A Game-Theoretic Analysis of Minority Language Use in Multilingual Societies[1]

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Abstract

This chapter studies multilingual democratic societies with highly developed economies. These societies are assumed to have two languages with official status: language A, spoken by every individual, and language B, spoken by the bilingual minority. We emphasize that language rights are important, but the survival of the minority language B depends mainly on the actual use bilinguals make of B. The purpose of the present chapter is to study some of the factors affecting the bilingual speakers' language choice behaviour. Our view is that languages with their speech communities compete for speakers just as firms compete for market share. Thus, the conflict among the minority languages in these societies does not take the rough expressions such as those studied in Desmet et al. (2012). Here the conflict is more subtle. We model highly plausible language choice situations by means of choice procedures and non-cooperative games, each with different types of information. We then study the determinants of the bilinguals' strategic behaviour with regard to language. We observe that the bilinguals' use of B is shaped, essentially, by linguistic conventions and social norms that are developed in situations of language contact.

Keywords: Minority Language, Language Contact, Language Competition, Evolutionary Stability, Imperfect Information, Politeness Equilibrium.

JEL Codes: C72, Z10.

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1. Introduction

To put this chapter into context, we begin by outlining the use of game-theoretic tools in the study of the economics of language.

We know that communication and information transmission between human beings is done mainly by means of natural languages. Communication, information sharing and coordination are relevant topics in economics. Economists know that one of the requirements for reaching efficiency in competitive markets is that the participating agents should share any and all relevant economic information. But this condition is rarely met in real situations. And, to make the analysis more difficult, it is widely accepted in economics that agents do not have a preference for truth-telling. When they believe that lying is to their advantage, they will do so and will misreport their preferences or any private information they might have. This theory seeks to understand the mechanisms by which information may be shared when such information is private. This problem has attracted game theorists who found *signaling* (Spence, 1974) a method by which an agent reveals his private information by choosing costly actions. Farrel and Rabin (1996) conclude that in real situations most of the information sharing is done, not through complex Spence-style signalling, but through ordinary talk. That is, through "cheap talk". Since cheap talk may communicate private information in equilibrium, the study of the existence of that kind of equilibria gave rise to a large literature known as *cheap talk games*.

Even though natural languages are the main vehicles of information transmission, research on this subset of games has not thoroughly addressed the economics of the (natural) language area. The main reason is that in cheap talk games, what matters is any type of communication device or language players share: noises, signs, codes or words with meanings only the players involved know, can all be considered "language" in these contexts (See, in particular, Crawford & Sobel, 1982; Farrel & Rabin, 1996; Demichelis & Weibull, 2008; Heller, 2014). Blume and Board (2013) weaken the assumption of a perfectly shared language by assuming that individuals speak the same language but have different language competence and may therefore disagree about meaning. Individual language competence is then assumed to be private information, and Blume and Board show that in common-interest games efficiency losses can be severe. A domain where language competence may differ would be the natural language-based code developed under efficiency pressure inside a firm; the language is known by the members of the

firm but not well known by outsiders. Weber and Camerer (2003) show how different firm-specific languages might affect post merger performances.

A natural language is thought to be shaped by some sort of behaviour that tends to optimize the benefits of communication minus the cost of memory and articulation of linguistic expression (see, for example, Selten and Warglien, 2007). That is, a natural language maximizes the transmission of information with the minimum of effort. Along this line, Rubinstein (1996) uses optimality arguments as a potential explanation for why certain properties of binary relations are relatively common in natural language. As a general explanation, Rubinstein states that evolutionary forces would select human beings equipped with binary relations which are better for communication. In subsequent works on economics and language, Rubinstein and Glazer (2001, 2004 and 2006) present game-theoretic models of the pragmatics of debating in which a listener makes a decision after being persuaded by the arguments presented by some of the debaters.

An area of the economics of language where game theory has been applied is language learning. The pioneering work was conducted by Selten and Pool (1991). These authors presented a general model (with $n \geq 2$ countries and $m \geq n$ languages) that offers reasons why the inhabitants of a country choose to learn an additional language. In the model, languages are the strategies that players may choose to learn and the payoffs consist of gross communication benefits minus the player's learning costs. Selten and Pool showed the existence of an equilibrium in which players do learn non-native (natural and/or auxiliary) languages. The works of Church and King (1993), Ginsburg et al. (2007), Gabszewicz et al. (2011) and Ginsburgh et al. (2014) are all based on the Selten and Pool's model. The former two papers deal with theoretical issues related to the learning equilibrium; the latter two use data to estimate probable learning decisions. A detailed survey of these works can be found in the chapter by Ginsburgh and Weber in the present volume.

It can safely be said that the bulk of the literature on the use of game-theoretic tools in the economics of language is limited to *semantics* (the study of meaning) and *pragmatics* (the study of meaning in context), though the area of language-learning is a notable exception. In the present chapter we use game theory to deal with neglected issues related to *language status*. More specifically, we study the language choice behaviour of the speakers of a minority language in contact with a majority language. It is hard to understand why this competitive situation, in which languages and their

speech communities compete for speakers has been so thoroughly studied by sociolinguists but has not received the attention it deserves from game theorists. We hope the game-theoretic approach will shed more light on the situation of minority language and promote further inquiry.

The chapter is organized as follows. In Section 2 we present a multilingual society with two official languages that are linguistically distant. It is assumed that this society is a democracy with a high developed economy and high standard of living. The idea here is to create a benchmark for all societies with minority languages. In Section 3 we create a reference point for the bilingual agents of such a society. A reference point is used to compute gains and losses. We propose a bilingual speakers' reference point composed of linguistic rights, the linguistic notion of *face* (which will serve to model bilinguals' emotion-based utilities) and expectations. Section 4 describes a frequently used procedure by which bilinguals decide to use the majority language when they know that they are interacting with interlocutors, some of whom are non speakers of the minority language. It is called the maximin language choice. In Section 5 we provide justifications for the assumption of imperfect information about linguistic types in modern multilingual societies. Section 6 introduces the Ultimatum Language Game, which is based on the well known (Mini) Ultimatum Game (see Binmore et al.,1995), in which the linguistic type of the interactants is private information. In Section 7 it is presented a game of language use.[2] The purpose of the section is to study the play of the population of bilingual speakers to see how they might build a linguistic convention which will serve to facilitate their language coordination problem. In Section 8, we show how players' utility functions account for both the expected material payoffs and the emotions that arise in response to the opponent's choices. A new equilibrium concept derived from linguistic politeness theory is presented, the *politeness equilibrium*. It has produced, in our view, a more realistic result, which says that the bilinguals' linguistic conventions are based on two pure strategy politeness equilibria. Finally, in Section 9 some policy suggestions are offered for increasing the use of the minority language. Section 10 concludes the chapter.

[2]Pool (1986) introduced a conversation game between two bilinguals with perfect information, each having a different native language; the context and the issues studied in that work are very different from ours.

2. Multilingual societies

Let us consider societies with two official languages: A denotes the language spoken by every individual of the society, and B denotes the language spoken by the *bilingual minority* of the society. That A and B have official status means essentially that:

Language Equality: A and B are, by law, equal; that is, they have equal status, rights and privileges relative to their use.

Let α denote the proportion of bilingual speakers and $1-\alpha$ the proportion of monolingual speakers.[3] Notice that since the two languages are being used by the same social group, the bilingual speakers, we say that languages A and B are in *contact* (see Nelde, 1987 and 1995, and Winford, 2003).[4] Languages A and B satisfy the following assumption:

Assumption 1: *The languages with official status, A and B, are linguistically distant.*

Under this assumption, successful communication is only possible when the interaction takes place in one language. This assumption is important in order to demonstrate that the language choice is not a trivial one. In other words, it is not possible to have a conversation where one individual speaks A and the other one B because a monolingual agent would not be able to understand what is being said when someone uses language B.[5] This also implies that when a monolingual interacts with a bilingual, the interaction will necessarily take place in the majority language A. For instance, in the Basque Country, mixed language conversations are not common because the linguistic distance between A (Spanish or French) and B (Basque) is big enough to make mutual intelligibility impossible (Basque is a preindoeuropean language). In this volume, the chapter by Ginsburgh and Weber (2011) surveys the ways to compute the distance between two languages.

Languages with their speech communities compete for speakers very much

[3] In the present chapter, a monolingual speaker does not become bilingual by learning any second language. It should be clear from the outset that we are referring only to bilingual speakers in the two 'internal' official languages A and B.

[4] It is assumed too that B is spoken *only* in the concerned society.

[5] Passive bilinguals – those who understand B but do not speak it – are not allowed.

like firms compete for a market share. Language contact could be said to be the most extreme form of competition between languages.[6] The pressure of the competition is particularly felt by the minority of those who speak both official languages and support the continued existence of language B. The contact situation will influence the language choice behavior of this minority, the actual use they make of B in the interactions amongst themselves, their demand and supply of language B related goods and services, and the role they play in the transmission of B.

The survival of language B and its related culture depends not on linguistic rights but on the effective use bilinguals make of B. The advice of the *Council of Europe,* in the European Charter for Regional or Minority Languages, is to implement the following *(language) policy:*

> A minority language will only survive if it is used everywhere and not just at home. Therefore, the Charter obliges States Parties to actively promote the use of these languages in virtually all domains of public life: education, courts, administration, media, culture, economic and social life, and transfrontier cooperation. The Council of Europe monitors that the Charter is applied in practice.

In light of this policy advice, we may now introduce the concept of *Language B Loyalty.* It means quite simply that the bilingual is aware that the survival of language B depends on its use, as the Council of Europe advises, in addition to those in charge of the language policy concerning B. Note that in the type of societies we are dealing with, adults learn B, fathers send their children to schools where content is taught in B, and university students may choose some of their lectures in B, because these people support the policy of cultural recovery, of maintaining cultural diversity, of national pride and, also, the social benefits of bilingualism. Thus, it is mainly through the education system, mostly public, that people learn B and not as described by the Selten and Pool's (1991) model where the driving force of the decision to invest in the learning of B are the communicative benefits. Thus, leaving aside the learning by adults, the cost of learning B is relatively small and

[6] Of course, language competition and contact do not occur between languages, but between speakers of languages.

it will grant access to the language-related markets of a small community. Hence, the learning of B is more a cultural and political decision than an economic decision based on cost. Then one finds different levels (a continuum) of language B loyalty among bilingual individuals.

We distinguish two limit cases:

- *Strongly loyal to* B is a bilingual who will always use or intends to use B (orally or in writing) for communication.
- *Weakly loyal to* B is a bilingual who does not care much about the language issue, and uses language A most of the time.

(In Section 7, the language loyalties take the form of pure language strategies available to a bilingual).

Thus, what is at stake in this competitive situation is the society's linguistics and cultural diversity. In this chapter we do not want to describe the process of how a minority language and its culture fade away (see Crystal, 2002). On the contrary, what we want is to study the subtleties of language competition. Thus, we shall assume here multilingual societies which may compete economically and linguistically. Hence, we may add in Assumption 1 that we shall deal with *highly developed multilingual democracies.* These are, societies with a well-articulated language policy and resources devoted to schools, teachers, textbooks, editing houses, media and institutions, that support the teaching and transmission of language B and its related culture. They also have markets where language-related goods are traded.

Examples of multilingual societies which are economically developed, and satisfy Assumption 1 are the Basque Country, Ireland, Wales, and Scotland. In the Basque Country, the official languages are Basque and Spanish in the Spanish part and French in the French part; in Ireland it is Irish and English; in Wales Welsh and English; in Scotland, Gaelic and English.[7] The minority languages of these type of societies will set a kind of benchmark in the set of all threatened languages contemplated in Fishman (2001)'s question "Why is it so hard to save a threatened language".

One would think that steady increases in α, the proportion of bilingual

[7]We do not include the case of French in Quebec because, (a) it is obvious that the fate of French and its related culture is not exclusively in the hands of the Francophones of Quebec, (b) French is a minority throughout Canada, but not inside Quebec, and (c) within Quebec, some fractions of the Anglophones and Francophones are monolingual in their respective language.

speakers, would imply similar steady increases in the social use of B. Data concerning Basque shows that the proportion of bilinguals in the period 1991-2011 increased dramatically, rising from 22.30 percent to 27.00 percent. On the other hand, measures of the *Street Use of Basque* have been made since 1989.[8] In that year, the use of Basque registered at 10.8 percent. In 2001 use rose to 13.3 percent.[9] Ten years later, in 2011, the percentage of use was the same, 13.3. Data concerning the use of Irish, Scottish Gaelic and Welsh are obtained through census records (and other survey methods; see, for instance, the Beaufort Research, 2013 on the use of Welsh, and West & Graham, 2011 on Gaelic) and not from neutral observers, as in the case of Basque. Thus, truth telling incentives do not exist and those data are not statistically reliable. And yet the situation of the Irish and Scottish Gaelic described in those surveys is very dramatic. In Sperlich and Uriarte (2014) the data of Basque, Irish and Welsh are studied in the light of a model presented in Section 7.[10]

People concerned with the fate of all these languages observe that their actual use outside the educational system is rather weak. We would say that in these societies, there seems to exist a kind of paradox, which we may formulate as follows:

Why is it that having the political system and the legal instruments to facilitate the use of B, the resources, and the education system to implement a language policy in favor of B, and, most importantly, the people's support and preference for the language, there is such a weak use of B?[11]

[8] Using random samples of anonymously registered conversations in the streets at a given time and place (say, a municipality or sociolinguistic zone), the Street Use Measure of Basque shows the number of individuals observed in conversations speaking Basque out of the total number of individuals observed in the place. To our knowledge, the methodology for measuring the street use of a minority language based on anonymous observations has been developed by the group *Soziolinguistika Klusterra - the Sociolinguistic Cluster*, which operates in the Basque Country (see Altuna & Barturen, 2013).

[9] Notice that the probability of a bilingual random match is α^2 and therefore for a clear increase in the street use of B a drastic increase in α is needed. See Sperlich and Uriarte (2014).

[10] Of course, there are more minority languages satisfying Assumption 1 and belonging to *economically developed democracies*; the problem is that it is typically hard to get data which allow for deeper insight into the daily language use.

[11] In Scotland, the Gaelic Language Act of 2005; in the Basque Country, the Law of Normalization of *Euskera*'s Use of 1982; in Wales, the Welsh Language Measure of 2011, which gave Welsh official status.

3. The reference point: Linguistic rights, linguistic politeness and expectations

When linguistic rights are under discussion, it is always with reference to the rights of a minority group in a specified social context to use a certain language. Indeed, minority languages may have the right, but majority languages have the power, since their usage covers every conceivable domain, and has the support of the established political power (see Kimlicka & Patten, 2003).[12]

As with many economic questions, a *reference point* is needed for understanding bilinguals' language choice behavior. But note that here we are not dealing with consumption plans nor are we, say, trading with financial assets or in the insurance market. We are dealing with a collective good, language. Thus, we need to understand how bilingual people use the reference point to conceptualize and compute gains and losses.

In linguistic politeness theory (see Brown & Levinson, 1987), *face* is the public self-image that every individual wants to claim for himself consisting in two related aspects:

- *Positive Face*: one's self-esteem. Positive face is characterized by the desire to be liked, admired, ratified, and related to positively.
- *Negative Face*: one's freedom of choice of action and freedom from imposition.

A *face threatening act* is an act that inherently damages the *face* of the addressee or the speaker by acting in opposition to the wants and desires of the other. *Face* can be *lost*, *maintained*, or *enhanced*, and must be constantly attended to in interaction. This will be used to define (in Section 8) a utility function for bilinguals that will capture the emotions derived from acts that damage *face*. In general, people cooperate (and assume each other's cooperation) in maintaining face in interaction; such cooperation is based on the mutual vulnerability of *face* (Brown and Levinson, 1987). Politeness consists

[12] The concept of linguistic disenfranchisement developed by Ginsburgh and Weber (2011) by which some language(s) is(are) selected for, say, official use and as a consequence the individuals who do not speak the selected language(s) are disenfranchised and their well-being diminished, is related to linguistic rights. In the next lines we take the limit case, by which language B has passed from a state of no rights, and completely disenfranchised bilingual individuals, to becoming an official language.

of a set of verbal and non-verbal strategies intended to maintain each other's faces with the purpose of creating a common ground in which the interactants may bargain and compete. We shall use the vulnerability of *face* to define the bilingual's utility function (see Section 8).

An economist may think of *face* as an element of the reference point that any individual has. We propose a bilinguals' reference point composed of three elements: linguistic rights, the linguistic notion of face, and expectations. How do these three elements interact as constituents of bilinguals' reference point? To have a more precise view of the nature of bilinguals' reference point, we need to adapt the developments of prospect theory (Kahneman and Tversky, 1979; Tversky and Khaneman, 1992; Kozegi and Rabin, 2006), to the field of minority language economics. We should bare in mind that:

(i) we are dealing with a minority language in contact with a language known by all members of the society; thus for its survival, B has to be used in social situations to avoid being substituted by language A. Only bilinguals can do this job, for better or worse;

(ii) since B is, by law, equal to A, then legal linguistic equality is perceived by bilinguals as the *status-quo* for language B;

(iii) yet for bilinguals the linguistic equality claimed by the law is in fact an aspiration; it is what they expect to reach, rather than a reality. The European Charter for Regional or Minority Languages shows the language policy bilinguals must implement to convert that aspiration into a reality. As a consequence, bilinguals scrutinized one another's behavior for conformity to the policy;

(iv) given the difficulties derived from the competition with language A, the linguistic equality is for bilinguals the principal source of their expectations. Every bilingual has, to differing degrees, expectations about B increasing its speech population and not being always a minority language. Those expectations play a significant role in shaping the feelings of gains and losses when it comes to the actual usage of B. In Section 8, we assume that a bilingual computes gains and losses through the effect that the language actually used in the interaction has in his *face wants*.

4. The Maximin language choice

We present here a language choice procedure that is used very often. Let $C_j = \{c_{jA}, c_{jB}\}$ denote the language competence set of individual $j = 1, .., n.$; where c_{jl} denotes individual j-th's competence in language $l = A, B$. Let c_{jl} be a number in the set $\{0,\ 5,\ 10\}$, where 0 stands for no knowledge of language l, 5 for regular knowledge (he understands but cannot speak) and 10 for perfect knowledge. Let individuals r and s have the following language competencies: $C_r = \{c_{rA} = 10$ and $c_{rB} = 5\}$ and $C_s = \{c_{sA} = 10$ and $c_{sB} = 0\}$. Let the rest of the group $C_j = \{c_{jA} = 10$ and $c_{jB} = 10\}$, $j \neq r, s$. This is a group of friends; everybody knows who is bilingual, that r is a passive bilingual who understands fairly well what is said but cannot speak B, and that s is monolingual. Let us assume that the bilinguals form a majority in this group. When the conversation starts, there is a tendency to choose the language of the conversation by using, implicitly, the following rule (based on Van Parijs, 2011): let $V_l = (c_{jl}, c_{rl}, c_{sl})$ denote the vector of every individual competence in language $l = A, B$ and $j \neq r, s$. Let us consider two languages l' and l''

$$l' \gtrsim l'' \Longleftrightarrow \min V_{l'} \geq \min V_{l''}$$

That is, language l' is at least as good as language l'' if the minimum individual competence on l' is at least equal to the minimum individual competence on l''. Since $\min V_A = (10, ..., 10, 10) = 10$ and $\min V_B = (10, ..., 5, 0) = 0$, then the language which this predominantly bilingual group will choose will be A.

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Proposition 1: In the type of societies we are dealing with, an interaction in which the number of bilingual participants is greater than the number of monolingual participants, the language of the interaction is frequently determined by means of the maximin language rule.

Why do the bilinguals use the maximin language rule and not a different language decision procedure? Our view is that the *linguistic politeness norms* developed in a situation of language contact help monolinguals block the use of B in their presence.

5. Information in modern multilingual societies

As said in Section 2, we want to address the use of minority language B in multilingual societies which are economically highly developed. Since we are dealing with competitive societies both in the economic domain and the linguistic domain, we seek to know the conditions under which B might be used in the dynamic parts of these societies, in the urban areas, by the bilingual population working in the core industries of those economies. We think that the survival of B, not as a museum piece to be admired by scholars and tourists, depends on the rate of use of B by the bilingual population linked directly and indirectly with these parts of the society.

In modern societies, particularly in the areas mentioned previously, there is great mobility (both social and geographical) in the work force. In this context, bilinguals often participate in anonymous interactions in which the linguistic type (bilingual or monolingual) is private information.

Language contact is also a relevant element affecting information. As remarked by Nelde (1995),"neither contact nor conflict can occur between languages; they are conceivable only between speakers of languages and between the language communities!" That is, contact, competition and conflict occur among the bilinguals speakers of B and those who only speak A, the official language of the state. Permanent contact with a majority of speakers of language A eliminates the signals or traits of native speakers of language B; for instance, accents are erased. The accents are signals that could reveal who speaks B and who does not, but the contact situation means that both bilinguals and monolinguals will have a similar accent, shaped by the dominant language. For example, on the Spanish side of the Basque Country people of any linguistic type have Spanish accent, while on the French side, people have a French accent.

For Nelde (1987), "contact between languages always involves an element of conflict". Thus, in a language contact situation, the possibility of conflict is always present. Matching between a bilingual and a monolingual occurs more often than the bilingual-bilingual matching. Furthermore, if a monolingual is addressed in B, or observes in the interactive partner a display of markers signalling the desire to speak in B, he would be forced to reveal his type and confess his ignorance of the official language B; this might create feelings of insecurity. In terms of politeness theory (see Section 3), both the *positive*

face (i.e., the desire to be liked and admired) and the *negative face* (i.e., the freedom from imposition) of the monolingual would be damaged. Further, forcing the conversation in language A, the bilingual's *negative face* would be damaged too. And this injury of each other's *face* could hinder the minimal alignment of interests needed for an interaction to follow its natural path (to a common ground in which the interactants may bargain and compete). Thus, we may say that, in the present context, messages conveying support for B, preference for language B or the desire to speak in B could be harmful for both sides. In other words, *talk is not cheap*. (This is developed in Uriarte, 2015).

But in face-to-face interactions, people try to avoid conflict and to this end they develop specific strategies. Linguistic politeness-based strategies are just a behaviour built to avoid or minimize confrontation. In our context, this particularly affects to bilinguals because they may choose language. Hence, to complete the process of gradual elimination of linguistic informative signals occurring in modern societies, the bilinguals themselves develop uninformative linguistic strategies (see Section 7 for a formal definition) to avoid any possibility of upsetting the (unknown) monolingual. Essentially, that kind of strategy would be the following: if you are in the role of speaker, starting the conversation in language A; if you are in the role of hearer and you are addressed in language A, responding in language A. You would use language B only if your (unknown) speech partner speaks to you in B. Therefore, if two bilinguals play this strategy they would fail to coordinate in language B.

To conclude, in the type of societies we are dealing with, it could be assumed that, in many relevant domains and interactions, there is asymmetric information about the linguistic type of the interactive partners; see also how Blume and Board (2013) apply this assumption to language competence.

Assumption 2: *The participants in an interaction do not have, ex-ante, any information about the linguistic type (bilingual or monolingual) of any individual conversation partner. They only know the proportion of bilingual and monolingual speakers,* α *and* $(1-\alpha)$ *respectively, of the society.*

6. The Ultimatum language game

Assume a situation in which a representative of firm X located in a certain area of the country is sent to meet a representative of firm Y located in another part of the country to negotiate the price of an input produced by firm Y and used intensively by firm X. The representative of firm X is bilingual and is considering using language B in the meeting. The only information both representatives have about each other is their name and rank in the hierarchy of the firm. The average proportion of bilinguals in the country is α. The use of B in the meeting would only be possible if the representative of Y is bilingual too. Both representatives have imperfect information about the linguistic type of the other.

Contrary to the opinion of Binmore et al. (1995) that 'in everyday life, we rarely play pure take-it-or-leave-it games', bilinguals participate very often in conversations that might be viewed as a take-it-or-leave-it game. The game we describe in this section is an example of a common situation faced by bilinguals.

Let us suppose that both representatives are bilingual speakers with different levels of loyalty to the minority language; let the representative of X be very loyal to B and the representative of Y weakly loyal (see Section 2 for the definitions of loyalty). We can model a situation that is likely to happen by means of a simple game whose structure is similar to Selten's Chain Store Game, later used by Binmore et al. (1995) as the Ultimatum Minigame. In our context this is a game in which the linguistic type (bilingual or monolingual) is private information (see Figure1). Nature moves first and chooses a bilingual speaker to meet a bilingual hearer with probability α^2; and a monolingual speaker with a bilingual hearer with probability $\alpha(1-\alpha)$.

[INSERT HERE FIGURE 1]

Note that the game describes not the economic negotiation itself, that is, how an agreement is reached about the amount and final price of a certain input needed by firm X and produced by firm Y. The game shows a preliminary phase of the negotiation, the phase in which the language to be used in the negotiation is determined.

Let firm Y's representative be the player I, the *speaker*, and let the representative of X be player II, the *hearer*. Players have two actions. Player I's

actions are languages A and B. If player I chooses B, it is assumed that the highly loyal to language B player II will agree to negotiate using language B, and the game ends. But if player I chooses A, then we assume II would think, with few doubts, that Player I is monolingual and therefore his available action B is superfluous. He thinks that the actual set of actions for him would consist of language A and *No (negotiation)*. The latter action means that he would leave the negotiation table and both players would get zero.

Payoffs indicate the differences in the players' preference intensity for B. Player I is indifferent about using language A or language B; in both cases he gets 2. Player II, prefers to negotiate in language B. If player I chooses B, then II will get 3 (because for this players it is a signal of trust, and of being well treated by I). If I chooses A, then II must choose between following *reluctantly* the conversation in language A,which, in terms of payoffs, means he would get 1, and saying No, to end any possible negotiation, and, hence, getting zero for both.

Denote the probability that player I chooses language A by p_A; the probabilities assigned to node x and y are denoted by p_x and p_y, respectively. Given player I's choice of A, player II's information set is reached, and, then, regardless of II's belief in his information set, language A is II's optimal choice. Thus, the game has a weak sequential equilibrium in which the strategy profile is (A, A) and II's belief system consistent with this profile would be $p_x = \alpha$ and $p_y = 1 - \alpha$, because $p_A = 1$. In this equilibrium, bilinguals speak in language A.

The degree of loyalty of a bilingual speaker to language B will determine the propensity of choosing B, or, more generally, a strategy supporting the use of B, in a given interaction. In general, it is at the beginning of a conversation between bilingual people, unknown to each other, when loyalties condition the language to be used in the conversation. Indeed, it is the speaker, the one who initiates the conversation, who leads the process of choosing the language. But who starts the conversation is a matter of protocol and it seems that, by protocol, the first mover must be the host, player I. Under imperfect information, the weakly loyal Player I will choose A with a high probability because he does not care much about the situation of B as a threatened language. It could also happen that player I is not conscious that he is involved in a game and that player II might have a strong preference for using B in the negotiation. The only thing player I is sure of is that the main interest of II, as representative of firm X, is to reach a good agreement.

Proposition 2: Given the propensities of both players to choose B, and how player II perceives the game, the most likely outcome in a one-shot game is the weak sequential equilibrium with profile (A, A) and belief system ($p_x = \alpha$, $p_y = 1 - \alpha$). Thus, the language that will be used for the negotiation will be A.

One might ask why in this situation we do not give a chance to equilibria that are not weak sequential in which B would be spoken, such as (B, No) in which II's beliefs are unrestricted?. Note that in the *Ultimatum Game* you are being offered amounts of, say, money that you, as a responder, may accept or reject. Game theorists were led to reconsider the subgame-perfect prediction of traditional game theory because there was an increasing amount of experimental evidence that positive offers, below certain amount, were rejected (see Roth & Erev, 1995 and Roth et al., 1991). In the present *Ultimatum Language Game*, actions are languages whose use gives rise to communication benefits as payoffs. There is no empirical evidence of "rejecting" language A; that is, of player II, the hearer, refusing to speak in the language used by player I, the speaker. Of course, this does not mean that rejection never happens. But, contrary to the detailed study of responders' rejections in the *Ultimatum Game,* the frequency of language A rejections has not been studied. In fact, social norms encoded in politeness-based strategies coupled with imperfect information reinforce the weak sequential rationality and the use of A by bilinguals. Notice also that the representatives have two different hierarchical roles in this interaction. The representative of X is the potential buyer of a product sold by firm Y. Thus, the the representative of firm Y is in a position of relatively greater power and control. This situation determines asymmetric levels of politeness between Player I, the speaker, and Player II, the hearer (see Brown and Levinson, 1978). It is II who has to use a more careful *politeness strategy* in choosing words and language to avoid any confrontation. Thus, II has no choice but to get only a good agreement even if that means his linguistic preferences are not satisfied at all.

One might also ask why II has not contemplated the case that a Player I choosing A could be bilingual too, and include B as an additional action that would allow Player I to code switch from A to B. Code switching is allowed in a game presented in Iriberri and Uriarte (2012). But in the context of the present game, Player II's actual action set seems to be, again, the result of *linguistic politeness norms* grown in a language contact situation, coupled with player II's analysis of the game and the time pressure imposed by a con-

versation where decision-making (through responses) should be particularly fast.

7. The bilinguals as a player population: The building of linguistic conventions

Who is to blame in the *Ultimatum Language Game* (see Section 6) for the bilinguals speaking in language A? Is the weakly loyal Player I? Is the extremely loyal Player II who had extreme beliefs that led him to not considering a reply in language B? Did Player II misread the game? Is the imperfect information the main source of bilinguals coordinating in A? To answer these questions, we are led to study how bilinguals build linguistic conventions to solve their language coordination problem. Let us assume the following:

Assumption 3: *Bilingual players prefer to speak B rather than A.*

A monolingual speaker will always get a sure payoff (or net communication benefit), say, n. Since language choices are made under imperfect information, a bilingual may choose A; in that case, we will assume that he will get, as a monolingual, the payoff n, because this was a voluntary choice. Bilingual speakers will get the maximum payoff, m, when they coordinate in B. However, $(n-c) > 0$ would be the payoff to a bilingual speaker who, having chosen B, is matched to a monolingual and, therefore, is forced to speak A. Then c denotes the frustration cost felt by this bilingual. In the present context, the payoffs could be interpreted as the net benefits obtained from satisfying the communication needs and, additionally for bilinguals, the degree of language preference satisfaction.[13] The next assumption orders these payoffs.

Assumption 4: *For a given α such that $0 < \alpha < (1-\alpha)$, the payoff ordering is given by $m > n > c > 0$.* Further, $\alpha(m-n) > c(1-\alpha) > 0$

The first inequality, $m > n$, is due to Assumption 2. Since bilinguals

[13] n = Communication benefit−Speech production cost in language A $= b_1 - c_1$.
m = Communication benefit+Language B preference maximization benefit− Speech production cost in language $B = b_2 - c_2$.

prefer B to A, then they will get a higher utility when they interact in their preferred language B than in the case when they choose to use A. Further, c is smaller than the weighted benefits. In a language contact situation bilinguals face frequent language choice situations. Their linguistic behaviour would then be shaped by repetitive language decision-making. Thus, it is natural for bilinguals to have both language *strategies* and *linguistic conventions* which would serve to minimize the frictions associated with their frequent language coordination decisions and communication problems. We have here a nice real-life example of a one-player population game: a game played by the population, N, of bilingual speakers. To facilitate the evolutionary analysis, we now build the *Language Use Game* (LUG). Under the Assumptions 1-4 the bilinguals' language behavior is captured fairly well by the following pure strategies:

s_1: Always use B, whether you know for certain you are speaking to a bilingual individual or not. Use A only when the speech partner reveals he is of the monolingual type.
s_2: Use B only when you know for certain that you are speaking to a bilingual individual; use A otherwise.

Notice that in choosing s_1, the bilingual type is revealed. With s_2 the type is hidden; thus, s_2 reinforces the asymmetric information setting and if both bilinguals play strategy $s_{\mathbf{2}}$, they will speak A. The agents of the bilingual population play the LUG having $S = \{s_1, s_{\mathbf{2}}\}$ as their *common* strategy set. Let x denote the fraction of bilingual agents playing pure strategy s_1 at any point t in time. We want to build a selection mechanism in continuous time that favours some strategy over the others, the *replicator dynamics*[14]. The replicators are the pure strategies s_i $(i = 1, 2)$ and the *replicator dynamics* will tell us, at each moment of time, the fraction of bilinguals playing s_1 and s_2. The LUG could be easily explained now as follows (see Figure 2). There are two possible states of nature: *bilingual* and *monolingual*. Bilingual speakers are unsure of the state when they choose a strategy. A bilingual

[14]We assume that the bilingual population consists of a large but finite number of individuals who play a certain pure strategy $s_{\mathbf{i}}$, $(i = 1, 2)$ in the two-player game LUG. The interactions are modelled as pairwise random matching between agents of the bilingual population; that is, no more than two (randomly chosen) individuals interact at a time. To derive the replicator dynamics, it is assumed that the LUG is played continuously in the described manner. For more details, see Weibull (1995).

expects to meet another bilingual with probability α and play the game described by the payoff matrix on the left side of Figure 2 (see Assumption 4). With probability $1-\alpha$, the bilingual expects to meet a monolingual and, depending on the strategy chosen, get the corresponding payoff shown in the payoff column on the right side of Figure 2 (the monolingual will get, as said above, n). Notice that in choosing s_1, there is the risk of getting the minimum payoff, $n-c$. With s_2 the bilingual would expect to get, at least, n.

[INSERT HERE FIGURE 2]

Table 1 shows the matrix of expected payoffs associated with the game.

[INSERT HERE TABLE 1]

Iriberri and Uriarte (2012) prove the following result.

Proposition 4: Under the Assumptions 1-4, there exists an interior mixed strategy Nash equilibrium in which the proportion of the bilingual population playing s_1 is $x^* = 1 - \frac{c(1-\alpha)}{\alpha(m-n)}$. This equilibrium is evolutionary stable and asymptotically stable in the associated one-population replicator dynamics.[15] There are two additional Nash equilibria (s_1, s_2) and (s_2, s_1) which are unstable.

The Mixed Strategy Equilibrium as a Linguistic Convention

Evolutionary stability in the present context means that the equilibrium x^* is a *linguistic convention* built by the bilingual speakers.[16] Indeed, the

[15] It is known that the replicator dynamics could be derived from behaviours observed in social interactive learning settings; for instance, the aspiration-based learning model of Binmore, Gale and Samuelson (1995).

[16] For the relation of evolutionary stability equilibrium and conventions, see Weibull (1995).

bilingual population is optimally partitioned in two groups, Nx^* and $N(1-x^*)$. Bilinguals of the former group speak B when they interact with any other bilingual; bilinguals of the latter group speak A between them.

Does this evolutionary equilibrium x^* have predictive power? The answer is yes if we redefine x^* by assuming n is the only payoff that does not change with α. Then Sperlich and Uriarte (2014) obtained increasing and convex Nash equilibrium functions $x^* = x^*(\alpha)$, that associate to each α the corresponding mixed strategy Nash equilibrium. With data about the use of Basque, Irish and Welsh, they show that the empirical models based on $x^*(\alpha)$ could be good predictors of the fraction of bilingual speakers who, in real-life situations, use language B in their interactions.

8. Linguistic politeness equilibrium

This section is based on Uriarte (2015). In the maximin language choice procedure (Section 4) and in the Ultimatum Language Game (Section 6) we conjectured that the language choice behaviour in those two settings was shaped by linguistic politeness-based social norms developed in a situation in which a minority language comes into contact with a majority language. In particular, bilinguals's uninforming strategies are built to avoid possible conflicts and the difficulties derived from imperfect information (see Section 5). The strategy s_2 of hiding the bilingual type does not contradict the interlocutor's language, whether A or B; s_2 is an easy strategy to follow that does not contradict with any linguistic type. Revealing the bilingual type, i.e. playing s_1, makes coordination in B possible, but it is rather risky because you might suffer a frustration cost, and it is more demanding since it requires you to lead the language coordination process, which may conflict with monolinguals. Hence, we may say the following about the relative popularity of $\mathbf{s}_1$ and $\mathbf{s}_2$:

Corollary 1: Based on *politeness theory* (Brown and Levinson, 1987), *dialog theory* (Garrod and Pickering, 2007), and the *principles of communication effectiveness and efficiency* (that is, the maximization of the *benefits* of communication relative to the memory and articulation *costs* of linguistic production, as emphasized by Selten and Warglien, 2007), the strategy $\mathbf{s}_2$ may easily become more popular than $\mathbf{s}_1$.

Let us define now a bilingual's utility function that captures the *vulnerability of face* as follows:

$$\begin{aligned} u_I(s_I, s_{II}) &= F_I(s_I, s_{II}) \times \pi_I(s_I, s_{II}) \\ u_{II}(s_I, s_{II}) &= F_{II}(s_I, s_{II}) \times \pi_{II}(s_I, s_{II}) \end{aligned}$$

Suppose that two bilinguals play the combination of strategies (s_I, s_{II}), where $s_i \in S = \{\mathbf{s_1}, \mathbf{s_2}\}$ is player $i's$ strategy, $i = I, II$. The elements $\pi_i(s_I, s_{II})$ denote the expected material payoffs to bilingual I and II derived from the strategy profile (s_I, s_{II}), as shown in Table 1; $F_i(s_I, s_{II})$ is the parameter denoting the feelings of player i caused by the strategy profile (s_I, s_{II}) . The value of the parameter will capture the vulnerability of *face*. As stated by Brown and Levinson (1987), in an interaction *face can be enhanced* (by a certain factor when both play s_1 and thus talk in B; that is, $F_i(s_1, s_1) = f^*(> \alpha(m-n)/[\alpha(m-n) - c(1-\alpha)])$), *maintained* (so $F_i(s_2, s_2) = 1$, $F_I(s_2, s_1) = F_{II}(s_1, s_2) = 1$) *or lost* (so $F_I(s_1, s_2) = F_{II}(s_2, s_1) = -1$). *Face* is *lost* because the bilingual choosing the uninforming strategy s_2 is hurting the *face* of the one who chooses s_1, and it is *maintained* because the one choosing the safe s_2 is not bothered by the other's choice. Thus the elements of the new matrix of expected utilities would be: $u_i(s_1, s_1) = f^*[\alpha(m-n) - c(1-\alpha)]$, $u_i(s_2, s_2) = 0$, $u_I(s_1, s_2) = u_{II}(s_2, s_1) = -\alpha(m-n) + c(1-\alpha)$ and $u_I(s_2, s_1) = u_{II}(s_1, s_2) = \alpha(m-n)$, $i = I, II$.

Now let us assume, as usual, that each bilingual seeks to maximize his utility function given the emotions he has felt during the course of the interaction. The following result has been proved in Uriarte (2015).

Proposition 5: The LUG has two symmetric politeness equilibria in pure strategies, (s_1, s_1) and (s_2, s_2), which are evolutionary stable, and an interior mixed strategy equilibrium. In the (s_1, s_1) equilibrium bilinguals speak their preferred language, B, and in the (s_2, s_2) equilibrium they speak language A.

Corollary 2: From Corollary 1, the politeness equilibrium (s_2, s_2) seems to be more likely to occur than the (s_1, s_1) equilibrium.

Corollary 2 says that, under the Assumptions 1-4, in real-life situations bilinguals will coordinate in language A more often than in language B.

Predictions from politeness analysis.

The following two predictions can be derived from our analysis.

1. *The best response to* s_1 *is* s_1 and *the best response to* s_2 *is* s_2. These predictions seem to be closer to real bilingual's behaviour because the stylized facts are that when a bilingual is addressed in language B his answer would, very likely, be in B. And when a bilingual is addressed by an unknown speaker (monolingual or bilingual) in language A, it seldom happens that the bilingual would code-switch to B in his answer, as stressed by the Ultimatum Language Game (Section 6).
2. With imperfect information bilinguals use the convention (s_2, s_2) amongst themselves, that is, language A, more often than the convention (s_1, s_1), that is, language B.

9. Policy suggestions

This chapter suggests the implementation of policy measures aimed at increasing *positive signaling of bilinguals*. Positive means that signals should have a wide social consensus. The following examples of policy measures could be useful.

Example 1: Visual Signals to reduce imperfect information. The society should accept that bilinguals need to recognize each other by means of (well designed) visual signals (e.g., pins).

Example 2: Cheap-Talk**.** In the absence of external signals and before starting or at the start of a conversation, bilinguals should have the opportunity to send a message indicating their linguistic type. The content of the message should be well thought so that it should cause no harm or cost to monolinguals (see Section 5).

Example 3: Active bilingual speakers**.** In situations where the maximin language rule is usually applied, bilinguals should take a more active role; e.g. one bilingual might translate what it is being said to those who do not speak B.

Example 4: Policy makers should clarify the implications of language strategies. That is, strategy s_1 has to be related to behaviour in favour of *cultural diversity*. And the strategy s_2, should be considered to be the source of bilinguals not speaking B.

10. Conclusions

In this chapter we have assumed modern multilingual societies, such as those found in western Europe: the Basque Country, Ireland, Scotland and Wales. These societies have two official languages which are linguistically distant. We have assumed that in the dynamic parts of these modern economies, bilinguals frequently choose the language to be used in the next interaction under conditions of imperfect information. Thus, we have considered the language contact situation occurring in economically well-endowed societies, with well-articulated language policies to promote the minority language and with enough resources to finance an education system capable of satisfying the societies' demands for a bilingual education and language diversity. The reason to proceed this way is to set these societies as a benchmark in the set of multilingual societies with threatened minority languages. Given this setting, the chapter has focused on the study of the language choice behaviour of bilingual speakers.

Bilinguals participate very often in conversations that might be viewed as a take-it-or-leave-it-language game. That is, bilinguals, as listeners, are frequently addressed in the majority language. It is possible that the speaker is also bilingual. Then the bilingual listener will, frequently, respond in the majority language, even though he would prefer to speak in the minority language. Our view is that this behaviour may be explained by the influence of imperfect information coupled with social norms encoded in politeness strategies grown in a context of language contact. All these elements reinforce the weak sequential equilibrium outcome, in which two bilinguals will be speaking in the majority language (see Figure 1).

A more complete strategic analysis shows that bilinguals play, essentially, two pure strategies: $\mathbf{s}_1$- *reveal your bilingual type* -and $\mathbf{s}_2$- *hide your bilingual type*. The former is riskier than the latter; further, $\mathbf{s}_1$ might be perceived as a perturbation to the alignment process between interlocutors of different type. In linguistic politeness theory, $\mathbf{s}_1$ could be labelled as a face threatening act that damages the *face* of the monolingual. Thus, under imperfect information, bilinguals find the strategy of hiding the type (i.e. of keeping the imperfect information), $\mathbf{s}_2$, less demanding and could become easily more popular than $\mathbf{s}_1$.

If we redefine the bilingual speakers' utility functions to make them sensitive to *face threatening acts*, then we find that the politeness equilibria (s_1, s_1) and (s_2, s_2) are the linguistic conventions that the bilinguals use to solve their language coordination problem. This result seems to be a more realistic description of when two bilinguals speak B or when they speak A. The politeness model predicts that the relatively low use of B observed in the societies under study (from less to more usage: Irish, Scottish Gaelic, Welsh and Basque) is because, under imperfect information, the convention more frequently used by bilinguals is based on the strategy *hide your bilingual type*; that is, the politeness equilibrium (s_2, s_2). Accordingly, the future research will be on dynamics: the empirical and theoretical reasons of why the system points into the basin of attraction of the (s_2, s_2) equilibrium.

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