

When do interactions increase or decrease primacy bias?

S. Huet and G. Deffuant

Cemagref, LISC, BP 50085, F-63172 Aubière Cedex
sylvie.huet@cemagref.fr - guillaume.deffuant@cemagref.fr

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Abstract: We propose an individual based model of attitude dynamics which, in some conditions, reproduces primacy bias behaviours. The primacy bias takes place when the attitude of an individual depends on the reception order of features describing an object. Typically, when receiving a strong negative feature first, the individual keeps a negative attitude whatever the number of moderate positive features it receives afterwards. We consider a population of individuals which receive the features by from a media, and communicate with each other: in some cases, interactions increase the number of individuals exhibiting a primacy bias, in other cases they decrease this number. To better understand this phenomenon, we developed aggregated models of the individual based model with interaction.

Keywords: Primacy bias, Information filtering, Agent-based model, aggregated model, collective effects of interactions

1 Introduction

“Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour” Eagly and Chaiken (1998). Attitudes have been postulated to motivate behaviour and to exert selective effects at various stages of information processing (Eagly and Chaiken 1998): information may be filtered by the individuals, i.e. they ignore it. Festinger in his theory of cognitive dissonance (1957) proposes some mechanisms for this selection: people seek out information that supports their attitudes and avoid information that challenges them, in order to minimise their cognitive dissonance. Following this theory, even if they assimilate information which contradicts their global attitude, people are reluctant to talk about it, because they avoid expressing their dissonance. Such selection mechanisms can imply sensitivity to the order of information delivery, which leads to the primacy bias: the attitude is determined by the first pieces of information received.

Several researches in social modelling include some effect of attitude on information transmission and vice-versa (Allport and Postman 1947; Lawson and Butts 2004; Galam 2003, Huet and Deffuant 2006; Tsimring and Huerta 2003). The bounded confidence models (see Urbig 2003 for a review) implement reception and emissions filters on attitudes or opinions. In the model of innovation diffusion of Deffuant et al. (2005), this opinion dynamics is coupled with an information propagation. However, none of these models focuses specifically on the primacy bias.

We propose a simple agent based model (ABM) of individual primacy bias, which abstracts from the cited researches in social psychology. We particularly focus on the following question: do the interactions between agents modify the likelihood of individual primacy bias in the population? With the simple model we consider, the answer is clearly positive. In some cases, the number of

agents which show primacy bias is significantly higher, and in other cases significantly lower when agents interact than when they are isolated. To better understand the interaction effect, we follow a general approach of “double-modelling” (Deffuant 2004) which aims at providing explanations of the collective effects observed in ABM simulations, using aggregated models of the ABM behaviour. Thus, we build two analytical aggregated models of the agent-based model global behaviour, following the method presented in (Deffuant, 2006b). Our previous papers are limited to some cases where interactions increase primacy bias (Huet and Deffuant 2006, Deffuant and Huet 2006a). This paper provides also cases where interactions decrease the number of primacy bias in the population.

First, we describe the individual-based model we study. In section 3, we focus on the analysis of the dynamics without interactions. Section 4 is devoted to dynamics with interactions. Then, we use aggregated models in order to explain the interaction effects. Finally, we conclude and outline next steps of this research.

2 Sensitivity to event order and primacy bias: an individual model

2.1 A model of dynamics of attitudes

A central concept of our model is attitude, understood as a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour (Eagly and Chaiken 1993).

We model the dynamics of attitude considering its links with information. Attitude formation and attitude change are linked to accumulation and organization of information about people, objects, situations and ideas. Moreover, attitudes motivate behaviour and exert selective effects on information processing.

The basis of our modelling consists of the dissonance theory (Festinger 1957) on the one hand, and on Allport’s work on rumor diffusion (1947) on the other hand. We notice that individuals avoid incongruent information, and, keep only important information.

We consider a population of N individuals who discuss about an object. As shown on figure 1, we define this object by a set of features $F = (1, 2, \dots, d)$, which are associated with positive or negative real values $(u_1, \dots, u_j, \dots, u_d)$ with $u_j \in \mathfrak{R}$. An individual can have a partial view of the object, in which case it has a real value for some features and nil for others. To simplify we use feature instead of feature value.

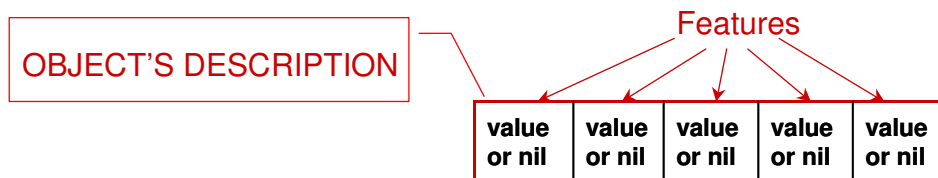


Figure 1. The description of an attitude object

An individual i is characterised by:

- g : an initial attitude (In the following, we suppose that all individuals of the population have the same initial attitude).

- L_i : a subset of F containing the features currently retained by the individual; This list is supposed empty at the beginning.
- $G_i = g + \sum_{j \in L_i} u_j$: the global attitude about the object. This choice can be related to information integration theory of Anderson (1971),
- a neighbourhood corresponding to the subset of individuals with whom i can communicate.

The dynamics of the model have four main aspects:

1. **Exposure to feature values:** individuals are exposed to features, which are made available by the medium, or, interaction between individuals.
2. **Selective retaining:** individuals retain a feature if it is important enough. Incongruent features are more difficult to retain than congruent ones. A feature is congruent when it has the same sign as the individual's global attitude to the object, incongruent otherwise. In other words, when $G_i \cdot u_j \geq 0$, feature j is said congruent for individual i , and incongruent otherwise. The dynamics of filtering are determined by a positive number, Θ the incongruence threshold. Being told about feature j , an individual will react as follows (see figure 2) :
 - ◊ If j is congruent \rightarrow "retain the feature.
 - ◊ If j is incongruent: if $|u_j| > \Theta \rightarrow$ "retain the feature"; otherwise "ignore the feature" .
 Here, "retain the feature" means that j is added to L_i (if L_i does not include j yet), "ignore the feature" means that the feature is filtered (not added to L_i).
3. **Selective emission:** individuals only talk about congruent features
4. **Computation of attitude:** an individual computes its global attitude each time it retains a new feature. As presented in the characteristics of the individual, the global attitude to the object is the sum of the feature values the individual retained and its initial attitude, g .

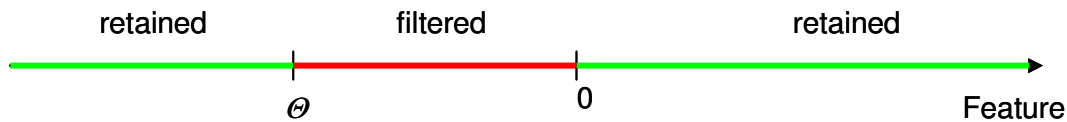


Figure 2. For $g > 0$, the negative features are filtered if they have an absolute value lower than Θ .

2.2 Individual trajectories

From the definition of the dynamics presented above and if we assume that each feature is equally diffused to all individuals, it is easy in most cases to define the final sign of each initial group of the population. We consider that a feature is randomly delivered to the population. The delivery frequency is, on average, the number of individuals who are exposed to a feature per iteration.

2.2.1 Most cases are simple

We first consider very simple cases, in which the model behaviour is easy to predict:

- If all the features are of the sign of g , then the final global attitude is the sum of g and all the features.

- If all the features are higher, in absolute value, than Θ the "incongruence" threshold, then the final global attitude is the sum of g and all the features.
- If all the features are, in absolute value, below Θ , then final global attitude is the sum of g and all the features of same sign as g .

In these cases, the individual is not sensitive to the order of feature reception. Thus, we have only one possible trajectory for each individual.

However, in other cases, individuals are sensitive to order of feature reception and exhibit the primacy bias. In these cases, an individual has several possible trajectories depending on the order feature reception.

2.2.2 Some cases are sensitive to feature order

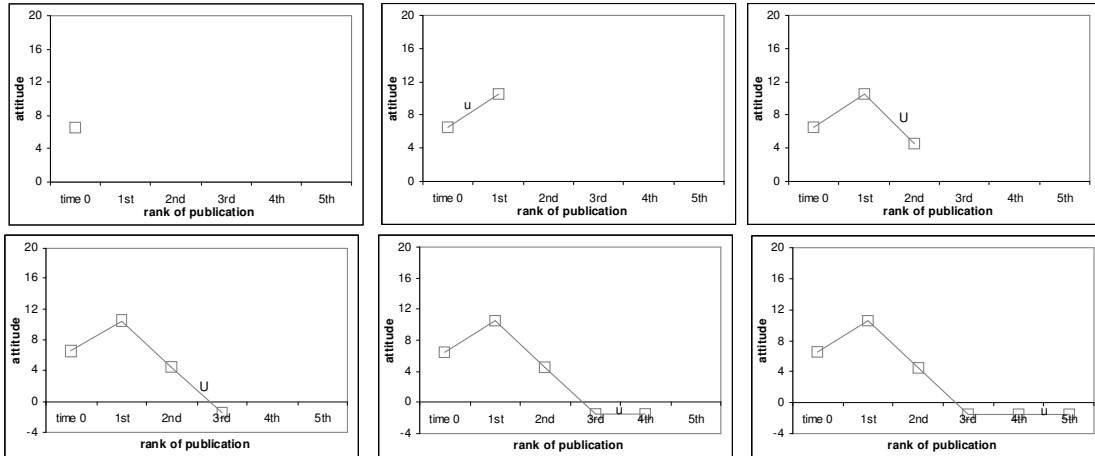
We now consider an individual with an initial attitude $g > 0$, and an object with at least one negative feature of absolute value higher than Θ , and positive features lower than Θ (the same reasoning can be done with inverted signs). In this case, the final attitude can depend on the reception order:

- If the individual receives the negative feature first, if g is low enough, it can change its global attitude, and the positive features become incongruent. As they are lower than Θ , they are not retained.
- If the individual receives the positive features first, these features are necessarily retained.

When the individual attitude is sensitive to the feature reception order, we can observe primacy bias: the individual's attitude sign is defined by the first few features it receives.

This leads us to our more concrete example to help understand how bias appears. We suppose that the initial attitude g is positive. Then we consider an object described by 5 features: two major negative ones, called of value $-U$, such that $U > \Theta$, and three positive ones, called u , such that $u < \Theta$. We suppose that the object is globally neutral, that is: $3u - 2U = 0$. For instance, we choose $U = 6$ and $u = 4$, with $\Theta = 5$.

Figure 3 shows the evolution of a global attitude, for a given reception order. Initially, our individual has an attitude $g = 6.5$. First, it receives a positive feature, which is retained because it is congruent, and its attitude increases to 10.5. Second, it then receives a negative feature, which is incongruent, but is retained because its absolute value is higher than the threshold, and its attitude decreases to 4.5. Next, it receives the second negative feature, which is incongruent and also retained and its attitude decreases to -1.5 . It is now going to be exposed to the fourth and the fifth positive features, which are incongruent with an absolute value below the threshold, and therefore they are not retained. Its attitude thus does not change anymore. It has finally a negative attitude although the object is globally neutral.



Figures 3. Example of temporal evolution of the attitude of an individual which receives features in order u, U, U, u, u

The figure 4 shows another order of feature exposure which begins with the three consecutive positive features received first. All features are retained in this case and our individual's attitude follows another trajectory, leading to a final positive attitude.

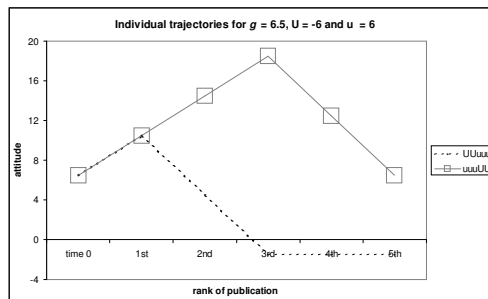


Figure 4. Two possible individual trajectories

A last diagram on figure 5 shows the ten possible trajectories of attitude. As all positive features are equal and all negative features are also equal, we just have to consider 10 different feature orders to describe all possible individual trajectories. Depending on the cases, the first, the two first, or at the most, the three first features received determine the final sign of attitude: this is the primacy bias.

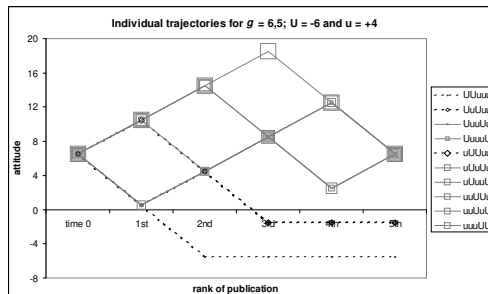


Figure 5. All possible individual trajectories in case $g = 6.5$, 5 features composed of 2 U and 3 u with $U = -6$ and $u = +4$

3 Isolated individuals

3.1 A directly readable global state

We consider now a population of isolated individuals, with the same initial attitude g . Each trajectory shown on figure 5 has the same probability of occurring. Figure 6, shows the final state, of the population, which includes, 70 % of individual with a final positive attitude, because we observe 7 final positive trajectories out of 10 total trajectories, and, 30 % of individual with a final negative attitude, because we observe 3 final negative trajectories out of 10 total trajectories.

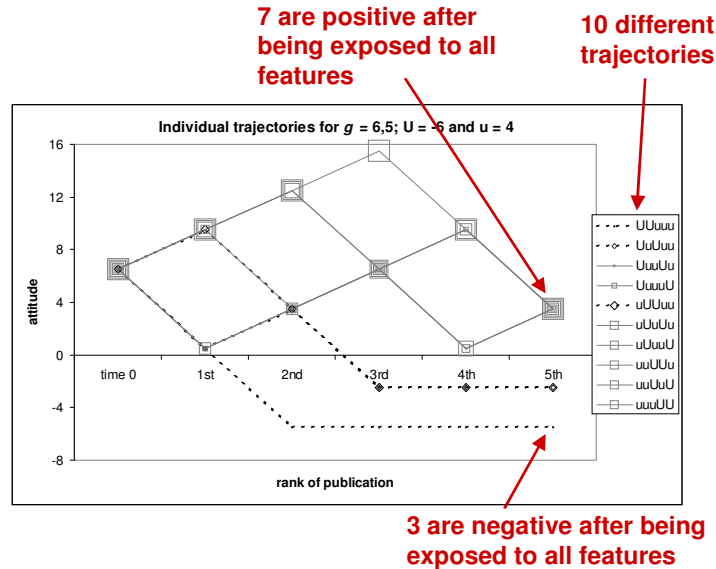


Figure 6. Deducing final population state from individual possible trajectories, in case $g = 6.5$, 5 features composed of 2 U and 3 u with $U = -6$ and $u = +4$

3.2 The major role of g , the initial attitude

We can observe on figure 7 the final percentage of negative individuals for various values of the initial attitude, g . Horizontal axis represents the attitude intervals corresponding to one possible value of the bias defined as the percentage of final negative attitudes. Since we are on the zone of "primacy bias", from $g > 0$ to $g < 2|U|$, we observe its effect: from 80% to about 10% of individuals are finally negative. This takes place even though we have no negative individuals initially and a neutral global value for the object. This strong influence of the initial attitude g can be seen as the first primacy bias.

We can read again that, for an initial attitude of 6.5, 30% of final attitudes are negative.

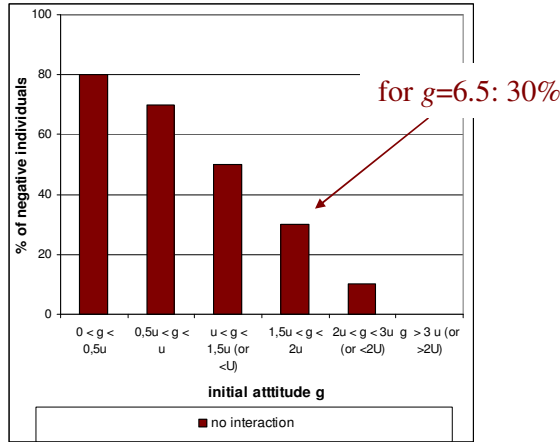


Figure 7. Final percentage of negative individuals for various value of g

4 Population state from simulated individuals in interaction

We add interaction between individuals by a simple algorithm. We consider two cases:

- an individual with a reception and an emission filter;
- an individual with only a reception filter; this last case will help us to better qualify the result.

To simulate the interactions, we choose at random a couple (i,j) in a given social network. In the case of an emission and reception filter, i tells j about one of its randomly chosen congruent features. In the case of only a reception filter, i tells j about one of its features, chosen at random, whether it is congruent or not. The complete algorithm, containing exposure to the diffusion by media and exposure from interaction is:

For a population of N individuals, at each time step:

N times repeat:

- *Media diffusion.* choose individual i at random with probability f , choose feature j at random in the object, send feature j to individual i .
 - *Interactions:* choose couple of individuals (i,j) at random:
 - ◊ *Emission and reception filter case:* i tells j about one of its randomly chosen congruent features
 - ◊ *Reception filter case:* i tells j about one of its randomly chosen features.
-

Now, we examine how primacy bias can be amplified or decreased by the interactions.

4.1 Interactions can increase the number of primacy biases

Figure 8 shows a comparison of the number of final negative attitudes (and therefore of primacy bias) between the isolated and the interaction (with reception and emission filters) cases. The isolated case is represented by brown bars, and the interaction case is represented in green bars (average results on 100).

We observe that, for an initial attitude ranging from 0 to the absolute value of the most important incongruent feature (in this case 6), interactions induce more negative final attitudes than the

isolated case. For example, for an initial attitude $g = 2.5$, we obtain 83% of negative individuals with “interaction”, but only 70% in the for isolated individuals.

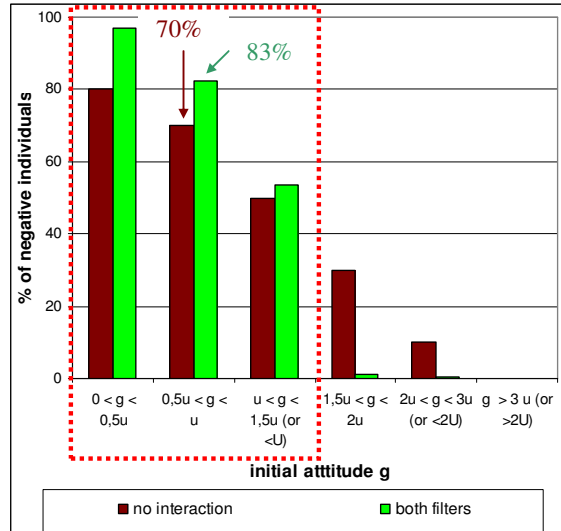


Figure 8. Final percentage of negative individuals for various values of g for both approaches: deduce from analysis of isolated individual and simulated with interaction between individuals

We might think that the emission filter explains this result, but this is not the case. On figure 9, we add to our previous results the case of interactions without emission filter (in purple). We also observe an increase of primacy bias, in some cases higher, in some cases lower than the increase observed with the emission filter, but for these values of g , we observe an increase of primacy bias due to the interactions, for interactions with or without emission filter. We shall refer to this as the “decrease primacy bias (PB)” effect of interactions.

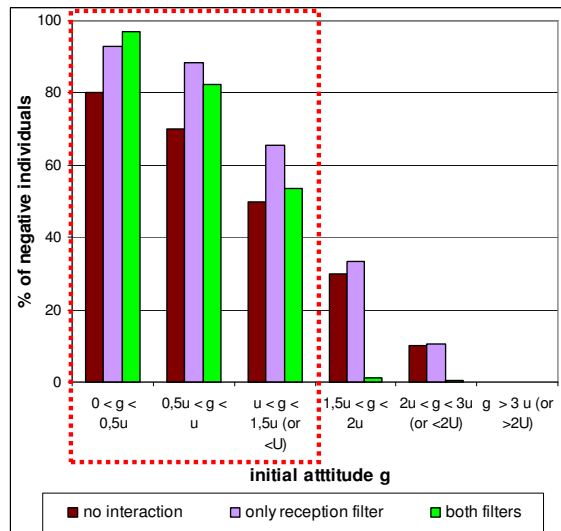


Figure 9. Zone of primacy bias increasing. Final percentage of negative individuals for various value of g for three dynamics: isolated individual; interactions with both filters (reception and emission) and interactions with reception filter only.

4.2 The interaction can decrease the effect of individual primacy bias

On the right of the figure 10, we note that an initial attitude $g = 8.5$, the isolated case yields 10% of negative individuals whereas the “interaction with both filters” yields only 0.4% of them (green bars). This is the “decrease primacy bias (PB)” effect of interaction. This effect takes place for initial attitudes between U and $2U$, which correspond to the values between the absolute value of the most negative feature U and the sum of the absolute values of positive features. This implies that this “decrease PB” effect cannot be observed with object having only one negative feature (as in our first investigations).

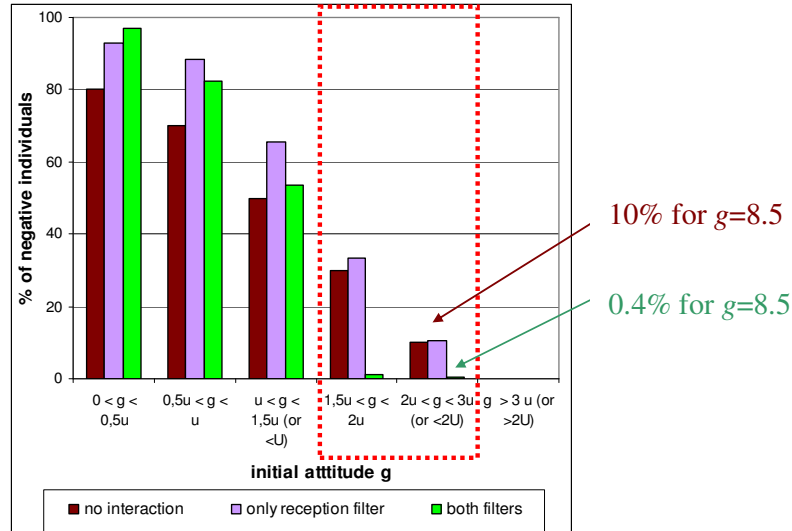


Figure 10. Zone of decreasing primacy bias. Final percentage of negative individuals for various value of g for three dynamics: isolated individuals; interactions with both filters (reception and emission) and interactions reception filter only

Note that with only a reception filter (in purple), we do not observe the decrease PB effect. In fact, an individual which has an initial attitude comprised between U and $2U$ and which receives first a negative feature, has still a positive attitude. Due to the emission filter, it does not communicate about the negative feature it retained while others communicate the positive feature. If it receives a positive feature right after the negative one, it will never be negative. The only possibility to be negative is to receive the two negative features first. The probability of this case is decreased by the interactions because these interactions are only about the positive features.

4.3 These interaction effects persist even the object is not neutral

We observed that the primacy bias can be increased or decreased by interactions. Until now we considered a neutral object (i.e. the sum of features is 0). We can check that this effect remains when the object is slightly positive or negative. Here, we increase or decrease the global value of the object. We have changed values of U or u with respect of conditions to observe the primacy bias.

In the case of an "increasing PB" interaction effect, table 1 presented values of U and u we have tested with $g = 2.5$. For the case of an "increasing primacy bias" interaction effect, the tested value with $g = 6.5$ are presented in table 2.

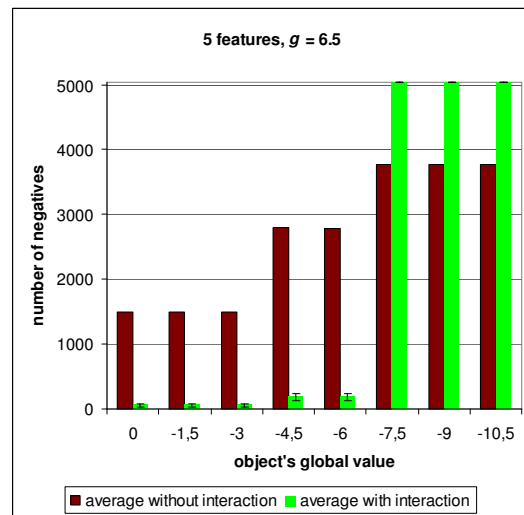
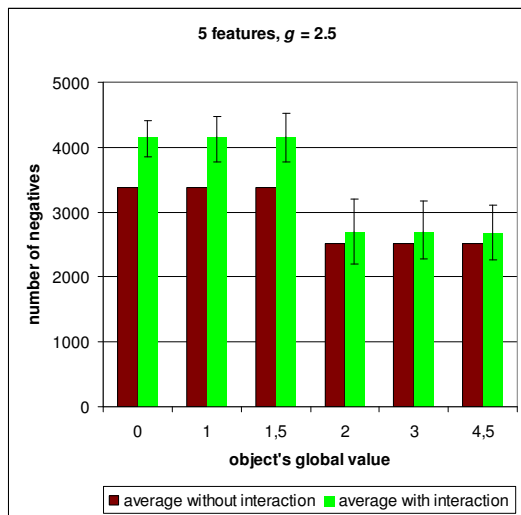
U	u	Global value of the object (sum of features)
-6	4	0
-5,5	4	1
-6	4,5	1,5
-5	4	2
-6	5	3
-6	5,5	4,5

Table 1. Values of U and u implying different global values of the object tested with $g = 2.5$

U	u	Global value of the object (sum of features)
-6	4	0
-6	3,5	-1,5
-6	3	-3
-6	2,5	-4,5
-6	2	-6
-6	1,5	-7,5
-6	1	-9
-6	0,5	-10,5

Table 2. Values of U and u implying different global values of the object tested with $g = 6.5$

Figures 11 show that the interaction effect remains in average for several positive or negative objects. On the left, we can see the "increasing" negatives effect persists for a positive global value of 1.5. On the right, the "decreasing bias" effect persists for a negative global value of -6.



Figures 11. Increase PB (on the left) and decrease PB (on the right) effects of interaction for different global values of the object.

To better understand the interaction effect, we build aggregated models using the individual trajectories identified in section 2 taking into account interactions.

5 Analysis of the result using aggregated models

5.1 How to build aggregated models?

The building method has been elaborated to study the "increase primacy bias" interaction effect for a three feature object (Deffuant and Huet 2006b). Now, we built two aggregated models for a 5 feature object: one to study the "increase PB" interaction effect; the other to study the "decrease PB" interaction effect.

The general idea to build the aggregated model is to consider groups of agents and to define the transfer equations which rule the flows of probability densities between the groups. First, we need to determine the groups, and the possible flows between them. A group is defined by a list of retained features. These groups depend on the value of the initial attitude g . Table 3 lists the final sign of the ten possible individual trajectories: we see that the primacy bias can be observed for $0 < g < 3u$ because some trajectories are finally positive while others are negative. We know from the study presented above that the "increase PB" interaction effect appears for $0 < g < 1.5u$ and the "decrease PB" interaction effect appears for $1.5u < g < 3u$.

Exposure order	$g < 0$	$0 < g < 0.5u$	$0.5u < g < u$	$u < g < 1.5u$	$1.5u < g < 2u$	$2u < g < 3u$	$g > 3u$
<i>UUuuu</i>	-	-	-	-	-	-	+
<i>UuUuu</i>	-	-	-	-	-	+	+
<i>UuuUu</i>	-	-	-	-	+	+	+
<i>UuuuU</i>	-	-	-	-	+	+	+
<i>uUUuu</i>	-	-	-	-	-	+	+
<i>uUuUu</i>	-	-	-	+	+	+	+
<i>uUuuU</i>	-	-	+	+	+	+	+
<i>uuUUu</i>	-	-	-	+	+	+	+
<i>uuUuU</i>	-	+	+	+	+	+	+
<i>uuuUU</i>	-	+	+	+	+	+	+

Table 3. Final sign of attitude for the ten different trajectories and all different values of g

We select two possible sets of values of g to construct two aggregated models: one corresponding to an "increase PB" interaction effect, $u < g < 1.5u$; the other corresponding to a "decrease PB" interaction effect, $2u < g < 3u$. Following the method presented in Deffuant and Huet (2006), we simplified the problem by aggregating the groups from which have the same sign of attitude. Figures 12 and 13 show the graph of the different groups to model the "increase PB" (figure 12) and the "decrease PB" interaction effects (figure 13).

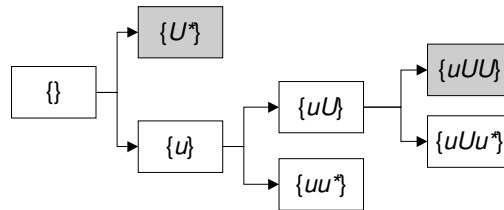


Figure 12. The graph of transitions between the groups for $u < g < 1.5u$, defined by the set of retained features (increase PB interaction effect). The groups with a negative attitude are in grey.

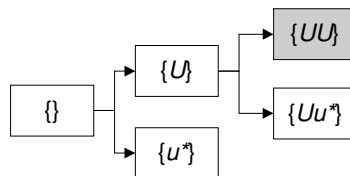


Figure 13. The graph of transitions between the groups for $2u < g < 3u$, defined by the set of retained features. (decrease PB interaction effect) The groups in grey have a negative attitude.

The second stage of the modelling approach is to determine the flow through each transition. This requires to evaluate the probability that the agents in each group retain a feature which makes them change their group. This probability is directly related to the features which are sent by each group. This is broken down in tables 3 and 4.

Group	Media	{U*}	{u}	{Uu}	{uu*}	{uUU}	{uUu*}
Communicated features	U, u	U	u	U	u	U	u

Table 3: communicated features for each group in the case $u < g < 1.5u$ or U .(increase PB effect)

Group	Media	{U}	{u*}	{UU}	{Uu*}
Communicated features	U, u	none	U	U	u

Table 4: communicated features for each group in the case $2u < g < 3u$ or $2U$.(decrease PB effect)

This work done, it is possible to write down evolution equations of each group, summing up the flows in and subtracting flow out the group. For $u < g < 1.5u$, we get:

$$\begin{aligned} \frac{dS_0}{dt} &= -S_0(f + S_u + S_{U^*} + S_{uU} + S_{uu^*} + S_{uUU} + S_{uUu^*}) \\ \frac{dS_{U^*}}{dt} &= S_0 \left(\frac{2f}{5} + S_{U^*} + S_{uUU} \right) \\ \frac{dS_u}{dt} &= S_0 \left(\frac{3f}{5} + S_u + S_{uu^*} + S_{uUu^*} + S_{uU} \right) - S_u \left(\frac{4f}{5} + S_{U^*} + S_{uUU} + \frac{2}{3}(S_u + S_{uU} + S_{uUu^*} + S_{uu^*}) \right) \\ \frac{dS_{uU}}{dt} &= S_u \left(\frac{2f}{5} + S_{U^*} + S_{uUU} \right) - S_{uU} \left(\frac{3f}{5} + \frac{1}{2}(S_{U^*} + S_{uUU}) + \frac{2}{3}(S_u + S_{uUu^*} + S_{uu^*} + S_{uU}) \right) \\ \frac{dS_{uu^*}}{dt} &= S_u \left(\frac{2f}{5} + \frac{2}{3}(S_u + S_{uUu^*} + S_{uu^*} + S_{uU}) \right) \\ \frac{dS_{uUU}}{dt} &= S_{uU} \left(\frac{f}{5} + \frac{1}{2}(S_{U^*} + S_{uUU}) \right) \\ \frac{dS_{uUu^*}}{dt} &= S_{uU} \left(\frac{2f}{5} + \frac{2}{3}(S_u + S_{uU} + S_{uu^*} + S_{uUu^*}) \right) \end{aligned}$$

with:

S_0 : proportion of individuals with a void list of retained features,

S_u : proportion of individuals with a list of retained features containing only u ,

S_{U^*} : proportion of individuals following all trajectories beginning with U ,

S_{uU} : proportion of individuals with a list of retained features containing only u at first and U at second

S_{uu^*} : proportion of individuals following all trajectories beginning with uu .

S_{uUU} : proportion of individuals following all trajectories beginning with uUU .

S_{uUu^*} : proportion of individuals following all trajectories beginning with uUu .

f : frequency of media feature communication.

For $2u < g < 3u$ or $2U$, we have:

$$\begin{aligned}\frac{dS_0}{dt} &= -S_0(f + S_{u^*} + S_{UU^*} + S_{Uu^*}) \\ \frac{dS_{u^*}}{dt} &= S_0\left(\frac{3f}{5} + S_{u^*} + S_{Uu^*}\right) \\ \frac{dS_U}{dt} &= S_0\left(\frac{2f}{5} + S_{UU^*}\right) - S_U\left(\frac{4f}{5} + \frac{S_{UU^*}}{2} + S_{u^*} + S_{Uu^*}\right) \\ \frac{dS_{UU^*}}{dt} &= S_U\left(\frac{f}{5} + \frac{S_{UU^*}}{2}\right) \\ \frac{dS_{Uu^*}}{dt} &= S_U\left(\frac{3f}{5} + S_{u^*} + S_{Uu^*}\right)\end{aligned}$$

with :

S_0 : proportion of individuals with a void list of retained features,
 S_U : proportion of individuals with a list of retained features containing only U ,
 S_{u^*} : proportion of individuals following all trajectories beginning with u ,
 S_{UU^*} : proportion of individuals following all trajectories beginning with UU ,
 S_{Uu^*} : proportion of individuals following all trajectories beginning with Uu .
 f : frequency of feature diffusion by the media.

The systems can be simulated considering different values for dt . After several tests, we chose $dt = 0.1$. We compute the evolution of groups at the end by calculating, for each group S :

$$S = S + \frac{dS}{dt} dt$$

The final number of negative attitudes in the population is obtained by summing values of finally negative trajectories.

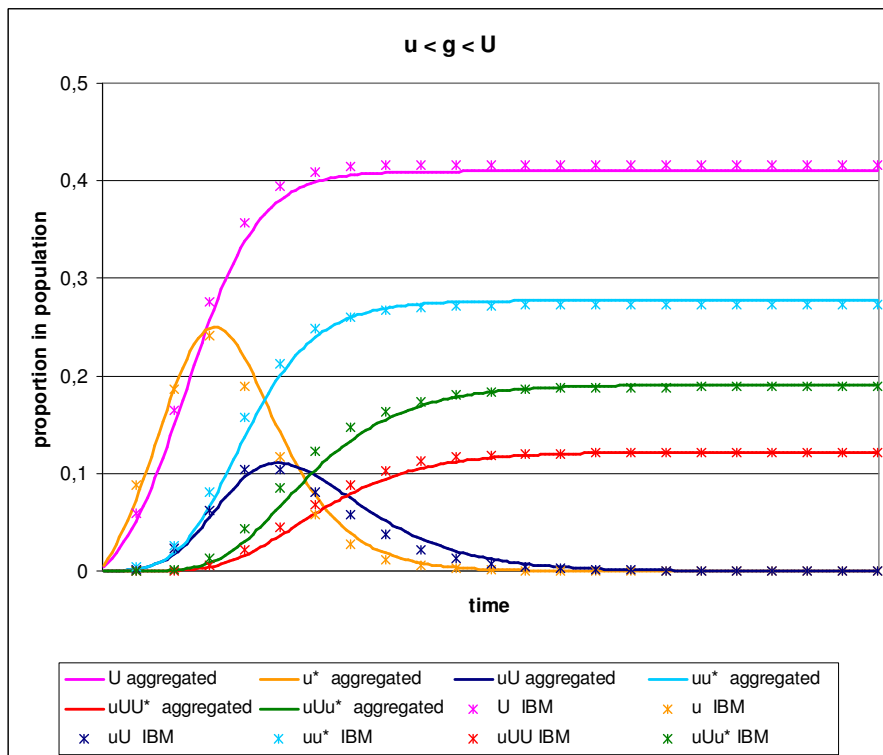
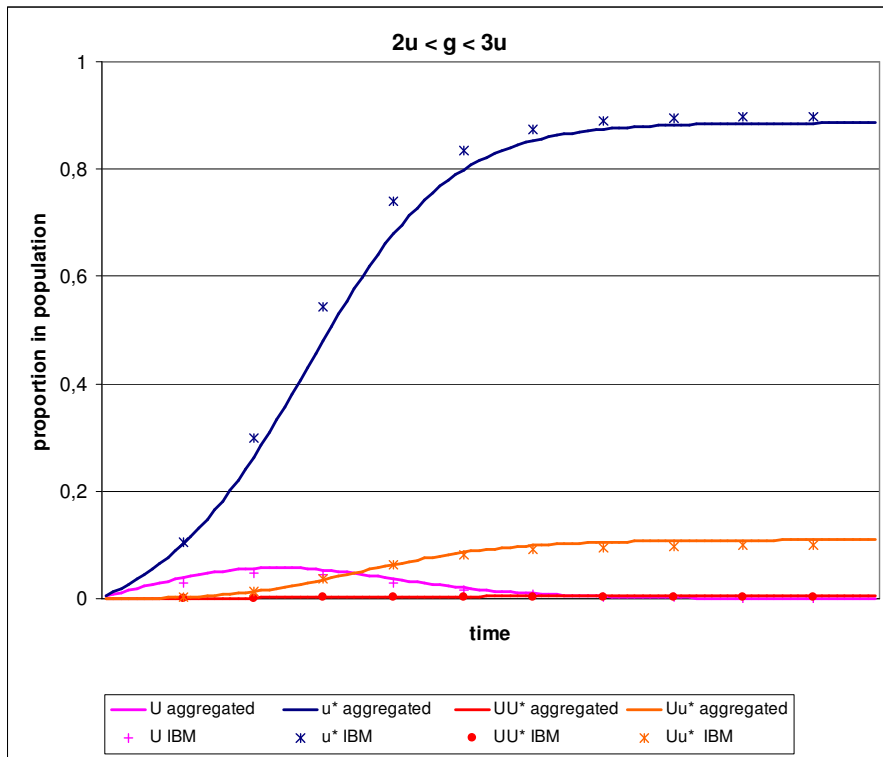
5.2 Comparing aggregated models with the agent-based model

For the ABM, we consider a population of 5041 individuals. From runs of the ABM and aggregated models, it results that the part of final negatives in the population for:

- $u < g < 1.5u$ is 53.3% on average for the ABM (with a minimum of 45% and a maximum of 64% on 100 replications) and 53.2% for the aggregated model with $dt = 0.1$;
- $2u < g < 3u$ is 0.4% on average for the ABM (with a minimum of 0.2% and a maximum of 0.8% on 100 replications) and 0.4% for the aggregated model with $dt = 0.1$;

It appears that the aggregated model gives an accurate approximation of the average number of negative individuals in the population.

Figures 14 show the evolution of the part of agents in each group during the simulation for the ABM on the one hand, and for the aggregated model on the other hand. One more time, we observe that both models, ABM and aggregated, give very close results.



Figures 14. Comparison of trajectories of each groups of aggregated and IBM model: "increase" interaction effect case on the left; "decrease" interaction" effect case on the right. One measure of the IBM's replicas is put all the ten measures of the aggregated model

5.3 Better understand the interaction effect with the analysis of the aggregated models results

From the results of the aggregated model, we obtain the proportion at each time step of the negative feature U communicated during interactions. This proportion of U emission by interaction can be compared with the proportion of U emission from the media. Figures 15 and 16 show this comparison for both "increase PB" and "decrease PB" cases.

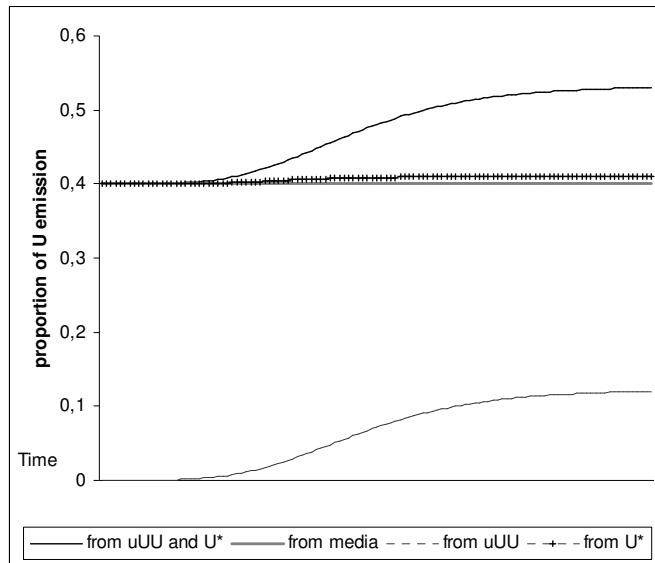


Figure 15. Comparison of probability of U emission due to interaction with the probability of U emission due to medium for the "increase PB" interaction effect case

We see on figure 15 that the global probability of U emission by interaction begins at a value equal to probability of U emission by medium. It increases with the U emission from the negative group uUU .

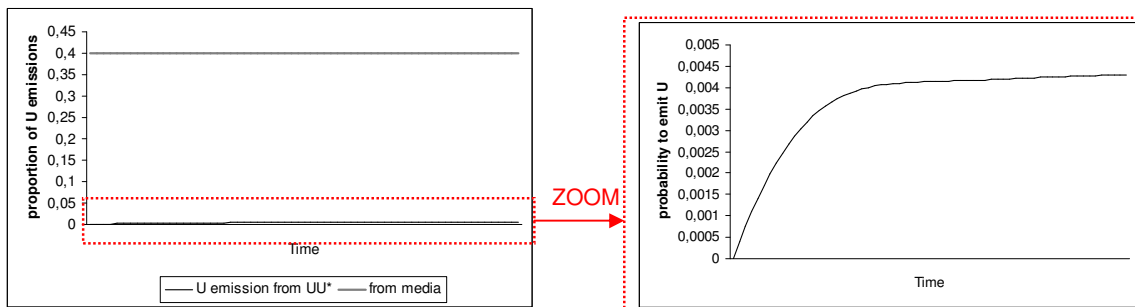
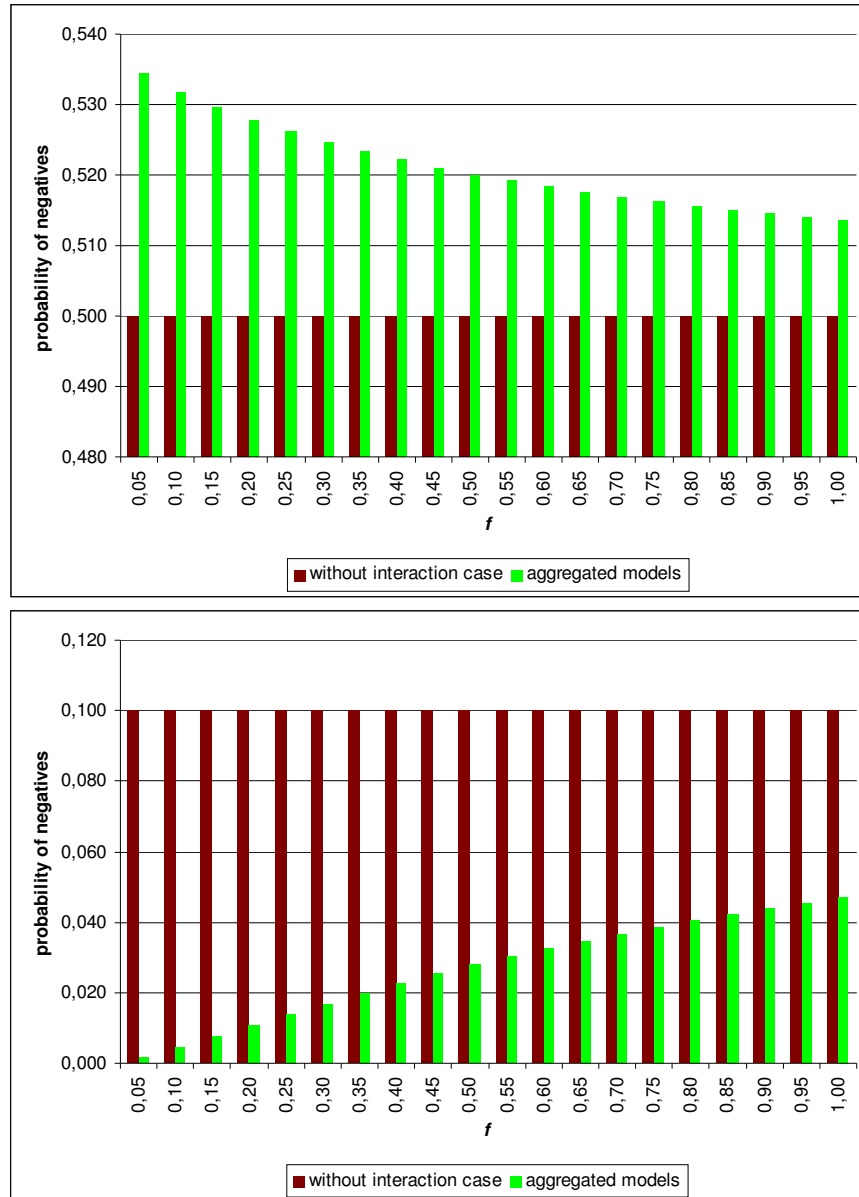


Figure 16. Comparison of probability of U emission due to interaction with the probability of U emission due to medium for the "decrease" interaction" effect case

Contrary to the "increase PB" case, we see on figure 16, for the "decrease PB" case that the global probability of U emission by interaction is always lower than the probability of U emission by the media. Due to the emission filter, we can see on figure 15 that no group of the two initial branches of the "trajectories" emits U .

We can think that the frequency of diffusion, which defines how many agents on average during an iteration are exposed to a feature delivered by the media (parameter f) can change the result and suppress the interaction effect. From previous work on the ABM (Deffuant and Huet 2006), we know that for weak frequency of diffusion (0.001 and less), the model tends to yield replicas in which either all final attitudes are positive, or all are negative. Thus, for a weak frequency of diffusion, the aggregated model can not be equivalent to the individual based model. However, for higher frequency of diffusion, we can study the persistence of the interaction effect with the aggregated model varying the media diffusion frequency.



Figures 17. Comparison of final negatives part for different value of the frequency parameter f in case "without interaction" and case "with interaction" with the aggregated models: "increase" interaction effect case on top; "decrease" interaction" effect case at bottom.

Figures 17 show the sensitivity of the results to variations of f . We notice that, even when the frequency is at its maximum value 1, the "increase" or "decrease" PB interaction effects are maintained, even if they are lower. Frequency does not change so much the part of final negatives in the population.

Figure 18 shows that, when the initial attitude g is less than the absolute value of the negative feature, we observe the "increase PB" effect; and we observe that the proportion of final negative trajectories (shown in blue in the graph) is higher than the proportion of negative feature diffused by the medium (shown in red in the graph). Thus, the interactions diffuse more negative features than the medium does. Notice also that only one negative feature is sufficient to observe this "amplified" effect.

Of course, as we have previously observed, no particular interaction effect takes place when the proportions of negative features emitted by interactions and by the medium are equal (see Deffuant and Huet, 2006b).

For several negative features, we have the "decreasing PB" effect each time the proportion of negative trajectories, in blue, is lower than the proportion of negative feature diffusion, in red. In this case, more positive features are diffused by the interactions than by the medium.

This simple analysis provides a means to quickly estimate the effect of the interactions on the primacy bias.

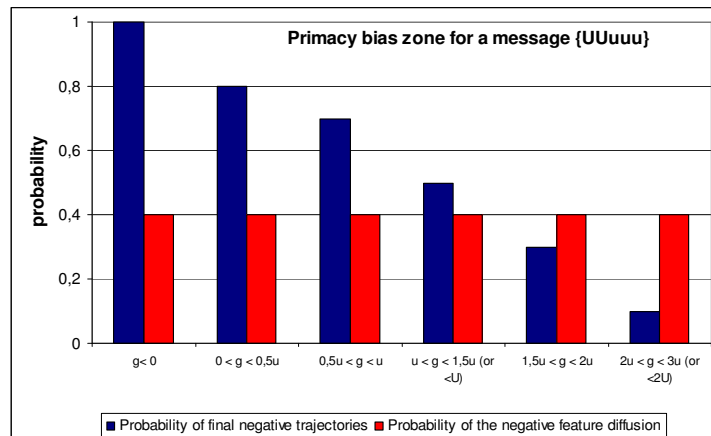


Figure 18. The asymmetrical individual reception filter

6 Conclusion and future research

We propose an individual based model of "information" filtering, which refers to the theory of cognitive dissonance of Festinger and work on rumor from Allport. In this model, an individual attitude can be sensitive to the order of feature publication, and in this case, we observe a primacy bias at the individual level. This order sensitivity is due to an asymmetrical reception filter, which filters the incongruent features which have an absolute value below a threshold.

This sensitivity to the order takes place in the case of neutral objects, involving 2 major negative and 3 minor positive features (of course the signs can be inverted without modifying the conclusions), that we studied more particularly in this paper. The major features have an absolute

value higher than the threshold, while the minor ones have an absolute value which is below the threshold. Interactions between individuals modify the proportion of individuals subject to the primacy bias :

1. they increase the primacy bias when initial attitude g is below U ; the reception filter is responsible for this effect.
2. they decrease the primacy bias when the initial attitude is above U ; this effect is due to the emission filter.

Moreover, in other experiments, we observe that primacy bias still takes place on objects which are moderately negative or positive (i.e. not neutral).

We analysed the increase and decrease primacy bias interaction effects, using an aggregated model. These analyses helped us to understand these phenomena, and led us to propose a simple indicator to predict the nature, and to some extent the amplitude of this interaction effect.

In the future, we plan to study in more details the effect of the structure of interaction and the spatial distribution of initial attitudes on the "interaction" effect, following the work initiated in (Deffuant and Huet 2006b). Moreover, we have found no social psychological reference about of the effects of interactions on the "primacy bias". This work suggests to perform experimental studies, particularly in laboratory, in order to check if the existence of these interaction effects on real subjects.

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