Sequential vs. Simultaneous Schelling Models: Experimental Evidence[1]

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Abstract

This work shows the results of experiments where subjects play the Schelling's spatial proximity model (1969, 1971a), in which choices are made sequentially, and a variation of it where the decision-making is simultaneous. The results of the sequential experiments are identical to Schelling's prediction: subjects finish in a segregated equilibrium. Likewise, in the variant of simultaneous decision the same result is reached: segregation. Subjects' heterogeneity generates a series of focal points in the first round; the subjects in order to locate themselves use these focal points immediately, and as a result, the segregation takes place again.

Keywords: Schelling models, economic experiments, segregation.

1. Introduction

Schelling's model (1969, 1971a) represents a paradigm inside the theory: it is a simple model, laconic in hypothesis and with very powerful results, from a theoretical point of view. In addition, it is an empirically relevant model since it offers a clear explanation of the segregation phenomenon, a problem that worries planners since the second half of the twentieth century.[3] Moreover, segregation has turned out to be one of the most important topics in the socio-political and public economic debate (The Economist, 2001).

In general, there are two basic variants of Schelling's "model of spatial proximity"[4]. The first version is a one-dimensional model and is introduced in Schelling (1969). In Schelling (1971a) a two-dimensional version is presented, which also appears later in Schelling (1971b, 1978). This work analyzes experimentally the one-dimensional model.

In the one-dimensional version of Schelling's spatial proximity model (1969, 1971a) a society is modeled through a sequence of individuals distributed along a line[5]. Two types of individuals form the society: whites and blacks. The adjacent neighbors to the left and right hand side define

[3] It is interesting to bear in mind that there are many forms of segregation. The segregation can happen in a racial context, but it can also appear for religious matters, sexual orientation, etc.

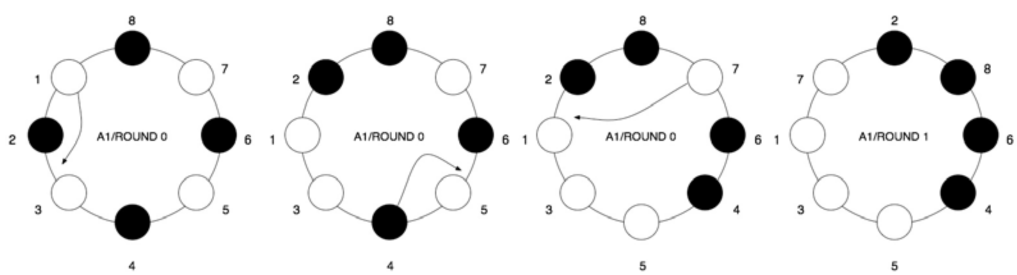
[4] Schelling calls this microeconomic model of neighborhood segregation as *spatial proximity model.* There are other variants of Schelling's model in the literature, both in linear and in matrix form, see Young (1998) or Zhang (2004a, 2004b).

[5] The number of individuals can be infinite, but Schelling (1971a) refers to the possibility of an infinite continuous line or a circle. The advantage is that in these cases all the individuals have the same number of neighbors.

the neighborhood of each individual[6]. The individuals who compose this society are utility maximizers, that is to say, they look for their best interest. The preferences of an agent are marked by his level of tolerance regarding the number of neighbors equal to him. For example, a slightly tolerant agent would be one who demands that all his neighbors next to him are of his same type. Nevertheless, a "moderately" tolerant agent would accept that half of his neighbors were like him[7].

In short, a striking result of Schelling's model is that even beginning from a society where individuals are moderately tolerant regarding the number of neighbors of their same type (as it has been defined above), the sum of the individual options generates a totally segregated community. Figure 1 illustrates how beginning from a situation of complete social integration (circle a) we reach, after individuals are allowed to move, a completely segregated society (circle b).

Figure 1: Integration (a) versus segregation (b) with N=8 subjects



[6] In this way, if we say that each individual has four neighbors, those will be the two on his right hand side and the two to his left.

[7] In this last frame, together with the assumption that each agent uses the information of the type of neighbors he has to his right and to his left, we could say that agents have very minimum requirements about the composition of their neighborhood.

This solution of equilibrium is a very powerful result since it seems to point out that it is not possible to do anything against segregation because it is simply the equilibrium configuration.

Nevertheless, Schelling's model, in its original version, has some particularities. One of the most important is the fact that subjects move sequentially in order to reach the equilibrium outcome. All the individuals who are not in a situation beyond their threshold of tolerance are organized to carry out their displacement in the society. This is, first an individual decides if he wants to move or not, then the following one decides, and this process carries out up to the last one.

From a theoretical point of view sequentiality is not trivial. This is so as in the sequential model the *k*-th subject already observes as given the first *k-1* decisions and he can only decide on the remaining *N-k*. Thus, in the sequential model every subject has different information, which depends on the moment when the individual decides. On the contrary, in a simultaneous model, all the subjects would decide on the *N* possible positions simultaneously and the amount of information available to each subject would be identical between them[8].

The aim of this work is to experimentally test Schelling's model making the subjects to play both in a sequential and in a simultaneous way. This is the

[8] In a simultaneous game, in which all individuals chose at the same time, no one knows *a priori* the choices made by the rest of the agents.

first work in which a laboratory experiment of Schelling's model, with individuals choosing simultaneously, takes place[9].

In order to carry out the experiments, Schelling's model is first designed in its original setting (where subjects take decisions sequentially) and later a modification is proposed, which will consist of the simultaneous decision of all subjects. The results of Schelling's model experiment when subjects decide sequentially coincide with the theoretical prediction of Schelling's model: in a single round subjects end up in equilibrium with total segregation. Surprisingly, in Schelling's model experiment when individuals decide simultaneously we obtain the total segregation outcome, as well. In this second case, subjects' heterogeneity generates a series of focal points in the first round, which are used by the subjects in order to locate themselves and, as a result, total segregation emerges again[10].

The rest of the work is structured as follows: the second section shows Schelling's standard model and its equilibrium prediction. In the third section we introduce a variation of Schelling's model, in which subjects take the decisions simultaneously. The fourth section describes the design of the experiments carried out and their execution. The fifth section analyzes the results obtained, in order to conclude in the sixth section.

[9] Benito et al. (2009) presents a sequential Schelling's experiment two different settings, with and without moving costs.

[10] A round is defined in this work as the moment in which all the participants have made their choice. In the simultaneous model it occurs when everyone has decided, the first round would be their first choice, while in the sequential model it occurs when all have chosen, that is, when the last agent who is supposed to choose has made his decision.

2. Schelling's spatial proximity model.

2.1. Schelling’s sequential model.

In order to represent Schelling’s sequential model we start from a circle in which we distribute *N* subjects of two clearly differentiated types (whites and blacks) [11]. Each subject has his neighborhood defined as well as his adjacent neighbors to the left and the right hand sides, that is to say, every individual has two neighbors, the first one to his left and the second one to his right. This way, the number of neighborhoods in the circle is equal to the number of individuals that compose it, *N*. The model is defined by the following properties: first, subjects are supposed to have a utility function according to which they reach happiness when they have at least a neighbor of their same type[12]; second, subjects move sequentially and without cost (the first one decides first, then the following one decides, and this way up to the *N*-th agent[13]).

Though costs of mobility do not exist, Schelling imposes that subjects move to the most nearby place that satisfies his neighbor demand, bearing in mind that moving to the most nearby place means to be located in the closest space. A space is the distance between two persons. With these minimal requirements the society will change from a complete social

[11] Even though it is not necessary, we assume by symmetry that the number of subjects *N* is even, and that there are *N/2* subjects belonging to each type.

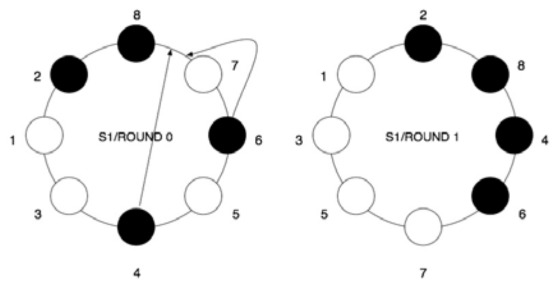
[12] This should be understood as a not very strict requirement of the model: individuals only need one neighbor equal to them in order to acquire their maximum utility or happiness.

[13] The decision about the selection of subject who starts moving is random. But starting from the first one all the rest move in a consecutive way, for example towards the right. Whether individuals move to the right or to the left hand side is not relevant, what matters is that there is an order of movement and that it has to be clear.

integration situation (figure 1, circle a) to a situation of absolute segregation (figure 1, circle b).

How is total segregation reached? Figure 2 illustrates the movements for a society of 8 individuals, (*N=8*).

Figure 2: Movements in the sequential game



In the initial situation (figure 1, circle a) subjects are completely unhappy given that they do not have any neighbor of their same type. Let's suppose that the white player on the top left side is the first one taking his decision (who will be called 1). Given that he is not happy he moves to the closest place where he is happy. As a consequence subject 2 is happy now (and also is subject 8) and therefore this player does not move. Subject 3 is also happy (since subject 1 has placed to his side). Nevertheless, subject 4 continues being an unhappy person since he still does not have any neighbor of his type. Therefore subject 4 moves next to subject 6. This makes happy both subject 6 (who is of his same color) and subject 5 (who is located next to subject 3). Finally, subject 7 that is not happy moves next to 2 and with it complete segregation is reached (see figure 2, circle 4).

In short, given the minimal requirements regarding the preferences of the model and with only three movements, full segregation is achieved. This is the "magic" of Schelling's model. Nevertheless, the sequential movement makes everything very simple: when the players take decisions they already know what has happened, specifically they know that the previous subjects cannot move anymore, for which risk does not exist. For example, when subject 4 moves he knows that neither subject 5 nor subject 6 are going to move, not before not later (that is, they will not harm him afterwards).

2.2 *Schelling's simultaneous model.*

To describe Schelling's simultaneous model, we are going to suppose, as in the previous case, that *N* subjects, who can be of two different types, distributed along a circle, compose the society. We define the neighborhood for each one of them in the same way we did in the previous model. In this case the model comes characterized by the following properties: first, we continue assuming that subjects have a utility function according to which they reach happiness when they have at least a neighbor of their same type; second, subjects move without costs, but in this case all subjects decide whether to move or not at the same time, that is to say, it is a simultaneous decision; finally, subjects can move to any place they wish along the circle since their movement is not restricted to the most nearby place.

The theoretical model to approach this problem would be a game in strategic form with *N* players. Every player would have *N-1* pure strategies, which correspond to moving to each of the spaces that the N players form along the circle (these are *N-2* strategies) or remaining still. Therefore, in the case of 8 players we would have the strategy of jumping clockwise into the second space, the third space and so on, up to the sixth space. Notice that to move either to the first or seventh space is to remain still. This finite game has, at least, an equilibrium in mixed strategies but in addition, multiple equilibria in pure strategies. With these requirements, the simultaneous model should be completely different from the sequential model. Nevertheless, the equilibrium outcome is also complete segregation.

To explain the equilibrium outcome lets suppose that we are in a situation like the one represented in of the second circle of figure 2, in which individual number 4 is unhappy, as well as 5, 6 and 7. We are going to focus only on the movement of players 4 and 6[14]. In this simultaneous game, player 4, does not know *a priori* if player 6 will be waiting for him when he arrives, if he decides to go next to him[15], therefore, subject 4 will probably decide to move to the least uncertain place, i.e. he would go to the "group of 2-8". The reason is simple: the group 2-8 is more certain than subject 6. There are many reasons why going to the big group is better: first, both subject 2 and 8 are happy one next to the other and,

[14]To simplify the explanation, we assume that subjects 5 and 7 do not move, even though, as we will see, in the case in which they also moved, none of them would choose to locate between subjects 2 and 8, because this position would not be a good strategy for them.

[15] It is important to remember that all subjects make the choice of moving (or not moving) simultaneously, therefore when subject 6 chooses to move, he does not know what subject 4 is going to do.

therefore, they will not move; second, subject 4 could "anticipate" that subject 6 might be thinking in the same way he is, that is, subject 6 is thinking to move to the big group and will not be in his position if subject 4 would choose to go to his side. Figure 3 represents the situation in which only subjects 4 and 6 move, and a situation of absolute segregation is reached (figure 3, circle 2).

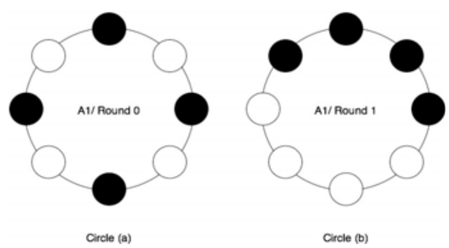


Figure 3: Movement of 4 and 6 in the simultaneous game

In a game with these characteristics, subjects can often coordinate their intentions or expectations with others, as each one knows that the other is trying to do the same thing he is doing. Most of the situations provide some hints for coordination, some focal points (hints) for every agent of what others might expect from them.[16] It is evident that if there is no convergence, the process of prediction and interaction turns out to be unsuccessful. The key is that when taking their decisions individuals try to accomplish a common task, not an individual one[17]. Each one reduces his

[16] Quoting Coricelli and Nagel (2009, p. 9163): "*Psychologists and philosophers define this as theory of mind or mentalizing, the ability to think about others' thoughts and mental states to predict their intentions and actions*".

[17] Rizzolatti, Fogassi and Gallese (2006) suggest that in primates and humans there are specific neuronal circuits in order to interiorize the tasks or movements of other human

space of search by means of the spontaneous use of hints that have the highest probability of making both of their expectations convergent, which Binmore and Samuelson (2006) call as the *exploitation of framing information* (use contextual information).

To find the hint, or rather the search for this key, is to find some code that is mutually recognized by all subjects as the key. This search may depend on precedents, accidental agreements, symmetry, geometric configuration, etc. And it is in this way that these keys turn out to be focal points of the game, Schelling (1960). In summary, it seems that only focal points are needed for the subjects of the simultaneous game, in order to generate the full segregation obtained in the sequential model.

3. Design and implementation of the experiment.

The experiment was carried out using an instructions book (set) where it was explained the proceedings of the game and how subjects could obtain the maximum happiness (see a copy of the instructions in the annex). In order to achieve that each of the individual participants in the experiments had a preference on the composition of his neighborhood, from which they could obtain happiness, each of them there was paid with two Euros if at least one of his adjacent neighbors (one to his left and another to his right hand side) was of his same type by the end of the experiment. If none of the adjacent neighbors was of his same type, the payment received was

beings or members of the same specie or of other species. See as well Fogassi et al. (2005) and Gallese, Keysers and Rizzolatti (2004).

zero (the individual was unhappy). In all the games, both in the sequential and in the simultaneous ones, the initial configuration was that of maximum unhappiness for all the subjects that compose the society (figure 1a), and therefore they were not obtaining any payment. Only the movement allowed subjects to reach the maximum happiness and to receive the stipulated payment. For simplicity, an equal size of 8 subjects was used in all the cases.

The 8 subjects were placed in two rows (4 subjects in each) and received a white or black scarf to be identified as a *white* typed or a *black* typed subject. Subjects were explained to make a circle between both rows and they were asked to identify the color of the scarves of their adjacent neighbors. Thus, from the initial position, each subject could verify that his neighbors were different from him, and therefore all the subjects were unhappy.

In the execution of the game, subjects who played the sequential game had to wait for their turn to decide if they were moving or not (observing what had happened). However, in the simultaneous game all the subjects were taking their decisions simultaneously (without knowing those made by the others). A control sheet served to inform either in one case or another (see the sample in figure 9 of the annex). The experiment played just once (one shot game).

The experiments were carried out in the Universidad Pública de Navarra (in Pamplona) and in the Universitat de València, following the subsequent distribution:

- Pamplona: 56 subjects distributed in sequential models (2 groups of 8 subjects) and in simultaneous models (5 groups of 8 subjects); and,
- Valencia: 40 subjects distributed in sequential models (2 groups of 8 subjects) and in simultaneous models (3 groups of 8 subjects).

In both universities, the experiments took place after finishing a regular class with students who willingly chose to remain. There was no recruitment of students or subjects who specifically came for the experiment. The task did not last more than 10 minutes and all the subjects earned 2 Euros (on average and in mode since all they won, see Tables 1 and 2). There was no show-up fee.

4. Results

4.1 Results of the sequential games

Three out of four of the sequential games worked exactly as theory predicts (see table 1 below). That is to say, subject 1 (who was not happy) moved next to subject 3, making subjects 2, 3 and 8 happy, then subject 4 (who was not happy either) moved next to subject 6, making subjects 5 and 6 happy. Finally subject 7 (who was not happy yet) had no other choice but moving next to subject 1 (see figure 2).

Complete segregation was generated as a consequence of the movements of subjects 1, 4 and 7.

Group	City	Round	Movers	Non movers	Happies	Non-happies
A1	Pamplona	0			0	8
		1	1,4,7	2,3,5,6,8	8	0
A2	Pamplona	0			0	8
		1	2,5,8	1,3,4,6	8	0
A3	Valencia	0			0	8
		1	1,4,7	2,3,5,6,8	8	0
A4	Valencia	0			0	8
		1	1,4,7	2,3,5,6,8	8	0

Table 1: Results of the sequential games.

Nevertheless, for one of the groups (group A2 of Pamplona, see figure 4) an interesting variation was produced. In this group, subject 1, in spite of being in a situation in which he was not happy, realized (technically “he anticipated") that he could stay still and allow the others to solve the situation later. In other words, subject 1 realized that the other players would have no other choice but moving to be happy and that he would end up being happy without needing to move. Subject 2, who was not happy given that subject 1 had not moved, fulfilled subject one’s expectation and moved next to subject 4. Thus, he made subjects 1, 3 and 4 happy. As in the previous case, at the end three players moved (subjects 2, 5 and 8, see figure 4), ending up in a situation of complete segregation of the society where all subjects are happy.

Result 1: The players of Schelling’s sequential model reach the equilibrium of complete segregation with the three movements foreseen in the theory.

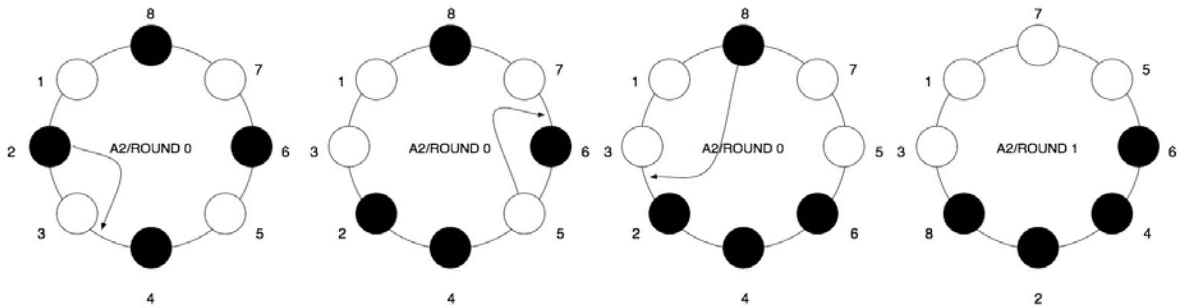


Figure 4: Sequential game in which p. 1 being unhappy does not move

4.2 Results of the simultaneous games

A priori, and as we anticipated previously, we should expect different results for the simultaneous game with regard to the sequential game, mainly for two reasons:

1. First, in the simultaneous game, all the subjects possess, at all times, the same information. In the sequential games we find that after each decision the past information is bigger (since the subjects already know the movements that have happened) and the future information is minor (fewer movements are left to be solved). Nevertheless, in the simultaneous game all the subjects decide at the same time for each round without knowing the decisions of any of the other subjects, since there is not any order for decision-making.
2. Second, in the simultaneous game the results are only probable (not assured), this is, a subject can decide to go into a position in which, when he arrives there, the subjects he expected to find are

not there anymore, because the subjects have decided to move as well.

Therefore, how should subjects play in this game? The optimal way of playing in the simultaneous game is the following:

- first, every subject generates for himself a distribution of types of players, in which he will consider those individuals who are going to move and those who will remain still;
- second, given this expectation the subject will decide which is his best response, i.e., he will move to the most convenient place for him given what he anticipates that the other subjects will do.

As suggested by the literature of "levels of reasoning" (Nagel 1995, Bosch *et al*. 2002) one can expect to find variety in the best responses, this is, we can find subjects that (optimally) do not move, move a little or a lot. And therefore, given the initial situation of white-black-white-black-white-black-white-black and the heterogeneity of types[18], it is very probable that at least two focal points of size 2 would appear: white-white or black-black.

Table 2 presents the number of subjects that moved in every round and the number of happy subjects when each of the rounds finished. Figures 5, 6, 7 and 8 show the result for the 8 simultaneous games. Figure 5 illustrates the case of two of them (S1 and S3), Figure 6 shows how other two games were played (S2 and S7), Figure 7 represents how the game

[18] If all subjects were identical, any movement will generate the initial situation given that all subjects would carry out the same movement and the only result would be a spin with identical distribution.

S6 was played, and Figure 8 presents game S5. Notice that two of the 8 games are missing.

Group	City	Round	Movers	Non-movers	Happies	Non-happies
S1	Pamplona	0			0	8
		1	7	1	4	4
		2	4	4	8	0
S2	Pamplona	0			0	8
		1	5	3	4	4
		2	4	4	8	0
S3	Pamplona	0			0	8
		1	4	4	4	4
		2	3	5	8	0
S4	Pamplona	0			0	8
		1	6	2	8	0
S5	Pamplona	0			0	8
		1	4	4	7	1
		2	1	7	8	0
S6	Valencia	0			0	8
		1	6	2	7	1
		2	1	7	8	0
S7	Valencia	0			0	8
		1	7	1	4	4
		2	4	4	8	0
S8	Valencia	0			0	8
		1	5	3	8	0

Table 2: Results of the simultaneous games

Both in Pamplona (group S4) and in Valencia (group S8) we found that the Schelling's simultaneous game was played in such way that it came to a distribution of maximum segregation in just one round. It went from Figure 1a to 1b without intermediate steps. In these two cases, an explanation to the result is that all subjects made an accurate prediction and reached equilibrium in one movement. The alternative explanation is that it occurred accidentally, which is not surprising since this result is, according to theory, relatively probable (20 %).

The rest of Schelling's simultaneous games have been represented in the 4 figures already mentioned. In four of them, the two most *a priori* expected focal points were created (white-white and black-black): in two of them the focal points turned out to be placed one next to the other (Figure 5); and, in the other two, the focal points are placed distant from each other (Figure 6).

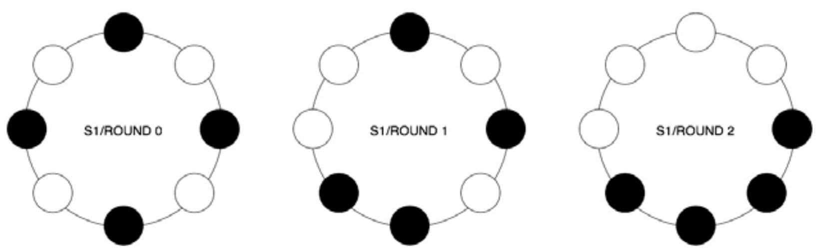


Figure 5: Neighbor Focal Points

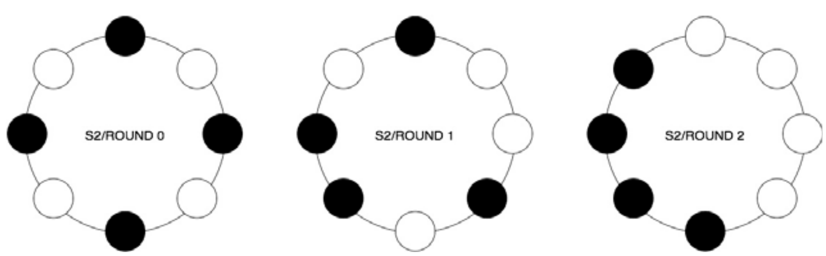


Figure 6: Distant Focal Points

Regarding the generation of the focal points, there are 4 games (S1, S3, S2 and S7, Figure 5 and 6) in which, 2 focal points appear during the first round (close or distant). In one of the games (S6, Figure 7) during the first round, a distribution with two focal points composed by three subjects of every type (white-white-white and black-black-black) was reached, and only two individuals, one of each type, were unhappy after making their decision.

Finally, in a game (S7, Figure 8) the almost perfect segregation was obtained after the first round: only one subject remained out of his desired neighborhood.

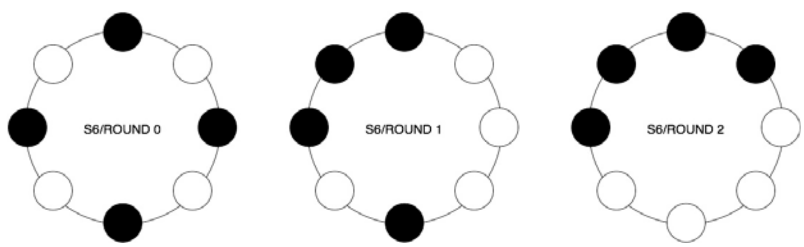


Figure 7: Two big focal points

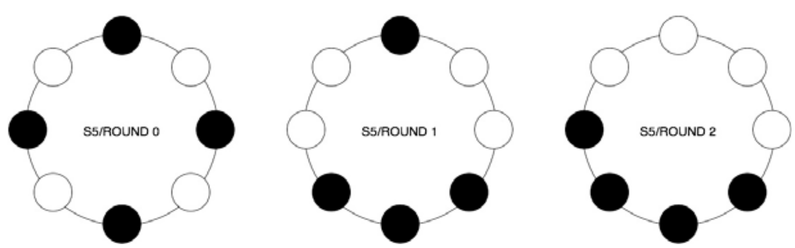


Figure 8: A big focal point and a small focal point

It is interesting to highlight that in all the cases the maximum segregation distribution was reached, in two cases after only one round and in six cases after the second round. The simplest explanation for this surprising result (total segregation in the simultaneous games) can be found in the theory (see for example, Reny, 1988, 1993 and Samuelson, 1992 among others) and it is sustained upon two principles: rationality and common knowledge.

- From the rationality point of view, all the subjects that were not happy moved to the right place for them to reach happiness.
- From the common knowledge of rationality point of view: subjects who were happy "knew" that those neighbors who were composing the focal point together with them, would not move because they are already happy and therefore, they are not moving either[19]. In addition, those who were moving knew they will go to spaces from where, assuming rationality, nobody would move.

Therefore, a requirement as basic as rationality (with common knowledge) is sufficient to make the requirement of sequential movement not so important. In other words, rationality with common knowledge generates the same result that the one obtained from a sequential model.

Result 2: As a consequence of rationality (together with common knowledge), subjects of Schelling's simultaneous game reached, in a maximum of two rounds, the completely segregated equilibrium.

Result 3: The completely segregated equilibrium appears in an almost immediate way with or without sequential movement.

[19] If two people have the same *a prioris*, and their *posterioris* for a given event are common knowledge, then these *posterioris* should also be the same. For a broader discussion about the concept of common knowledge in decision-making in games see Aumann (1976).

5. Conclusions

Schelling's spatial proximity model (1969, 1971a) is established with a series of minimal requirements with regard to the subjects that form society: subjects look for their best interest with some slightly inflexible preferences (a neighbor of his same color). Nevertheless the equilibrium outcome of this model is very powerful: complete segregation of society.

The aim of this work was to verify, through the experimental analysis, first of all, if complete segregation takes place. The second aim of this study was to verify if Schelling's model would give the same result of absolute segregation after modifying one of its most important properties: sequential movement for subjects, in contrast to playing simultaneously. The results obtained are forceful.

1. First, we obtain that when subjects play Schelling's sequential model, the result is a society that ends up completely segregated.
2. Secondly, when subjects play Schelling's simultaneous model nothing changes and complete segregation emerges without difficulty.

Therefore, in spite of the fact that the set of information that players handle between one environment and the other is radically different - and in addition uncertainty after the movements appears - the result turns out to be the same: complete segregation of the society.

In Schelling's model, the movements of the individuals are ruled to satisfy their preferences. The individuals look for their happiness and whatever others have done or are going to do, does not intervene in their decision.

This is so because of the assumption of the sequential movement, which makes them consider their decision as a problem of individual optimization: they do not need to learn anything and neither they have to signal anything for the future.

In the simultaneous environment, the existence of multiple equilibria makes them look for a coordination system. Therefore, in the first round a code is established and it turns into public knowledge for all the individuals. The first round serves to identify the types of players; it is then a phase of learning. The second round is a new refinement of equilibria where the selection criterion comes given by a follow-up to the focal points that have been created in the previous stage. Once more, it is crucial that individuals behave rationally (a player moves if he is not happy) and rationality is common knowledge (all the players know that happy players will remain still). As a consequence, subjects reach in a simple manner the complete segregation in which they all are happy.

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APPENDIX

EXPERIMENTAL INSTRUCTIONS

The instructions for the subjects who took part in the experiments are detailed below. Subjects were distributed in groups of eight for both of the treatments carried out: a treatment in which they were playing Schelling's sequential model (Case A) and another treatment in which they were playing Schelling's simultaneous model (Case S). The instructions that we introduce as follows are for the subjects with Black scarf in both treatments. For the subjects with White scarf the instructions are the same, just changing the color by which the subject is identified and the color of the neighbors who make him happy.

Instructions Case A:

1. Please, tie the scarf around your neck.
2. For the accomplishment of the task you are 8 subjects: 4 in a row of desks and other 4 in the desks behind. Turn around to see all your partners.
3. There are two types of subjects: those with a white scarf and those with a black one. As you already know, you are Black.

How do I earn money?

4. If at the end of the exercise AT LEAST ONE OF YOUR NEIGHBORS is of your same color, you earn 2 Euros. This is:
   - If both your neighbor to your right and to your left hand side are white, then you will NOT earn anything.
   - If your neighbor to your right or to your left hand side (or both of them) is black, you will earn 2 Euros.

5. We allow you to move (if you want to!). You can locate yourself in the most nearby space that you wish. A space is the distance that exists between two persons. You can jump as much as you wish (a place, two places, etc). You can only move to your right, this is counter clockwise.

6. How can I move? You have to write in your sheet the place to which you want to move. Write on your sheet your current position in blue and the position where you wish to move in black, if you do not move write in black your current position. Your sheet will be picked up and then you will be told the new set up.

Well, we are going to play

7. Now we will throw a dice. With this dice, the first person to move will be chosen. In consecutive order (towards the right) the rest will move. The beginner will make his choice (not moving, moving, jumping one place, moving by jumping two places, …, moving by jumping 6 places). When you are told, you will have to make your choice. Write on your sheet your current location in blue and the position where you are moving in black, if you are not moving write in black your current location.

8. Your sheet will be gathered, and your set up will be communicated to you.

9. If at the end of the exercise AT LEAST ONE OF YOUR NEIGHBORS is of your same color then you will earn 2 Euros.

Instructions Case S:

1. Please, tie the scarf around your neck.
2. For the accomplishment of the task you are 8 subjects: 4 in a row of desks and other 4 in the desks behind. Turn around to see all your partners.
3. There are two types of subjects: those with a white scarf and those with a black one. As you already know, you are Black.

How do I earn money?

4. If at the end of the exercise AT LEAST ONE OF YOUR NEIGHBORS is of your same color, you earn 2 Euros. This is:

- If both your neighbor to your right and to your left hand side are white, then you will NOT earn anything.
- If your neighbor to your right or to your left hand side (or both of them) is black, you will earn 2 Euros.

5. We allow you to move (if you want to!). You can locate yourself in the most nearby space that you wish. A space is the distance that exists between two persons. You can jump as much as you wish (a place, two places, etc). You can only move to your right, that is, counter clockwise.

6. How can I move? You have to write in your sheet the place to which you want to move. Write on your sheet your current position in blue and the position where you wish to move in black, if you do not move write in black

your current position. Your sheet will be picked up and then you will be told the new set up.

Well, we are going to play

7. You will make your choice (not moving, moving, jumping one place, moving by jumping two places, …, moving by jumping 6 places). When you are told you will have to make your choice. Write on your sheet your current location in blue and the position where you are moving in black, if you are not moving write in black your current location.

8. Your sheet will be gathered, and your set up will be communicated to you.

9. If at the end of the exercise AT LEAST ONE OF YOUR NEIGHBORS is of your same color then you will earn 2 Euros.

Figure 9 shows the graph given to the subjects where they could clearly identify both their position and that of the rest of individuals in their group. In the case of the simultaneous game, every individual had one like this, which was gathered in order to determine the decision made by each subject, whereas in the sequential case the same graph went from one subject to another, considering the order of movement, and therefore the graph was automatically updated with each subjects annotations.

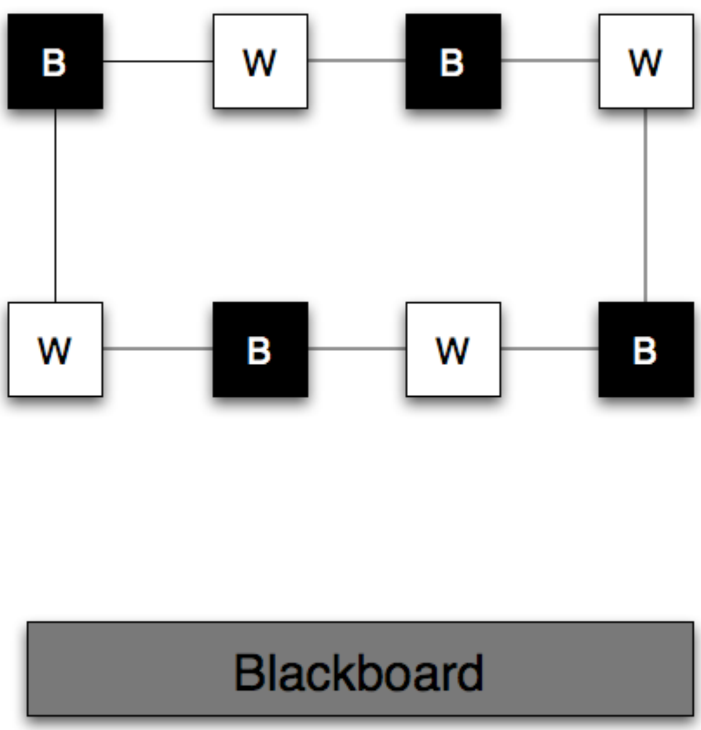

Figure A: Control Graph for each group