

# Is Fake News Consistent with the Truth?

JeanFrançois G\*

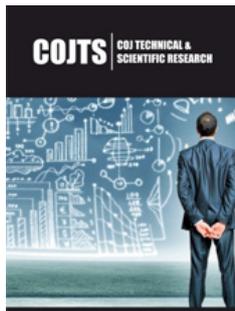
WARPA, France

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## Abstract

Fake news is a concept which recently appeared in the political speech. In this paper, we try to mathematize what it could be. We achieve this through trying to catch the notion of what information, in a human context, is. This brings us to a model which seems to work pretty well. As a consequence of this approach, we draw the conclusion that fake news broadcasting does not imply lying. We also take into account the cultural context and prove that some true information, in a given cultural context, can be felt as fake news. Finally, we also tackle permanent information channels and discuss their possibility to manipulate the information while we tackle in some way the contrary through looking at fake news in the context of historical research.

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\*Corresponding author: Jean François G, WARPA, 30, chemin Boudou, 31200 Toulouse, France

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## Introduction

Since the election of Donald Trump as the president of the United States of America, the word “fake news” has become famous and has found kind of a social status, becoming a subject of concern around the world. I will not take part in the discussion about who releases fake news or not, but the goal of this paper is to give a mathematical definition of what fake news is. Once this is done, the next problem is to see if, as many research and development programs aim at, it is possible to find a parade to fake news. The answer is no, there is no real parade in some sense, but there is even worse: fake news can be obtained just telling the truth. The paper is organized as follows. We explain in part 2 how the writing of this paper was triggered, and that fake news is a concept which already exists and is well known in cryptology. In part 3, we give a definition of what information is. This definition is mathematical and not completely rigorous. Our scope here is human and social science, we are outside information theory, and this therefore brings us much further, conceptually. The notions we define are simple, but they have a big range. Part 4 is a reminder of the law of the mean [1]. In part 5 we define what we call the civilization context and give an embryo of the definition of what could be called a civilization consensus. Part 6 has many subparagraphs and is dedicated to the study of many different cases of fake news we can encounter in real life. In particular we can prove that telling fake news is not contradictory of telling the truth. We dedicate part 7 to short or even very short-term information like permanent info channels such as CNN, BBC, France 24, etc. We prove that these means mainly are propaganda ones. In part 8 we tackle the difficult problem of what history is and should be and how it should be interpreted. In particular we point out today’s drift to interpret past events under the light of nowadays civilization, which obviously brings to fake history. Finally, we call for building on this theory together with computer means in order to act, stop and denounce, honestly, fake news.

## The Landscape

What triggered the writing of this paper was the reading of a paper written by Erwan Lamy, associate professor at ESCP Europe<sup>1</sup>, who, referring to a declaration of Reporters Sans Frontières<sup>2</sup>, complains about the fact that for RSF, freedom of opinion is guaranteed by the free exchange of ideas and information based on facts<sup>3</sup>. Even if Lamy is more than convincing in his paper, this is not the subject which will be tackled here, the question is more to know what we call information, since Lamy challenges RSF’s definition. On the other hand, we have, for a long time now, an example of kind of fake news which has been treated mathematically in the field of cryptology and which seems to have been forgotten if ever known by the

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<sup>1</sup><https://theconversation.com/debat-non-la-liberte-dopinion-na-pas-a-etre-fondee-sur-des-faits-106635>

<sup>2</sup><https://rsf.org/fr/lespace-global-de-linformation-et-de-la-communication-un-bien-commun-de-lhumanite>

<sup>3</sup>La liberté d’opinion est garantie par l’échange libre des idées et des informations fondées sur des vérités factuelles

protagonists of today's discussions. This is perfectly well described in Simmons's paper whose title is the prisoners' problem and the subliminal channel [1]. Basically, in any communication channel, there can be a subliminal one whose purpose is to give extra hidden information. Obviously, for the one who only gets access to the non-subliminal channel, this can be considered as fake news, since the ultimate goal of the communication is to deliver the content of the subliminal one. The question therefore is to know if we can give a more general result and reach it without calling for the cryptologic background which might look a bit complicated. I achieve this only through reasoning in an easy mathematical framework, with no calculation.

### What is Information?

Before speaking about fake news, we must give a definition of what information is. For RSF, as we saw above, it seems to be facts. Is it? As we shall see soon, it is not! But before saying what information is, we must describe its scope. And this is where the breakthrough occurs.

First, information is only worth in the human context and it therefore refers only to human activity. What I mean here is that whatever the fact, it is interesting as long as it concerns our "environment". This word is into quotes because it covers all what you can think about, from material to the intellectual, existing, past or to come and so on about man and its global environment (without quote that time). And, of course, our environment changes or can change, so we shall note it as a random vector:

$$(Y_1(t), \dots, Y_n(t), \dots)$$

This vector can be infinite the case being and depends on time. Its components represent a state of the system we live in. For example, if we look at the physical world before a storm, there is a bridge, a river, some lawn around it and so on. The components represent the state in which it is, that is, the bridge is new, the lawn is cut, the river flows at its normal level, etc.

Now, informing will consist, in a first phase, in reporting some facts and giving the picture of the potentially changed vector  $(Y_1(t_1), \dots, Y_n(t_1), \dots)$  with  $t_1 > t$ . The "news reader", can check the facts if we consider RSF's approach and measure what happened through calculating  $Y(t_1) - Y(t)$ , where  $Y$  stands for the whole vector, or, at least, evaluate, not necessarily through a formal subtraction, what has changed. And we could stay at this point.

But this would be far from enough! Indeed, describing the facts out of any context simply is nonsense. We absolutely need a context because what people want, the ones who receive the information, is to understand what occurred, why, if it could have been avoided, etc. For example, to keep on with the example above about the storm and the river, if there is flooding, the case being with deaths, people want to understand why and if it is possible to fix this in order to avoid it next time. As we can see, and this will seem obvious, informing calls for the intelligence of people

who receive it. However, intelligence is not any well-defined notion. Almost everybody has his own idea about what intelligence is. Our question, therefore, is to know whether there might be a mathematical concept which would match with any concept about what intelligence is. The proposed answer in this paper is yes and let us consider that this is the concept of a function in mathematics which seems to be the best adapted.

Let us go a bit deeper into mathematics. The transformation of the environment vector can be written as

$$(Y_1(t_1), \dots, Y_n(t_1), \dots) = f((Y_1(t), \dots, Y_n(t), \dots))$$

where  $f$  must be a "logical" function<sup>4</sup>. So, information should consist in both giving the resulting environment vector and the logical function. More formally, if we call  $\mathbf{Y} = (Y_1, \dots, Y_n, \dots)$  a piece of information should be the triple

$$(\mathbf{Y}(t), \mathbf{Y}(t_1), f)$$

Let us be a bit more accurate. Given an event which we shall note  $Y(t) \rightarrow Y(t_1)$  where  $Y$  is a vector, there are potentially several functions which will fit. We can, for example, have

$$\mathbf{Y}(t_1) = f(\mathbf{Y}(t)) = g(\mathbf{Y}(t)), f \neq g$$

And we can expect that for two individuals who would respectively "interpret" the events through these two different functions, there would be a disagreement about the information by itself. And we see it on a very regular basis, since it is pretty rare when, in a society, any two persons fully agree (i.e., 100%) exactly on the same interpretation of the facts. Without defining it, we might think about a distance, through a mathematical norm, which would allow computing  $\|f - g\|$ . And we could define basic agreement when we have

$$\|f - g\| < \varepsilon$$

where "epsilon" is a given value which is intrinsic. What is meant by intrinsic is that "epsilon" is the threshold in a social consensus for a society. If we consider the function  $f$  as the social reference, every individual having in his interpretation  $g$  such that  $\|f - g\| > \varepsilon$  is out of the consensus.

Now, this is the consensus for one individual. The problem, at the global society level, is to consider some kind of mean value. For a given society, what is the percentage of people it can accept such that  $\|f - g\| > \varepsilon$ ? And of course, If we consider the many events which occur in a society, we shall have a lot of vectors  $\mathbf{Y}_i(t)$  with people who will not necessarily agree on the interpretation of some and will agree on the interpretation of others. For example, let us consider two events  $\mathbf{Y}_1(t) \rightarrow \mathbf{Y}_1(t_1)$ , and  $\mathbf{Y}_2(t) \rightarrow \mathbf{Y}_2(t_1)$ . Let us consider two individuals who will have respectively two interpretation functions, namely  $f_1, f_2, g_1, g_2$ . We could have  $\|f_1 - g_1\| < \varepsilon$  and  $\|f_2 - g_2\| > \varepsilon$ . Now, between

<sup>4</sup>It is probably worth here to warn the reader. Logical does not mean, strictly speaking, mathematical logic even if mathematical logic is at stake. Indeed, logical here means in the societal or cultural context, which can imply religion, law and so on.

these two individuals, we should evaluate their disagreement on all  $\mathbf{y}_j(t) \rightarrow \mathbf{y}_i(t)$  the possible events and it is not so difficult to evaluate if they globally agree or not. Is it? No! In fact, all the events do not have the same weight, obviously and it depends for every individual how much he was impacted by the events. Indeed, if we consider flooding as before, and if you lost, say, your child who died, the importance of this event for you will be much bigger than if you live at 1000 km from the flooding.

So, let us keep on building our mathematical model. We shall note the individuals  $1, 2, \dots, N$ . Their interpretation function of the event  $j$  will be  $f_{i,j}$ . Add where  $i$  means individual  $i$  and  $j$  event  $j$ .

Now, we must add some weight to the event per individual  $i$  and we note it  $a_{i,j}$ . Now, the global agreement/disagreement function at the global societal level is going to be evaluated as

$$\sum_{i=1}^N \sum_{\text{events } j} \|a_{i,j} f_{i,j} - a_{k,j} f_{k,j}\|$$

Depending on its value, you have a societal agreement (consensus?) or not. Let us introduce politics! Indeed, people might disagree on the interpretation of some events, but if we take for example climate change, they might not blame their governments in any way. Therefore, at government level, a subset only of the sum above is to be taken into account since what the government targets is only satisfaction on its only action (or the one the population is expecting it will). And we have some theoretical tool to manage and measure what we could call "good governance". Please notice that this works for any entity, be it a government as we said, but also any company, or sports club and so on.

The difficulty is to make this theoretical model worth and applicable, because we introduced numbers through the use of norms, but where could these numbers come from? This is the problem we tackle in the following paragraph.

**The Law of the Mean**

We refer here the reader to [2] for more details and give a rough flavor of what is at stake. Indeed, let us use again the same way of describing the environment with a random vector

$$\mathbf{Y}(t) = (Y_1(t), \dots, Y_n(t))$$

This is the environment vector, which means that there are random variables representing physical or social contexts. Now, when facing an environment, any individual must be more or less adapted to it, otherwise, he dies or does not live well. We know, from an old theorem of mathematics, that if we consider 2 random variables  $X$  and  $Y$ , the best adaptation we can perform is to "calculate"

$$E[Y|X]$$

which is the expectation of  $X$  knowing  $Y$ . Now, for several independent random variables, the best adaptation is given by

$$E[Y_1|X_1], \dots, E[Y_n|X_n]$$

And this is the way it worked in the old ages of the caveman [2]. But now, man has invented money. The "virtue" of money is to make the formerly independent variables become dependent, since everything has a price or a cost [2]. And the optimum for adapting now becomes

$$E[(Y_1, \dots, Y_n) | (X_1, \dots, X_n)]$$

In addition, because money is not any finite resource, it is proved in [2] that instead of looking for a mean value, say, physical value, the transformation of the physical optimum into a "currency optimum", brings to a kind of a race to target the maximum of money creation; creation out of nothing, of course.

The goal of this paper is not to come back on the consequences of this whole theory, but to explain that the figures we were looking for in the preceding paragraph do exist and they even have a unit, an only unit which is, according to where you are renminbi, dollar, Euro, etc. So, there is a foundation to consider things as we did in the preceding paragraph and introducing numbers for the evaluation.

But let us come back to our subject which is information.

**A First Problem**

From now on, we simplify the problem. Indeed, for the sake of simplicity and for better understanding, we shall not treat the problem in its full generality as it is described. Therefore, we are going to deal with what we call "mean functions". For example, if we consider as above the functions  $f_{i,j}$  weighed by their coefficients  $a_{i,j}$  we shall consider a corresponding function, say  $f_j$ , for a given event for which the majority of the different actors of the society verify

$$\|f_j - a_{i,j} f_{i,j}\| < \epsilon$$

Basically, this means that  $f_j$  represents the socially accepted function. By the way, it does not mean this is the best and it does not mean that such a function is unique. In most cases, we can think about it for the following of this paper and the purpose we treat as the one which is the government's target. It will be noted simply  $f$  when we do not refer to any particular event.

Now, if you start from a given situation and get a new one, the big problem you face is that you can have plenty of functions  $f$  which will fit the equation above and which are "logical", as we saw it. So, how can you choose the right one?

In fact, if we try to better understand how the human society works, there are civilizations. What is a civilization? This is a common way to share the understanding of the environment.

<sup>5</sup>These functions are implicitly or intuitively known by the population. This is what means that some is a representative of a civilization. On the other hand, it is trivial that any migrant coming from any alien civilization, will not be in such a situation and can understand the news differently.

Therefore, this is going to restrict, in the problem just mentioned, the number of possibilities for the functions  $f$ .

Typically, for a given civilization, this will consist in having a restricted family of functions<sup>5</sup>, say  $F = \{f_\alpha, \alpha \in I\}$ , where  $\alpha$  is a parameter and  $I$  is a set. So, for a given fact, the explanation of a given civilization will consist in picking out one (non-unique!) function  $f_\alpha$  as the logical cause of the events which occurred. This function  $f_\alpha$  not only covers the purpose of giving a logical explanation, it also has the purpose of “closing” the set, that is, showing if not proving that the foundations of the civilization allow tackling and solving the problem in a meaningful and “positive” way. Just please notice that in theory, in a democracy, we should expect to have  $\|f_\alpha - a_i f_i\| < \varepsilon$  for a majority of people, but this is not even compulsory. For a dictatorship, the question does not even exist.

Now, let us come back to our initial problem. How to choose, given the two environment vectors  $(Y_1(t), \dots, Y_n(t), \dots)$  and  $(Y_1(t), \dots, Y_n(t), \dots)$  the “right” function  $f_\alpha$ , since there are many which fit? Obviously, paraphrasing Arrow and his famous theorem (which brought him to be awarded the Nobel Prize in economics), the choice is dictatorial. So, we point out, because we did not make any assumption about the regime in place, that informing, whatever the society, is dictatorial. Those claiming for democracy and the values of democracy should lower down their criticisms towards dictatorships given what we just noticed...

We shall come back on the comparison between democracies and so-called dictatorships later.

## Fake News

### Trivial fake news

The trivial fake news is when what is published is not the truth. Typically, assuming the initial vector was known, that is  $(Y_1(t), \dots, Y_n(t), \dots)$  you publish some false new environment vector,  $(Y'_1(t), \dots, Y'_n(t), \dots)$  which is different from the true one which is  $(Y_1(t), \dots, Y_n(t), \dots)$ . So, you deliberately lie. Such kind of fake news, whereas it exists, is not really interesting because it is too coarse. We therefore shall not insist on this, but we all know that such kind of fake news was at stake, such as the incubators in Iraq for the First Gulf War, the weapons of mass destruction in Iraq for the Second Gulf War, some false information in Romania in the 1990s and so on. You will notice that this is the only case thought about by RSF. And, as we are going to see in the following, this is a much too narrow point of view, far away from the reality. We shall end this subparagraph saying that this is the preferred means used in war time, simply because getting some information about the truth, that is the vector  $(Y_1(t), \dots, Y_n(t))$  may reveal to be quite difficult.

<sup>6</sup> Because this decreases the constraints on the choice Essentially because verifying the truth in a conflict zone is difficult.

<sup>7</sup> Essentially because verifying the truth in a conflict zone is difficult.

## Manipulation of the opinion

It can be bothering, when you govern your country, to choose the “right” function  $f_\alpha$  because it could compromise some interests. Therefore, it is often, if not always, tempting to shorten the environment vector into a smaller finite number of components. Typically, you only consider  $(Y_1(t), \dots, Y_m(t))$  with  $m$  small. This has the advantage of increasing, within  $F$ , the number of functions  $f_\alpha$  you can choose<sup>6</sup> and then improving your dictatorial choice. Such a way of doing things is known from the Catholics since the beginning. This is what they call lying by omission. And it is a fact that such fake news is very common in all societies. Just please notice that in this case, you have told the truth about the events which occurred. In order to fix things, let me take an example for which I shall not tell in which country it happened. There was a demonstration which was authorized in the capital of this great country, but not at the very downtown. The demonstrators did not respect this and forced the demonstration downtown, in front of the police. The demonstrators brought their children. They asked them to fall on purpose on the feet of the policemen who were bent, and this gave the impression, when only looking at this window time, that the policemen were beating young children. And this is this cut information which was broadcast in the western journals. For those who were present, the situation was radically different, and this simply was provocation from the demonstrators. You can therefore see, on a concrete example, what is meant, with mathematics, through the notion of “shortening the environment vector”. This is not new, but what we present is a mathematization of this.

### The fake news

What we have described was, say, in a national context. Now, globalization has occurred and the means to broadcast news are no more local so that information is global. CNN, RT, France 24, the BBC and many others release news 24/7 in the whole world. And here is how these organizations can release “fake news” strictly telling the truth. First, they can counter the two preceding ways of manipulating people we saw above. If the released environment vector is false, it is then straightforward to tell the true one and prove it. This will be considered as fake news in the adversary referential, but, at least, this case, once again, is too coarse to be really considered, even if this is the preferred one which is used in war time unfortunately<sup>7</sup>.

The second way to act is to extend the (voluntarily) shortened environment vector (as explained above) in order to “kill” the initial choice of the function  $f_\alpha$ . The reader should be obviously convinced that this is an easy attack. Indeed, if you are obliged to shorten the environment vector in order to find the “good” function  $f_\alpha$ , this means this function is “fragile” and can be dismissed with very few additional parameters. Fragile, here, mathematically means that

the number of additional “well suited”  $f_a$  you could get from the reduction of the length of the environment vector, is small, which gives a great probability to break it through extension.

Let us see this mathematically. Because of laziness (e.g., trying to decrease the cost) or manipulation will, most media if not all, voluntarily, as we saw above, shorten the environment vector into

$(Y_1, \dots, Y_m)$  with  $m$  small. Now, they therefore inform according to

$$(Y_1(t_1), \dots, Y_m(t_1)) = f_a((Y_1(t), \dots, Y_m(t))), f_a \in F$$

If you want to counter this, staying in the same civilization referential, what do you do? A possible way is the following. Pick  $k > m$  and inform according to

$$(Y_1(t_1), \dots, Y_m(t_1), \dots, Y_k(t_1)) = f_b((Y_1(t), \dots, Y_m(t), \dots, Y_k(t))), f_b \in F, f_b \neq f_a$$

Clearly, this is a bombshell! You strictly respect the truth, you give even “more truth” than the others, you stay in the civilization context, but you are going to be suspect of releasing fake news, as we can see this happening every day.

If we take again the example of the demonstration which was taken above, fixing the problem consists in extending the film shown at the breaking news, by, say, 10 seconds. Then, for sure, as you can easily imagine, you will tell a whole different story, within the same civilization context.

### The shock of civilizations

Let us now turn to the deep fight. Imagine we face two “competitors” from different civilizations. The set of functions for the first one is  $F$  whereas it is  $G$  for the second. Let us consider the national news which can be represented by the following scheme

$$(Y_1(t_1), \dots, Y_n(t_1), \dots) = f_a((Y_1(t), \dots, Y_n(t), \dots)), f_a \in F$$

But now, the “adversary” looking at the events through the prism of its civilization will inform according to

$$(Y_1(t_1), \dots, Y_n(t_1), \dots) = g_b((Y_1(t), \dots, Y_n(t), \dots)), g_b \in G$$

For sure, while the truth is saved in both cases, both sides will have a trend to consider that the information of the other is kind of fake news. Of course, I assumed that  $g_b \neq f_a$ , but the complicated case is when  $f_a, g_b \in F \cap G$ .

Let us detail all this a bit. Indeed, first, if we look at a favorable case in both countries, we shall have

$$\|f_a - a_i f_i\| < \varepsilon_F$$

And

$$\|g_b - b_i g_i\| < \varepsilon_G$$

This means that the information broadcast in civilization  $F$  is in line with the deep thoughts of the population while the information broadcast in civilization  $G$  is also in line with the thoughts of the population. We have some kind of a shock of civilizations since, without lying in any way, without even shortening the environment

vector, we have two different points of view on the events and this is characterized by  $f_a \neq g_b$ . For this very event, the distance between both civilizations can be measured by computing  $\|f_a - g_b\|$ . Of course to know how much the civilizations are far away from each other, we should calculate a weighted mean value over all the (past!) events during the same amount of time (i.e.  $t_1 - t_0$ )

But, as suggested, if the functions verify, in addition that  $f_a, g_b \in F \cap G$ , then we have a different interpretation in the same civilization context! This case is the most interesting because this is the most dangerous scenario. Indeed, let us consider the case when  $F$  is the so-called western civilization and  $G$  is the Chinese one. If we have  $f_a \in G$  and  $g_b \in F$  then the westerners will say that this is the Chinese way of seeing things and the Chinese will say that this is the western way. But, if both functions are within the intersection  $f_a, g_b \in F \cap G$ , potentially, the explanation of  $g_b$  might find supporters within civilization  $F$  whereas the explanation  $f_a$  can get echo in civilization  $G$ . Obviously, this creates interference! And if both choices of  $f_a$  and  $g_b$  have been made with back thought, that is if either or both  $f_a$  and  $g_b$  were not chosen as optimal in their respective societies, the result can be disastrous.

Moreover, now, on the contrary of the previous situation in which the actors obviously admitted that they do not think the same way and do not have the same civilization, in this very case, they can suspect the other to be willing to manipulate people. And, as usual in the art of war, it is always much more complicated to fight an attack from the inside than a one from the outside. Of course, if such a situation is replicated on many patterns and events, the situation can simply lead to war.

### The globalization context

Pursuing what we just said, we need to make a major remark. At world level, we are in the globalization context. What does it mean? It means convergence. This convergence can be proved to necessarily occur with the law of the mean which was already evoked above [2]. This means that people are converging, worldwide, towards the same way of life and therefore are going to face roughly the same problems and as a consequence, they will probably converge towards the same “ideas” or ways of appreciating the events. So, worldwide, we tend towards a very big intersection  $F \cap G$ . This is going to increase the probability of friction and interference in the society. And this will therefore increase the risk of war. Maybe one additional thing is worth being added. The very basis of this reasoning is the law of the mean, as already explained, which is a consequence of the existence of money. For money allowing convergence, obviously, it must play the same role in all the societies over the world. This means that we must more or less attribute the same value to the same things. This also means that all the different currencies must be convertible. And we can notice that this was the very goal of globalization. Therefore, not on purpose, of course, but globalization has the germ, in its very foundations, of the upcoming wars. Basically, the convergence of the ways of life will bring to

the convergence of the civilization prints (in terms of information, that is in terms of the logical interpretation of events) and this will bring to bigger sources of interference and therefore more friction, potentially up to war.

**Short Term Information**

Until now, we just considered times  $t_1 > t$ , and we made no assumption on the value of  $t_1 - t$ . But for several decades we have permanent information media which release permanent change, so that the information process can be described as

$$(Y_1(t + \delta t), \dots, Y_m(t + \delta t)) = f_{\alpha, \delta t}((Y_1(t), \dots, Y_m(t))), f_{\alpha, \delta t} \in F$$

Where  $\delta t$  is a very short amount of time, which implies shortening the length of the environment vector, at least for practical reasons if not for better manipulation as we already saw. I emphasized that the logical function will depend on  $\delta t$  on because the smaller  $\delta t$  the less “computation time” you have to choose the interpretation function or the less time you have to really think about what happened, which is even worse<sup>9</sup>. This has the obvious property of making this information very fragile and it can easily be counteracted via the methods of the above paragraphs.

So, it is not surprising that the notion of fake news took place just now, after the settlement of worldwide media informing people about very short-term events. Let us look at this more carefully, and let us take, for the sake of simplicity, a constant value  $\delta t$ . We have a recurring information process, as long as we consider the same variables in the environment vector (which is not necessarily the case in the true world, of course, but can be justified if we limit ourselves to a given subject) which we can describe as

$$(Y_1(t + k.\delta t), \dots, Y_m(t + k.\delta t)) = f_{\alpha_{k-1}, \delta t}(Y_1(t + (k-1).\delta t), \dots, Y_m(t + (k-1).\delta t))$$

For going from the time  $t$  to the time  $t + n.\delta t$  we have the explanation which is given by the function

$$f = f_{\alpha_0, \delta t} \circ f_{\alpha_1, \delta t} \circ \dots \circ f_{\alpha_{n-1}, \delta t}$$

In theory, there should be a constraint on  $f$  and it is very simple to write it. We simply need coherence, which means that  $f \in F$ . If the information delivered is “reliable”, this can put, under some circumstances, some constraints on the choices of the  $f_{\alpha, \delta t}$ . This is the difference between short-term manipulation and long term. The latter is much more difficult. Therefore, it is much easier to attack through “true fake news” from the outside, by showing for example that in fact  $f \notin F$ . But in the case of manipulation, limiting the possibilities for  $f$  might become difficult and since the manipulators will never insist on the function  $f$  itself (they will rather insist on the  $f_{\alpha, \delta t}$ ), it can be pretty easy to emphasize what the resulting function is for an opponent, killing the preceding propaganda, with the arguments of the adversary! In mathematical

terms this can be written as  $\forall i, f_{\alpha_i, \delta t} \in F$  but  $f = f_{\alpha_0, \delta t} \circ \dots \circ f_{\alpha_{n-1}, \delta t} \notin F$ , in the best case. The function  $f$  might even be not logical!

With this, we obviously see the double face of continuous information channels. On the one hand, they allow propaganda and brain washing of most of the people on the planet. On the other hand, if they are not rigorous (what they are never!), they just are very fragile. Why? Let us simply answer with a question. How many steps of elapsed time  $\delta t$  will it take to show that  $f = f_{\alpha_0, \delta t} \circ \dots \circ f_{\alpha_{n-1}, \delta t}$  is not coherent? And if you add the fact a foreign country might find, in the meanwhile, an alternative function  $g$ , in the same civilization referential, which is coherent, then you have the seed for deep trouble.

**History**

The point of view of the preceding paragraph also explains why the work of historians is difficult and, to some extent, what it consists in. Indeed, if the time  $t_1 - t$  is big, then you have to reconstitute, on the one hand, the function  $f$  as we just saw, check that  $f \in F$ , but if you want to be objective, you should also try to look at the events under the point of view of other civilizations, in particular when there has been wars between civilizations and look at the same events with  $g \in G$ . Discussing then what we can draw from the comparison of the different approaches should be of most importance to have a clear picture of what history was.

However, there is an additional big problem concerning history. Indeed, the civilization referential is going to change over time. Mathematically, this can be written  $F(t)$  to emphasize that the set of admissible functions varies with time. The problem occurs when we face the following situation. We historically explain a period between, say, time  $t$  and  $t_1$ , the function which explains what happened during this period, is, say  $f \in F(t_2)$  with  $t_1 < t_2 < t_3$ , we are at time  $t_3$  with  $F(t_3) \neq F(t_2)$  and, of course  $f \notin F(t_3)$ . Then there is, generally, the beginning of a judgment by the historians of people, with a referential which was not pre-existing at the time of the events. Unfortunately, not only this constantly happens, but it seems to be a kind of martingale from historians to use this method to discredit well-known respected historical figures who would not deserve such critics if they were “judged” by the criteria of their epoch. We should therefore care about what modern historians say and be very skeptical in many cases when they use obviously in their referential what we usually call the reading grid of today.

Indeed, what is the goal of history? Its very goal is to understand what happened under the circumstances at that time in the civilization referential and evaluate if the decisions which were taken were “good” or not; at least this should allow drawing some lessons for application or not in today’s circumstances and trying to make kind of a parallel. For sure, if we misinterpret what

<sup>9</sup>Our approach brings us to wonder whether the creation of permanent news channels was not deliberately put in place in order to better manipulate the people. Such creation could have been the result of a mathematical approach as the one I present here.

<sup>9</sup>The less computation time for the news broadcaster and the less time for the listener to think, could also be a valid interpretation

happens, whatever the parallel, since the premise is false, in good mathematics, you cannot conclude anything reliable.

### Democracy

The proposed model here brings us very naturally to define what democracy should be. Most people think that democracy can be summarized by having people vote. But, as far as we know, there are also votes in dictatorships. In Soviet Union for example, there were. So, what can be a democracy under the light of our model?

This is quite simple! In fact, it consists in discussing the content of the set  $F$ . The election process should consist in voting on  $F$ . Is it what happens, in particular in the countries which claim they are the champions of democracy? Obviously, no, be it the USA, the UK, France, Germany and so on. How is it possible to be so sure of this? Simply listening to the debates. This kind of topic is never tackled and, worse, the media do whatever they can to avoid having these deep discussions. For this they define the environment sub-vector of their choice as being the only one which will be discussed during the campaign such as  $(Y_1(t), \dots, Y_n(t))$  and they will take a very short looking at what the different candidates of their choice propose on this only. The ones who want to tackle other subjects are disqualified and cannot access the media and unfortunately the people are fooled whereas they are persuaded that they live in a democracy. This is only the method which differs, but in the end, the so-called democracies are true dictatorships.

### Fighting Against Fake News

Given what we have seen and easily proved, fighting against fake news is almost impossible since fake news can be consistent with the truth. But what do we see flourishing in western countries today? Simply anti-fake news algorithms, fake news detectors and so on. What can we say about this? Simply that these means are only propaganda!

### Further Research and Proposition

This paper can be considered as a first draft of a very complex mathematical model. We think that the proposed foundations here are worth being deepened and we believe that they constitute kind of a seed for tackling the problem of fake news over the world. Tackling here clearly means detecting, denouncing, analyzing and explaining to people what to really think in the most objective

way. This theory also would allow the nations and the different civilizations to think and even define what their set of acceptable function is, that is  $F$  but since governing is foreseeing, it should give them some clues of how to manage in fact  $F(t)$  along the decades and centuries and detect, when a new function is added, how much it impacts the former edifice. This might be a powerful tool to avoid revolutions. One again, we just planted the seed. We shall be delighted to collaborate with any organization, academic or not, who would want to pursue in this way and even build automatic information treatment which will be much more objective and efficient than the existing adulterated means of today.

### Conclusion

Fake news is a concept which to some extent is relative to a civilization, and some fake news, in the sense that it goes against the interest of the local power, can be released saying absolutely the truth. This is even easier when the massive use of short-term information has the only goal to manipulate the populations. Under such circumstances, all the countries, mainly the western ones, which want to fight against fake news, are in deep distress, since when they complain against fake news, they only complaint against their inability to fully manipulate their populations. It is also not complicated to use the approach of this study to find recipes for manipulating information and make fake news which is true.

### Acknowledgement

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