# Application of SRM to Diverse Populations

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**Abstract.** In today modern industrial cities we see that many people having different cultures share the same settlement and form a typical social complex system. People come from other cities or even foreign countries Newcomers bring their cultural values such as clothing, meals, likes and dislikes. As a result of interacting with other people some cultural values change, some completely forgotten while others become popular and known by the majority of people. There should be a mechanism helping some cultural values being more popular and causing other people being assimilated by majorities. Different cultures' interactions with each other and consequences of their interactions will be investigated by the principle rules of Simple Recommendation Model which is proposed by Bingol in 2006. The agents will be grouped according to their national origin and remember and forget the choices instead of agents. Also selections of interacted agents will be made according to people's choices.

**Keywords:** Emergence of fame, cultural choices, assimilation.

## 1 Introduction

Humans are social creatures and exchange ideas by interacting with each other. By doing so they learn new people, habituates or cultural values from their parents or from the people they interact.

In Simple Recommendation Model (SRM) each agent has a limited memory capacity and keeps other agents in his memory [1]. The agents interact with each other by exchanging agents in their memories. Since the memory capacities are limited, an agent is known in price of forgetting the other. There are giver, taker, recommended and forgotten agents in a recommendation process. Selections of the agents are random. Hence the model is called the Simple Recommended Model (SRM). As a result of simple recommendations, some agents become extremely known. This observation is interpreted as emergence of fame.

We will extend SRM by applying the model into the real life scenarios of today's world. In the SRM, an agent interacted with others completely randomly but in real life they interact within groups they belong to. Groups can be formed from friends, work, occupation or clubs. In our work we take ethno-national groups.

We will try to make predictions about the result of interactions of different ethno-national cultures by composing the SRM and work of Wimmer. We will propose a

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model in which agents interact with each other according to their choice of interactions according to their choice of interactions and impose their choices to others. We will extend the recommendation model based on Wimmer's work on a Swiss society with Italian and Turkish immigrants [2].

There are theoretical paradigms in Sociology, Order Theory of Durkheim that emphasizes the ways in which different groups progressively become more unified and indistinct and Conflict Theory of Marx and Weber that emphasizes the inequality among ethnic groups [3]. Our work will show whether the groups in our model will go to unify or distinguish in having common choices.

The rest of the paper is outlined as follows. Section 2 explains the Wimmer's work. Section 3 briefly explains Bingol's SRM since our model will extend the mechanisms of SRM. In Section 4 we will introduce our choice recommendation model. Section 5 will give the simulation results and finally we will give a related work and conclude the subject.

## 2 Wimmer's Work of Swiss Population

Wimmer conducted a series of researches in three Swiss Towns, namely St. Johann, the Breitenrain and the Hard neighborhood. All of the residential areas are highly populated with immigrants and suitable to group formation. In his research, he has worked on the relations between the native Swiss and immigrant populations [2].

Althouh there are many social groups, Wimmer has focused on the three largest groups, namely Swiss, Italians and Turks. The percentages of relations are as given in Table 1.

There is a sharp distinction between relations of Swiss Italians and Turks. We will run our simulations in the light of those interaction ratios given in Table 1.

As expected, a group prefers itself to interact. In this respect Swiss is the closest community and prefere Italians when they interact. Italians are slightly more closer than Turks. Note that this is a highly asymmetric system. For example Swiss prefer Turks with 0.8%, while Turks prefer Swiss with 20%.

**Table 1.** Ethno-national background of the people according to their choice of interactions

| | | National Background of Alteri | | | | |
|---|---|---|---|---|---|---|
| | | Swiss | Italian | Turkish | Others | Total |
| National Background of Respondent | Swiss | 85.5% | 5.0% | 0.8% | 8.7% | 100 % |
| | Italian | 17.8% | 68.9% | 0.7% | 12.6% | 100 % |
| | Turkish | 20.8% | 3.9% | 66.6% | 8.7% | 100 % |

## 3 Bingol's Recommendation Model

We will briefly mention the SRM of *Fame* [1] since our model will be based on the same principles. Then, we will give the variations of our model. Here is a brief description of SRM:

There are $n$ agents. Each agent has a limited memory capacity $m$ and initially randomly filled with other agents. If an agent $a_i$ resides in the memory of another agent $a_j$ then $a_j$ *knows* $a_i$, if not then $a_j$ does not know $a_i$ . The *knownness* or let us say the *fame* of $a_i$ is the percentage of agents that know $a_i$. An agent can know only $m$ agents which is $m<<n$.

The memory contents of the agents change as the recommendation takes place. In any simulation cycle there are recommender, taker, recommended and forgotten agents.The recommendation operation happens as follows; the recommender agent selects the recommended agent from its memory and recommends it to the taker agent. If the recommended agent is not in the taker's memory yet, the taker agent replaces the recommended agent with the forgotten agent in its memory slot and learns the recommended agent in the price of forgetting the forgotten agent. If it is already in his memory nothing is done. This is a simple recommendation operation of the model. All the selections are made randomly.

## 4 Choice Recommendation from Different Populations

Our model basically differentiates from SRM in that the population is divided into sub-groups, namely $A_S$, $A_I$ and $A_t$, that represents Swiss, Italian and Turkish populations respectively. The other important point is that our agents will keep their choices, let's say their cultural values, in their $m$ memories instead of keeping other agents. Those choices will be represented by consecutive non-overlapping numbers. Let $C_S$, $C_I$ and $C_t$ be the sets of choices of Swiss, Italians and Turks respectively. Every agent will have the same $m$. Assume that $M_S$, $M_I$ and $M_t$ are the memory contents of a randomly selected agent of Swiss, Italians and Turkish people respectively and, $M_s \subseteq C_s$, $M_i \subseteq C_i$ and $M_t \subseteq C_t$. The Number of choices will be proportional to the group's size, the bigger population will have the more choices. Initial popularity of a choice is calculated by the number of agents who keeps that choice in his memory. In other words, let $a_i \in A_s$ and $c_i \in C_s$ be a choice of $a_i$. Then initial popularity of $b_i$ is $P_I = |\{c_i \in M_j \,|c_i \in A_s\}|$. If a choice has zero fame at the end of the simulations, it will be completely forgotten and if it is known by all the agents then it will be completely known.

There is an important differences in the recommendation operation in our model, that is selection of taker agent. Taker agent will be selected according to the preference of the giver agent. Let $a_i$ is a giver agent in $A_S$ and $a_j$ is a taker agent in $A_I$. Then, $P_{AsAi}$ is the probability of $A_S$ interacting to $A_I$ and the taker will be in $A_I$ with $P_{AsAi}$. Giver agent is selected randomly. The rest of the recommendation process occurs as follows:

Giver agent selects the recommended choice from it's memory content randomly and recommends it to the taker agent. Taker agent is selected according to the ratios given in Table 1. by a random number generator. We care with the memory contents of Swiss, Italian and Turks choices. If the random number generator selects *others,* we just skip to the next simulation cycle. If the recommended choice is already in the memory of the taker agent nothing is done. If not, a choice selected randomly from the taker's memory and replaced by the recommended choice.

In our model $m=5$. The simulations will be made over $n=1000$ agents. The population ratios of Swiss, Italians and Turks living in three Swiss towns are given in Wimmer's work [2]. The number and percentages of empirical and simulation populations as well as the number of choices are given in Table 2.

**Table 2.** Etho-national background of the people according to their choice of interactions

| | Emprical Data | | Simulation Data | | | |
|---|---|---|---|---|---|---|
| | Populations | % of Populations | Sim. Populations | % of Sim. Populations | Memory Capacity of Each Agent | Number of Choices |
| Swiss | 23000 | 58.97 | 916 | 91.58 | 5 | 153 |
| Italian | 1360 | 3.48 | 54 | 5.40 | 5 | 9 |
| Turkish | 760 | 1.94 | 30 | 3.02 | 5 | 5 |
| Others | 21000 | 35.61 | - | - | - | - |
| Total | 46120 | 100.00 | 1000 | 100.00 | - | 167 |

Total number of choices for a group is selected to make initial popularity of choices be equal. For example, Italians are 54 agents. Each agent has a memory capacity of $m=5$. Then, total memory capacity is 270. When we distribute 9 choices to memory slots by a regular memory initialization scheme like in SRM model [1], the popularity of each choice will be 30. The other groups' choices are selected so as to make initial popularities 30. This popularity size is not strict and may be any number as long as initial popularity of every choice is equal.

## 5 Simulation Results

Simulations were held for $10^{11}$ cycles. 10 different simulations were held and their averages were taken as the result. We have inspected the results for maximum, minimum, average popularities and forgotten ratios of choices. The figures of the results are given in below figures.

### 5.1 Maximum Popularity

Maximum popularity is the total number of agents who know that choice. In our model, maximum popularity can be at most 1000 which means to be known by everybody.

Maximum popularity always belongs to Swiss population's choices but is not higher than 321 even after $10^{11}$. simulation cycles. It is far beyond to reach to be completely known. Although Turks' choices are almost half of the Italians' choices their average maximum popularities are almost the same and even gets higher than Italians. The result is given in Figure 1.

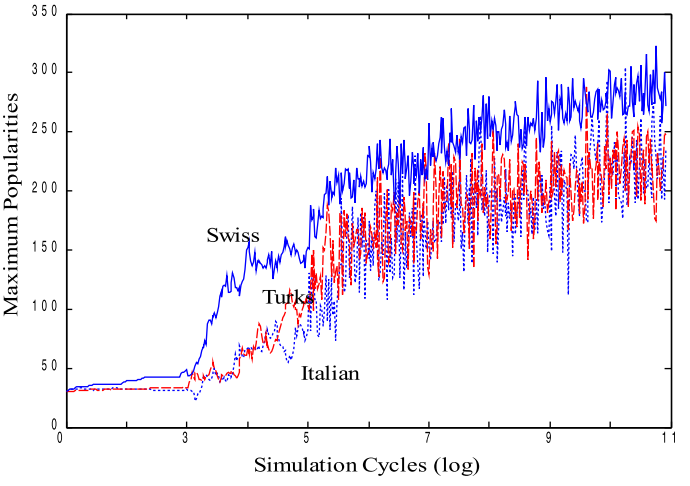


**Fig. 1.** Maximum popularities of choices

### 5.2 Minimum Popularity

Minimum popularity means to be least known by the whole agents. It is the smallest total number of agents who know that choice. Minimum popularity can be at least zero which means to be completely forgotten. Once a choice is completely forgotten there is no way to be known again. There is a sharp increase in the minimum popularities of all three societies after $10^3$ simulation cycles. Turks choices have less minimum popularities among others. Although their average popularities are less than Swiss, some of Swiss choices' popularities drops faster than Turks. The result is given in Figure 2.

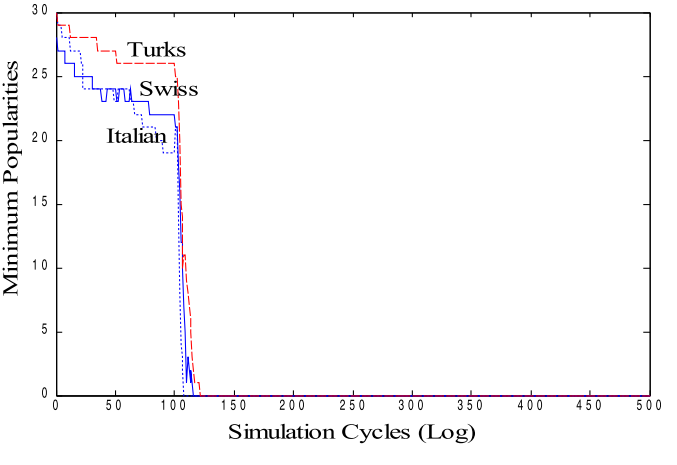


**Fig. 2.** Minimum popularities of choices

### 5.3 Average Popularities

Average popularities are calculated in two different ways. Firstly, popularities of each choice of a set are summed up and divided by the size of their own choice set. It is defined as follows;

$$p_{own}^{avg} = \frac{1}{|C_k|} \sum_{a_j \in A} |\{a_j \mid c_i \in M_j\}| \qquad \text{Where } c_i \in C_k \text{ and } A = A_S \cup A_I \cup A_T \qquad (1)$$

Secondly, the summation is divided by the total size of the three choice sets (167). It is defined as follows;

$$p_{all}^{avg} = \frac{1}{|C|} \sum_{a_j \in A} |\{a_j \mid c_i \in M_j\}| \qquad \text{Where } C = C_S \cup C_I \cup C_T \text{ and } A = A_S \cup A_I \cup A \qquad (2)$$

The figure of the first way of calculation is given in figure 3. It is trivial that Swiss' averages will be higher than others when calculated with the second way since Swiss are outnumbered Italians and Turks. Italians' popularities are also higher than Turks' popularities but at the end of $10^{11}$ simulation cycles, Turks' popularities are around 0.69 while Italians' popularities are around 0.38, even though Italians' choices almost double Turks' choices.

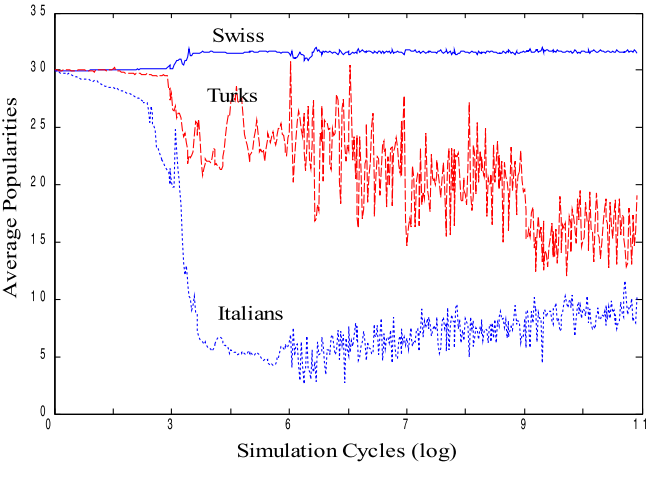


**Fig. 3.** Average popularities of choices. Averages are calculated within their own set of choices.

Here are the results of average popularities of choices given in Figure 3.

1. Swiss' popularities are always higher than others.
2. Italians' popularities are less than Turks' popularities.

There are two reasons. Firstly, Swiss prefer Italians five times more than Turks. So Swiss may impose their choices to Italians five times more than they do to Turks.

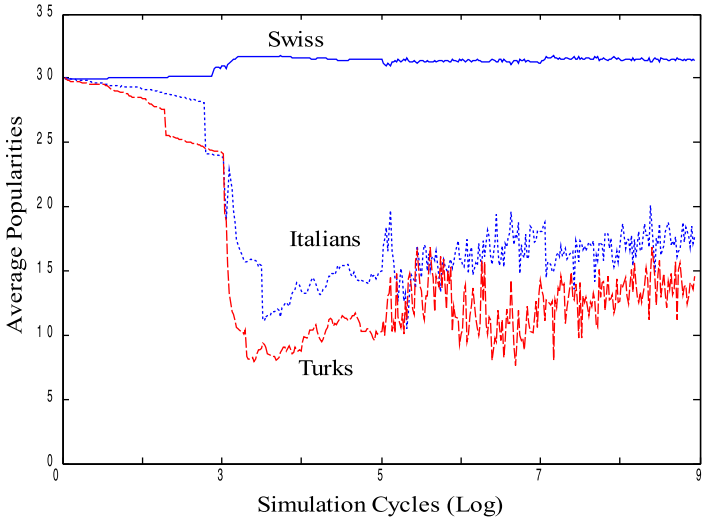


**Fig. 4.** Average popularities of choices when interactions of Swiss and Italians have been modified

Secondly, Italians prefer to communicate with other smaller minorities like Spanish and other Eastern European groups more than Turks do. Their preference of those minorities instead of Swiss adversely affect their choices' popularities.

We adjusted the relation percentages given in Table 1 to prove that hypothesis. We equalized Swiss preference of Italians and Turks. We also decreased Italians' preference of other groups to equalize it with those Swiss' and Turks' preferences. The result is given in Figure 4. As expected, Italians' average popularities got higher than Turks' averages.

We saw that although Turks have the fewest population they managed to overcome over Italians whose population are almost double of Turks. Swiss managed to impose their choices, let us say assimilate, other groups. We also conducted a series of simulations representing the interactions of two populations having the same memory capacities and population sizes. Population sizes were at the same ratios such as $n_1$=32 and $n_2$=968 representing Turks and Swiss respectively. Both of Swiss and Turks populations have $m$=5. Simulations were held for $10^9$ cycles.

Table 3 gives the results of above simulations. The ratios of maximum and average popularities and forgotten choices of two populations are given.

**Table 3.** Etho-national background of the people according to their choice of interactions

| Turks / Swiss | Two population simulations | Emprical data simulations |
|---|---|---|
| Maximum popularities | 0.81 | 0.80 |
| Forgotten ratios | 1.25 | 1.23 |
| Average popularities | 0.83 | 0.85 |

Those results coincide with the results of empirical data simulations of Turks and Swiss. Above results are very near to each other but not the same since there is random selection methods in the two population simulations but in empirical data simulations, selections are made according to populations' preferences.

### 5.4 Forgotten Percentages

Forgotten percentage is the percentage of forgotten choices in each set of choices. Swiss have zero value at $16x10^3$ th step, Italians have zero value at $8x10^3$ th step. and Turks have zero value at $21x10^3$ th step. After $10^4$ simulation cycles there is a linear increase in the forgotten percentages of Italians and Turks but there is a sharp (almost double) increase for Swiss choices after $10^6$ simulation cycles. Nearly two third of Swiss' choices have been forgotten around $10^6$ simulation cycles. The result is given in Figure 5.

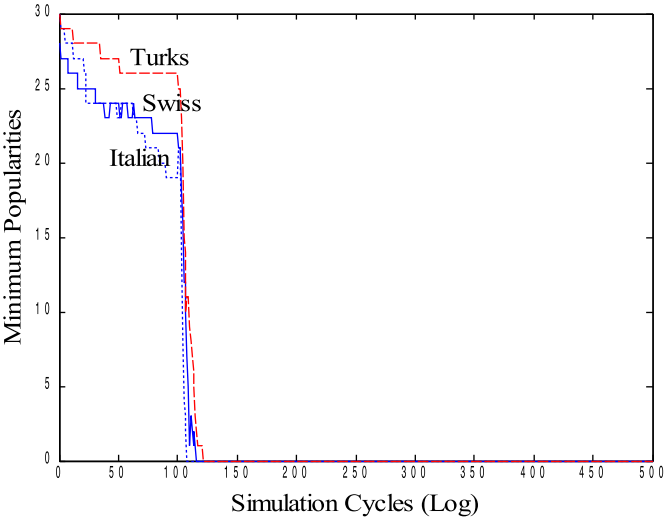


**Fig. 5.** Minimum popularities of choices

## 6 Related Work and Coclusions

Robert Axelrod and Ross A. Hammond have introduced *ethnocentrism* syndrome which can be described as in-group favoritism and out-group hostility of different groups living together. They have made simulations of agent based models in a square lattice [4]. They found that groups tend to show ethnocentric strategy with 76%, compared to 25% by chance. The results claims that groups will tend to diversify by choosing their own groups members for interactions rather than unify. Our researches show that they will unify after many simulations later.

In this research we have extended the SRM by using large populations of agents having small memory sizes. Agents have interacted by exchanging their choices

instead of exchanging agents. Here are some foresights about the consequences of their future interactions in the light of our simulations:

1. A group which is larger in population, has more chance to increase the popularities of its choices.
2. Close communities which interacts mostly among themselves have more chance to preserve their cultural values like Swiss population. Since social networks are scale-free, higher interactions rates between the agents of the same group makes topology more robust to outer influences and assimilations [5].
3. If an immigrant group is more popular for the dominant population than other immigrant groups, then it is more probable to be assimilated.
4. Assimilations take very long time. At the end of $10^{11}$ simulation cycles 95.5% of Italians' choices and 92% of Turks' choices have been forgotten. No complete assimilation is detected.
5. Although Swiss population's choices are more popular, none of them is known more than 32% of all populations even after $10^{11}$ simulations later.

We have found that communities tent to unify rather than diversify. All the interacting communities may show an ethnocentric behavior at first but sooner or later they will began to unify as they interact with each other. This will cause either integration or assimilation of minorities The model can be extended by applying other factors such as population's choices of religions and languages. Then some choices will not be easily changed by a simple recommendation model. It can be used some socio-economic researches of nations and cultural assimilation processes.

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