thus reacting with the existing extensions implemented in the current model.
2. Detach the conspiracy of silence extension from Axelrod's metanorms, creating a model ex novo and performing modular experiments similar to the ones described in this article, in order to compare them.

In both alternatives it would be suitable to compare the obtained results with real-world outcomes, hence evaluating the extent of similarity between them.

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