A NEW THEORETICAL MODEL FOR THE STUDY OF BILINGUAL CONTEXTS: THE CATASTROPHE THEORY

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1. Introduction

This paper suggests a new theoretical model based upon the analogy with the mathematical theory of catastrophes in order to go beyond the low correlations between language use and the most used variables (the concept of linguistic attitudes). Isomorphism, together with catastrophe theory, provides an answer to the main question: the number and type of variables that determine the use of languages. The resulting model has been corroborated in 5 surveys carried out in the main territories where Catalan is spoken. The excellent results obtained are to be found in the poster published with these proceedings.

1.1. A game to explain catastrophes

We propose to play a game to provide a better explanation for our research results. Factors that determine why Valencians chose Catalan or Spanish when talking are summed up in Figure 1.

We are sure you have noticed that the variables have been left blank: this not a mistake. This was done on purpose to show you step by step the path we have followed to fill in this gaps. We consider this to be the main question informing our research.

To answer it we first have to see which are the factors normally used in this kind of research. Were we to write down these factors, we are quite sure that, in addition to socio-demographic variables such has age, gender, social class, rural/urban setting, the list would contain: linguistic attitudes, motivation, identity, etc. If we look at studies based upon this variables, we will see that correlations obtained between the variables and the use of languages is very low. The surveys carried out according to the concept of language attitude very seldom go beyond 0.30, i.e. 9%. Pierre Bourdieu stated that

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"The error of the concept of attitude is its simplicity". Nevertheless, many people have insisted on going forward with this measurement method.

Figure 1. Segmentation of the sample according to the language group.
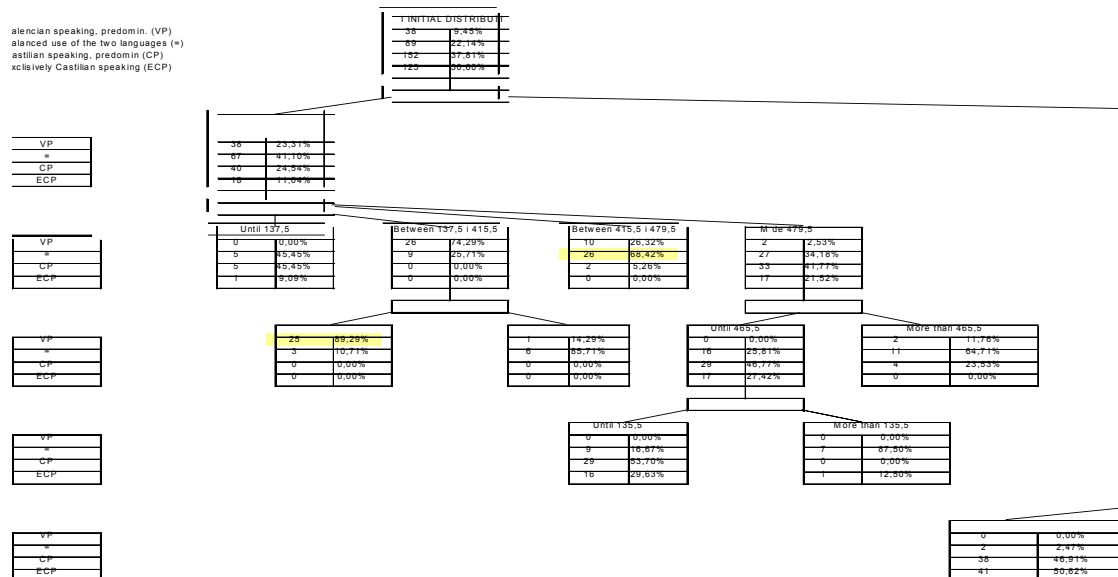
The question therefore is as follows: what can we do to propose other variables?

The answer is: a considerable number of things. Due to limits of space, we will have to proceed faster than we would like and to summarise those parts of the explanation which can be found in the poster published in these *Proceedings*.

A prior question: as we see it we have to include these kinds of reflection within the framework of *processes of language shift*, which we define (Querol, 2000: 49) as a gradual and reductive isolation of a language in its:

- demographic extension,
- geographic extension and,
- its domains of use and therefore also in the
- representation of its possibilities of use.

It seems clear that we should change this theoretical framework of language attitudes in order not to simply repeat the same results... yet how can this be done? First of all we will have to inquire about the *models of questions and answers* of the

sociology of language, i.e. the paradigm obtaining in this discipline. Georg Ritzer (1980) proposes a new definition of *paradigm*:

> A paradigm is the fundamental image of the topic of a science. It is used to define: what is to be studied, what questions have to be asked, how they have to be asked and which norms are to be used to interpret the answers. The paradigm is the widest union of consensus in a science and is useful to distinguish between a scientific community (or sub-community) and another one, to subsume, to define and to interrelate the *samples*, the theories and the existing methods and instruments.
>
> (Ritzer, 1980: 7)

This more thorough definition than those given by Kuhn, will allow us to apprehend which are the proposals provided by the sociology of language. Although we will not focus our reflection at the level of paradigms but rather do so one step below, i.e. models, we nevertheless consider that the above-mentioned criteria can help us to chose a model on good grounds.

2. State of the issue

2.1. Different approaches to the study of the relationships between languages

To analyse the state of the question, let us see the questions raised by Ritzer (1980):

What do we study? The use of languages.

Which questions do we ask? Why one or another language is used, i.e. who talks to whom? When? Where? About what? How? In the presence of whom? What for?

The two last questions require a longer answer that we will raise jointly:

How do we ask these questions?

Which norms must we follow to interpret the answers?

There are many ways to ask questions in the sociology of language depending on the number of languages, the number of active factors and the sociological paradigm in which they take place. There are therefore different levels of analysis[2] (see Table 2):

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[2] For a full description see Querol (1999a: 13-40, and 2000: 21-39).

Table 2. Levels of analysis.

NUMBER OF LANGUAGES	NUMBER OF FACTORS	SOCIOLOGICAL PARADIGM
MONADIC MODEL 1	MONOFACTORIAL *LINGUISTIC CONTEXT*	PARADIGM OF SOCIAL FACTS FUNCTIONALISM
BINARY MODEL 2	BIFACTORIAL *LINGUISTIC CONTEXT ---- USE*	PARADIGM OF SOCIAL BEHAVIOUR BEHAVIORIST SOCIOLOGY
TERNARY MODEL 3	TRIFACTORIAL *LINGUISTIC CONTEXT -------- PERCEPTION --------USE*	SOCIAL DEFINITION PARADIGM "**Man is the active creator of his own social reality**" ACTION THEORY SYMBOLIC INTERACTIONISM PHENOMENOLOGY (ETHNOMETHODOLOGY)

Source: own work.

2.2. The proposed level of analysis

The levels supplied by these three approaches can be either horizontal or spread out at intervals. We will focus on the ternary and trifactorial conception included in the paradigm of social definition.

Let us see which *are the problems* confronting the *questions* asked in the studies on *processes of language shift* and which will be the proposed solutions, as stated in the Table 3.

Table 3. Problems and solutions of the studies on language shift processes.

PROBLEMS OF THE QUESTIONS OF CURRENT STUDIES	SOLUTIONS
They are not matched by theorizing which fully justifies them	Find a formal analogy providing us with a new and more global theoretical framework
They use monocausal explanatory schemes	Propose more than one intermediate variable
They have a (+/ - 9%) empirical correlation with the concept of linguistic attitudes	Increase the correlations between use and the newly put forward proposals

Source: own work.

3. The new theoretical proposal

We will start to explain our proposed new model by using a comparison with construction works. With the reader's forebearance, we will do it in a very simple way. Let's imagine *another game*: we belong to a NGO which could be called "Architects without frontiers", a huge earthquake has devastated a very large area. There are thousands of refugees and the chaos is such that we cannot talk to the inhabitants. The organisation decides to use the large number of existing film footage of the area and to quickly rebuild it as it was before. The problem is that we do not know what the interiors of the houses were like, although some footage shows people walking in and out their homes. We can therefore only have a vague idea of the needs of the inhabitants. We neither know how many rooms to build, nor how to design them... You may have guessed that we are refering to the *black box* model, in which we know only the inputs and outputs of a given system, but not its internal functioning. Figure 4 below describes the black box model.

Figure 4. The black box model.
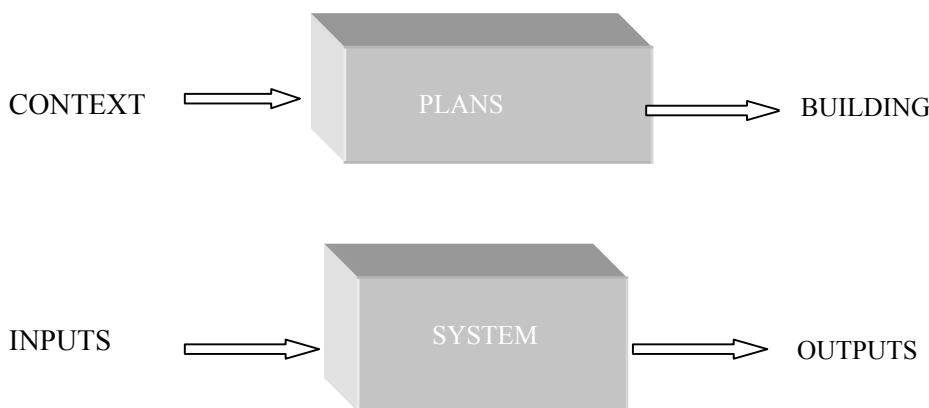
Source: own work.

We are therefore talking about the same structure as that of the *catastrophe theory* (which is similar to the black box). We can use this to draw an analogy with human behaviour and, especially, of the linguistic behaviour, as described in Figure 5.
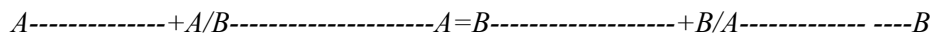
The first thing we have to do to obtain what the game proposes to us is to draw different plans, ranging from linear plans to the plan described in Figure 6.
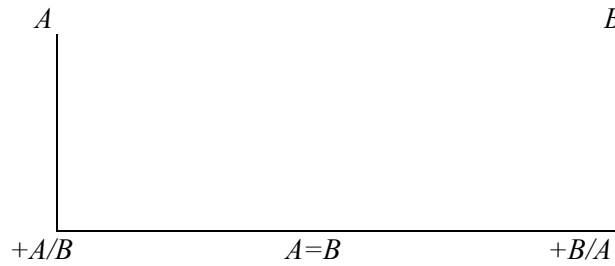
Figure 5. Proposed analogy.
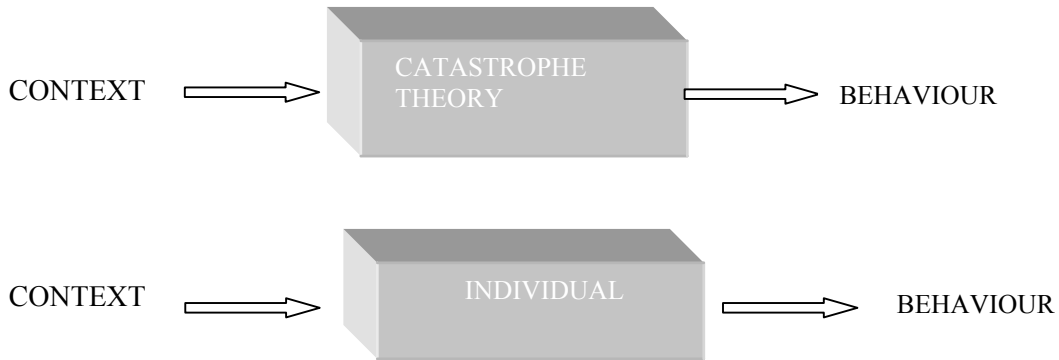
Source: own work

Figure 6. Stages of language shift processes.

$$A\text{-------------}+A/B\text{--------------------}A=B\text{-------------------}+B/A\text{-------------} \text{----}B$$
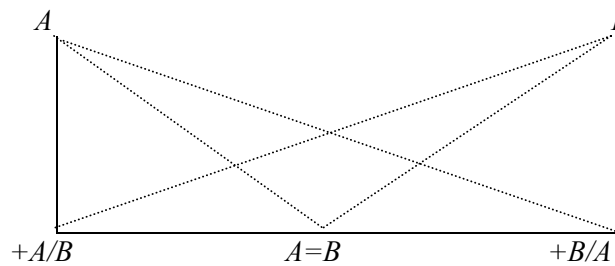
or:

Source: own work

Or taking into account that the process can also be discontinuous:

Figure 7. Discontinuities in processes of language shift.

Source: own work.

The continuous lines would here be equivalent to the linear plan stated above while the discontinuous lines would stress the possible discontinuities, the different gaps that can be skipped while going through one or two contiguous stages.

By chance, a friend introduces us to the most prestigious *architect*, René Thom (1972) who gets seven sets of *plans* covering the *basic* needs for the construction. We realise that some of our own draft plans look similar to the plans he shows us. Nevertheless his main concern is mathematics, and according to his terminology he says they are included in the *catastrophe theory...*

As limits of space do not allow us here to explain our model in details, we would respectfully refer the reader to the following publications: Querol (1997, 1999a, 1999b, 2001). Here, then, we can only put forward this proposed analogy that initially may look a little strange, but we think that a second comparison could prove useful in helping to fully grasp it. For the reasons stated in figure 3 we determined to seek a solution that was substantially different from previous proposals: the formal system provided by the catastrophe theory.

René Thom (1972) was the first mathematician to successfully study the discontinuities that for us are, precisely, the key-factor in the processes of language shift, as stated in figure 7. Because it is not the gradual changes that substantially determine the process but clearly the sudden changes, those which change the direction and the rate of change, and which can become *models for other changes*. Thom focuses on these discontinuities he calls catastrophes, and he describes up to seven easy ways in which systems may be modified.

Looking over these *plans*, we find those of a building for a family similar to the one for which we have to rebuild the house: the same number of members, the same ages, the same social class, the same neighborhood, etc. The factor which finally enabled us to see the similarity was the fact that one of the members of the family needs a wheelchair. We know then that the house cannot have architectural barriers. Thus where we see plans which lack these barriers we know that they fulfil this basic requirement.

Looking at Thom's proposals we realised which was the model we needed in that without the phase of bilingualism *A=B* we could not grasp the collective evolution of the language shift process because, unless a whole community decided to cross from

one to another phase (missing out the intermediate phase) it would necessarily need to go through this equality phase. René Thom himself (1972: 88) points out that this peculiarity even if stable from the structural point of view is nevertheless hard to observe directly due to its transitory state[3]. We have nevertheless to take into account that this state does exist and this will determine the election of the model that can help us to describe the process.

Four factors take part in the butterfly catastrophe pattern (we can imagine them as forces pulling in different directions), i.e.:

- normal factor
- splitting factor
- bias factor
- butterfly factor (i.e. of compromise)

To determine the degree of similarity between the two *levels* we can try to describe the stages of processes of language shift according to the characteristics of the butterfly castastrophe, as shown in Figure 8 below.

Table 8. Description of the processes of language shift in terms of the stages of butterfly catastrophe and their characteristics.

	No bias $c<0$	Bias $d>0$	= bias $c=0$	No compromise $d<0$	Compromise $d>0$
Monolingualism *A*	*			*	
Neither *A* nor *B*			*	*	
Monolingualism *B*		*		*	
Bilingual +*A*/*B*	*				*
Bilingual *A* = *B*			*		*
Bilingual +*B*/*A*		*			*

Source: own work.

Next we will proceed to describe the analogy stated in the table.

We take into consideration the same stages (individual or collective) as those of Figures 6 and 7 and we add the possibility of the non-presence of both language *A* and language *B*, which could be the case of immigrants who do not know any of the two languages in contact. If we study the speakers individually we will find the following outcomes:

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[3] Geometrically shown in the so-called *compromise* factor in the butterfly catastrophe pattern.

- *monolingual speaker language A,* as in the above-mentioned tables, will be the initial situation, and therefore, by defining him/her according to the characteristics of butterfly catastrophe, we will see he/she represents no bias vis-à-vis this usual situation nor any *compromise* with the others as the situation is *normal.* On the opposite,

- *monolingual speaker language B* represents a *bias* and there is no *compromise* with anyone in that he/she only can speak that language;

- *neither A nor B speakers* means there is no *bias* (as they don't speak any of both languages) nor any direct *compromise* in the interactions (they cannot speak with anyone who can only speak A or B): they are apparently external to the conflict.

In short these three types of speakers do not even have the possibility of *compromise* as they do not share any language. This is why we call them monolingual or unilingual. As regards bilinguals, we observe that they all have some compromise (see the three asterisks in the table): all three *converge* in some occasion with the interlocutor by speaking the language.

- *bilinguals +A/B* will present no *bias* because their main language is the usual language;
- *bilinguals A=B* will present the same *bias* compared to both extremes (*A* and *B*) and, finally,
- *bilinguals +B/A* will have a bias towards *B*.

In using the characteristics of butterfly catastrophe to describe the processes of language shift, we noticed that there was actually no need to change anything and the description was complete. What we have here, then, is not simply analogy but *isomorphism.* Summing up, the *levels* we are comparing are not only similar they are identical. We may wonder therefore which are the control factors operating in our *building* concept, since they could be the same as those in the butterfly catastrophe. In our comment on table 8 two clues have already emerged: the normal factor is language A and the segregation factor is language B We must now establish what the bias and compromise factors correspond to. For this we have noneless to introduce three more concepts.

Let us look briefly at the first which derives from the theory of social representations, put forward in social psychology. For our purposes, we use the

definition of *social representation* given by Denise Jodelet (1989: 36): "It is a form of knowledge socially which is socially constructed and shared; it constitutes a practical vision and is present in the construction of a reality common to a social setting".

Here briefly are the reasons for introducing this concept into our research: firstly because representations not only determine the vision of the social reality but are also involved in its effective construction. Secondly, because they play a crucial role in social communication: the verbal exchanges in daily life demand something more than the use of one single linguistic code. Thirdly, because they include innovation. Fourthly, because they make up personal and social identities. And, lastly, because they create common sense theories. For all these reasons we consider the theory of social representations can bring more light to the field of the sociology of language than any other of the known theories.

The second concept to be defined is that of *reference group*. According to Merton & Kitt (1950): "It helps to systematise the determinants and outcomes of the processes of evaluation and self-evaluation by which an individual takes the values or norms of other individuals and groups as reference framework".

Lastly, we take it that *social network* refers to all people sharing a language and establishing linguistic interactions among themselves.

In this section we have already seen the isomorphism that exists between the characteristics of the butterfly catastrophe and those of the processes of language shift. We have also already hinted that if a system shares the same characteristics with another, it may also share the same factors of control. This, then is what we propose to do: to seek out the missing control factors.

Having introduced the definition of these concepts, we can now state that the *bias factor* will be to have a certain representation, a more favourable *perception* of language *B*, that is, of the language which is different from that of the *normal* situation (*A*): a *bias* takes place therefore with regard to what is usual.

The *compromise factor, on the other hand* means to have a social network other than that of the first language spoken, a circumstance which makes convergence possible, that is, makes it possible to speak the language of the other.

We can sum up our discussion in the following table (Table 9).

Table 9. From the characteristics' isomorphism to the isomorphism proposal of the control factors.

BUTTERFLY CATASTROPHE: CONTROL FACTORS	CONTROL FACTORS OF LANGUAGE SHIFT PROCESSES OR VARIABLES HAVING AN EFFECT ON THE DEGREE OF USE OF A LANGUAGE
ATTRACTORS: - NORMAL FACTOR - SPLITTING FACTOR	*REPRESENTATION OF THE REFERENCE GROUP:* *MORE LANGUAGE A* *MORE LANGUAGE B*
BIAS FACTOR	*MORE REPRESENTATION OF LANGUAGE B*
COMPROMISE FACTOR (= BUTTERFLY)	*MORE REPRESENTATION OF THE B SOCIAL NETWORK*

Source: own work

Broadly speaking: the *attractors* will match with the representation of the groups of reference of speakers of each language. As we have already seen in the schemes showing the processes of language shift, as well as in our comment on table 8, we have located one language in every corner so that these will be the two poles which *will atract* the speakers towards one or another language. Within this framework, the second factor (namely, the bias factor) will match the social representation of language *B*, i.e. the way the speakers conceive it positively such that they will be drawn towards that language. Finally, the compromise factor (or butterfly factor) will also play its part as the positive representation of the social network of the second language and will have its influence on the intention to converge with the speakers of that language.

If we resume building our house (the one we were building earlier in the article), we can say now that to match the needs of its owners we should focus on the way they see it, which is the representation of its environment. On the one hand, we will look at the attractors involved, that is, the representation of the social group of reference that they apparently want to resemble. On the other hand, it would be useful to imagine how they conceive the houses (what their representations are) and, lasty, we will be able to see in the video what the kinds of houses the people with whom their interact are like (representation of the social network). The interaction between these three representations will therefore determine the type of house we have to build.

This isomorphism therefore allows us to establish:

- The number of variables.
- The characteristics of variables.
- New issues: languages which are not directly in contact.
- The establishment of 4 types of speakers.
- The reference group as central issue, which also coincides with the theory of social representations.

The table below shows how we have solved the problems stated in table 3.

Table 10. From solutions to the new model.

SOLUTIONS	THE NEW MODEL
To find a formal analogy allowing us to draw up a new global theoretical framework	Catastrophe theory
To propose more than one intermediate variable	Social representations: -of languages -of the social network -of the reference group
To increase the correlations between use and the new proposed variables	Empirical surveys in different periods and contexts

Source: own work.

We can go on to close this second section by discussing the second and third solutions, namely the possibility of increasing the correlations between actual use and the proposed intermediate variables. In our case, we have just seen, as stated in tables 9 and 10, there are three intermediate variables: the representations of languages, the social network and the reference group. Accordingly, the relation between these independent variables and the dependent variable (the use of languages) can be summarised as follows (Figure 11).

Figure 11. Relationship between the independent variables and the dependent variable (language use).
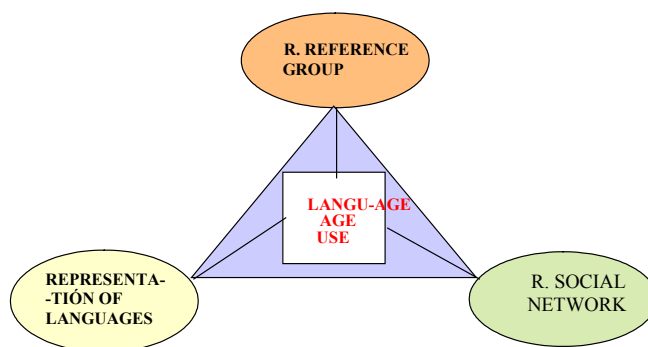
Source: own work

There is actually a feedback between all variables. From the perspective of the dependent variable we should say that use generates use and non-use leads to non-use, and the rest of variables contribute either to use or non-use. Thus the figure shows our theoretical proposal which actually is the pattern of the relations between the hypothesis we want to prove.

Finally we have to move back to the two questions submitted in the first section about the state of the issue and which originated our line of reasoning here. We refer to the model of questions and answers of the proposed paradigm (how questions are asked and which norms we have to follow to interpret the answers within the paradigm of the sociology of language).

Summing up, we formulate the questions from the proposed multifactorial model. As for the norms to be followed to intepret the answers, we propose to do is to insert them on top of the formal system of catastrophe theory based, as we have seen above, on continuities and *discontinuities*. This would help us to understand much more completely the evolution of the processes of language shift, either from a personal and collective perspective.

4. Empirical results

As for the third solution, that of increasing the correlations between the use and the new variables, we carried out 5 empirical surveys at different periods and contexts: Catalonia (1993 and 2000), Valencian Country (1998), Balearic Islands (2001) and

Andorra (2002). In all the surveys the target-group was made up of students in the last year of compulsory secondary education (around 16 years of age), using representative samples (and indeed the students' census of Andorra) and questionnaires with 378 items. We show in the poster[4] reproduced in these proceedings descriptive, explanatory and predictive results relating to language use.

The most salient issue of these results is that we have discovered that in all contexts two[5] of the proposed variables of our model attain a correlation of up to 73.56% (.868) and always more than 50% (compared to the 9% obtained from the linguistic attitudes analysis). Furthermore, the model is able to classify correctly up to 83.8% of students in one of the four linguistic groups, and is always above 60%. Also by means of the discriminatory analysis and the multiple regression analysis we have confirmed that the variables of our model are those that have a greater influence on the use of languages compared to those used in the questionnaire on ethnolinguistic vitality, identity, the instrumental and integrative reasons we have also included in our survey to compare accurately the adequacy level of our model compared to the concepts most usually resorted to in sociology of language research into language choice. By means of the induction graphs (SIPINA), we also reached the same conclusion. Nevertheless, in order to maintain the suspense a little longer... we will show the solution and all the results of our research in the above-mentioned poster you will find enclosed in these *Proceedings*.

Lastly, we also introduced the prediction of language use and thanks to the survey carried out in Catalonia in 1993 and again in 2000 we have been able to confirm that our predictions were right. The proposed model therefore matched the solutions we sought and we consider it places our proposal in what Foucault (1970: 244) called the *scientific nature threshold*, that is, in the area where discursive thought is not only based on empirical norms but also on a set of formal rules.

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[4] "Empirical corroboration of the model of the catastrophe theory in Catalonia (1993 and 2000), in Valencian Country (1998), in the Balearic Islands (2001) and in Andorra (2002)".
[5] Insofar as the third variable, the reference group, is not numerical it cannot easily fit in the analysis, although it did in the multiple regression analysis.

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