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Article abstract

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Abstract

It is assumed that language policy can influence the language in which parents choose to raise their children. A basic model of language transmission in the family is outlined and the effect of different policies on the vitality of a minority language is analyzed. It is argued that the habitation patterns and numerical strength of the minority have a strong influence on the cost effectiveness of various policy measures. It is shown that by classifying language policies into four distinct categories we can assign different policies to different minorities in a cost-effective manner, based on the size of the jurisdiction where the minority lives and its numerical strength within it. We provide a general intuitive discussion and a specific example to support the general analysis.

Résumé

Il est supposé que la politique linguistique puisse influencer le choix de la langue dans laquelle les parents élèvent leurs enfants. Cet article trace les grandes lignes d'un modèle simple de transmission linguistique dans la famille et analyse l'effet de différentes politiques sur la vitalité d'une langue minoritaire. Il est avancé que la taille de la population minoritaire et sa concentration sur le territoire ont une forte influence sur le rapport coût-efficacité des différentes mesures politiques. Il est démontré qu'en classant les politiques linguistiques en quatre catégories différentes, nous pouvons attribuer différentes politiques à différentes minorités de manière rentable en fonction de la taille du territoire où la minorité vit et l'importance numérique de la minorité dans le territoire considéré. Nous fournissons une discussion intuitive générale et un exemple spécifique à l'appui de l'analyse générale.

Language death has become an accelerating phenomenon in the modern world. It is expected that approximately one half of the languages spoken today will be gone in 100 years (Crystal, 2000; Nettle & Romaine, 2000). This has inspired many researchers to explore important factors behind this process and ask if it can be reversed if these factors are altered for any given language (Fishman, 1991)[1]. Other researchers have focused on the dynamic properties of the process leading to language shift and death.[2] Combining insights about the factors governing individual behaviour with respect to language choice with the dynamic structure of language shift, one can model language policy in dynamic settings, and it can be shown how the transmission of a language from one generation to the next can be influenced by the policymaker (Fernando, Valijärvi, & Goldstein, 2010; Templin, Seidl, Wickström, & Feichtinger, 2016).

This contribution focuses on the implementation of an optimal language policy where the goal of the policymaker is the revival of a threatened language. It builds on the admittedly very stylized insights from the literature on language policy in dynamic settings. We argue that various policy measures can have the same positive influence on the vitality of a minority language. However, policy measures result in different costs depending on the characteristics of the linguistic minority. Two dimensions of the minority are considered: its numerical strength and its habitation pattern. It is shown that the policy has to be adapted to the characteristics of the minority to be as effective as possible given the total expenditures. In other words, different minorities require different policies. No one policy fits all groups.

Cost-Benefit and Cost-Effectiveness Analysis

Economics is about making choices, and an economics approach to any social phenomenon should take this into account. In one way or another, benefits—or, more generally, effects—and costs are to be compared for the purpose of making informed decisions.[3] This is applied to the evaluation of public policies such as those relating to language. By examining policies one can distinguish between cost-benefit and cost-effectiveness analyses. In the former, the benefits or utility of a policy measure are quantified and compared to costs, in the latter a measurable goal is specified that can be fulfilled to various degrees. As a rule, the social value of reaching different levels of goal fulfillment is not specified. For a given budget, measures leading to a cost structure with the highest goal fulfillment are sought. That is, the degree to which the goal can be fulfilled is variable, and the poli-

1. Fishman has become a classic contribution. Some further articles on the theme can be found in Fishman (2001); see also Romaine (2006) and Grin (1992).

2. Abrams and Strogatz (2003) set up a model of two competing languages in a society that inevitably leads to the death of one of the languages. This demise is no more inevitable if individuals have an emotional attachment to their language; see Wickström (2005) as well as the overviews in Wickström (2014) and Templin and Wickström (2021).

3. For a discussion related to language policy issues, see Wickström (2016) or Wickström, Templin, and Gazzola (2018).

cymaker—who is restricted by a budget—chooses measures leading to the highest degree of goal fulfillment among all possible measures within the budget. Of course, with a bigger budget, a greater degree of goal fulfillment is possible. In the case of language policy, a cost-benefit analysis could determine if a certain policy measure—for instance, introducing bilingual street signs—will bring greater wellbeing to the members of a minority than it costs. An example of the cost-effectiveness case might be that of looking for a policy that makes the size of a minority as large as possible, given the available budget.

The biggest conceptual problem in a cost-benefit analysis is the measurement of the value of the benefits. Ideally, each benefitting individual should report how highly he or she values the measure, and these evaluations should be added to calculate the gross benefits. However, there are both theoretical and practical difficulties here.[4] Given this, in many practical policy evaluations, the benefits are simply fixed by the policymaker as a result of the political process. In a cost-benefit analysis, since the beneficiaries are individuals, the policymaker would have to specify the average benefits of the members of the minority, and the total benefits would be proportional to the number of beneficiaries. In a cost-effectiveness analysis, this problem does not occur, and the goals are simply defined without any specific reference to the wellbeing of the beneficiaries. Since, in practice, the benefits of the cost-benefit analysis are determined by the political process, as are the goals in a cost-effectiveness analysis, the differences between the two tend to become less important. In this contribution, the goal of the policymaker is taken to be the high vitality of a minority language. This is further specified as the language having a large number of users in everyday situations.[5]

The cost side is analytically the same with both approaches. In comparison to the benefit/effectiveness side of the analysis, with its subjectiveness, the cost side is usually objectively measurable, at least in principle. This certainly doesn't mean that the costs are easily measurable, only that there are objective, agreed-upon methods that can be applied. The problem is not that of measuring the costs, but rather of deciding which ones are relevant and should be included in the calculations. The costs, probably due to the complexity of

4. The theoretical difficulty is that the individual evaluations, the propensities to pay, are not well-defined, and that so-called Scitovsky paradoxes, see de Scitovszky (1941), or path dependencies can occur. That is, the evaluation of two policy measures (*A* and *B*, say) would be different if *A* is implemented first and *B* thereafter than if *B* is implemented first and then *A*. Especially in language policy, the probability of path dependencies can be very high, since it is to be expected that some measures, such as the right to communicate with the authorities in one's preferred language, might affect the demand for official documents in that language, or vice versa. The practical problem is that the individual evaluation has to come directly from the beneficiaries, who often have no incentive to speak the truth or are unable to make such an evaluation, see Ginsburgh (2017). Compare the situation of environmental damage; who can give an exact number reflecting the value to him or her of a reduction in CO_2 emissions by 10%?

5. Of course, in reality the goals of the government can be quite different. They can be discriminatory against the minority or against the majority, see Wickström (2020). In this article, we don't consider the merits of different goals, but take the goal as a given and pose the question: How can the goal be met in the best way?

the measurements, are also largely ignored in the literature.[6] In addition to the size of the costs, their structure opens up a broad spectrum of interesting questions that are the focus of this article. We will first discuss some key results that originate in the different structures of the costs of language-policy measures.

Basic Model Structure

In accordance with many real-world observations, we will assume that speakers of a minority language are bilingual in the majority language of their region.[7] The research question is how vitality, defined as the number of active speakers, can be improved through language policies. In exploring this question, we will discuss how different language policy measures can be thought to affect different minority languages when the communities of speakers differ in numerical size and in spatial habitation patterns.

To make the concept of language policy tractable we will define policy measures as the atoms of language policy. A language-policy measure is then the smallest meaningful good or service that the policymaker provides. Examples could be bilingual street signs in a town, the use of the minority language in the names of some public institutions, the publication of certain official documents in a minority language, etc. Since it is not very practical to have different rules for each measure, similar measures are brought together under the banner of a policy category. Such a category can be seen as a collection of measures for which the same rules for implementation apply. For the purpose of this article, it is convenient to define the categories according to the cost structure of the measures.

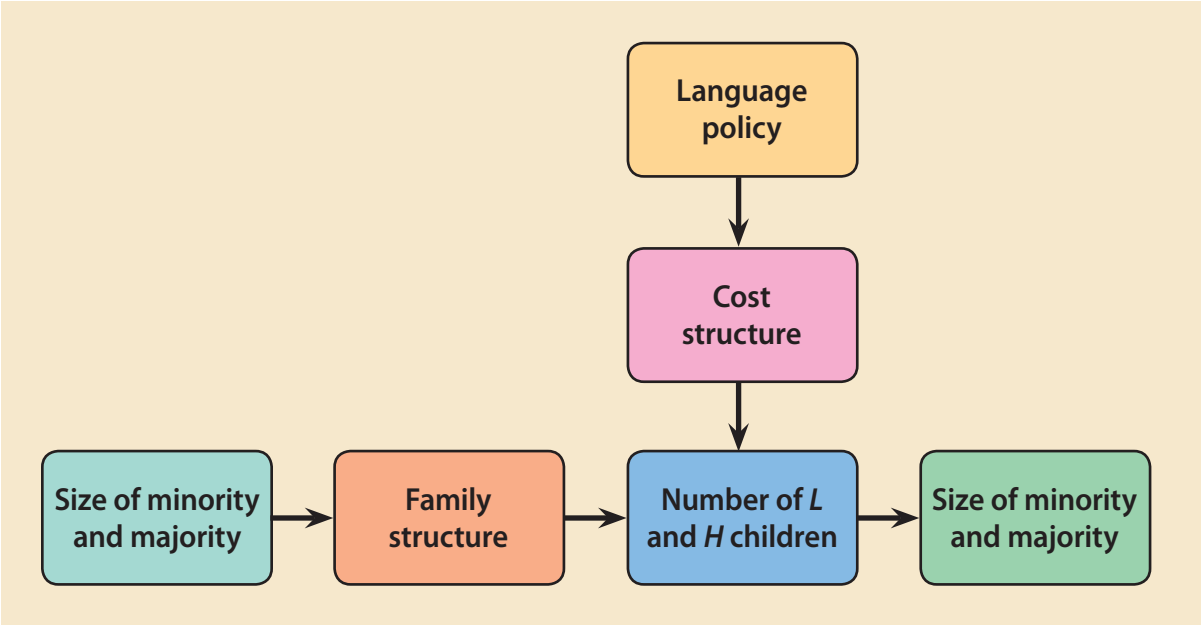
Before analyzing the importance of cost structures for language policy in the core of the article, we, in the immediately following section, briefly discuss the social dynamics behind the survival of minorities. Then, in the first of the core sections, we discuss the costs of language policy and define what we understand under cost structure. An intuitive analysis of the importance of costs for a meaningful language policy in support of the vitality of a minority language follows in the second core section. This is all illustrated in a

6. For some notable exceptions, see Vaillancourt (1997), Grin and Vaillancourt (1999), Vaillancourt and Coche (2009), Coche, Vaillancourt, Cadieux, and Ronson (2012), and Leblanc Desgagné and Vaillancourt (2016). These authors are economists and have the instruments of economics at their disposal, which often is not the case of the sociolinguists who usually deal with language policy. Admittedly, the calculations in the cited contributions are sufficiently complex and some aspects of the included costs could certainly be debated.

7. For small minorities in Europe, like Basque, Welsh, Scots Gaelic, Irish, Sámi, Sorbs, etc., this seems to be the case (according to Grin [1992], 4.2% of native Welsh speakers were unilingual in 1981). For bigger regional minorities, like French and Dutch speakers in various parts of Belgium; or German, French, and Italian speakers in different cantons of Switzerland, it certainly does not hold. In Canada, according to Vaillancourt (2018), in 2006 unilingual French speakers made up at most 3.85% of the native French speakers in the various provinces, with the exception of Quebec, New Brunswick, and Ontario. In Ontario, the fraction was 8.78% and in New Brunswick 31.33%. Of the native English speakers in Quebec, 30.65% were unilingual. Since we are interested in the vitality of threatened languages spoken by small minorities, the assumption however seems to be justified.

basic example in the penultimate section, and some general remarks in the last section close the article. The basic structure of the argument is illustrated in Figure 1.

Figure 1
Structure of the Analysis



Dynamics of Minority-Language Survival

There is a rich literature analyzing the factors determining the long-term vitality of minority languages.[8] The observation that decisions about language use are made by individuals is important.[9] Public language policy can only provide incentives to influence individual decisions. By way of example, we will concentrate on a situation with two languages in society: a high-status majority language *H* and a low-status minority language *L*. Further, we assume that all speakers of *L* are bilingual in *H*. Therefore, we divide the individuals in society into two groups: the speakers of *H* and the (bilingual) speakers of *L*. The fraction of individuals belonging to group *L* is denoted by p. In other words, the fraction belonging to *H* is $1–p$.

Since language knowledge and use is transmitted from one generation to the next, the relevant question becomes what fraction (p^{+1}) of the population will use *L* given that a

8. See, for instance, Wickström (2005) and Templin *et al.* (2016), as well as the references therein.

9. Already in 1980, Haugen (1990) observed that incentives, such as economic usefulness, govern the transmission of languages from one generation to the next.

certain fraction p in the previous generation used it. The transmission can analytically be divided into several processes. Considering that transmission usually occurs through a two-adult family, the types of the adults in the family is an important factor. For our purposes, three different types of families can be distinguished: *HH*, *HL*, and *LL*.[10] An *HH* family will predominantly produce children of type *H*, whereas *HL* and *LL* families will give rise to children of both types, *H* and *L*. There are a number of processes that we ignore in our stylized model, among these is the migration of the majority population into minority areas.[11]

In the following, we establish a basic stylized model of language transmission through the family. By including factors like migration, the quantitative results will change, but the qualitative ones remain largely unaffected. Hence, the conclusions remain valid. The first process is family formation. Mating is assumed to be generally random with varying probabilities of success. The probabilities of the formation of various family types, of course, depend on the frequencies of the *H* and *L* types in society, but are not necessarily equal to the result of random, or blind, encounters. In most cases, two *H* individuals or two *L* individuals will likely unite more easily into an *HH* or an *LL* family than an *H* and an *L* individual will become an *HL* family. If the probability of the formation of an *HL* family after a random encounter of an *H* and an *L* individual is a fraction θ as high as that of the formation of a family of the other types after an encounter of two individuals from the same group, we can write the frequency distribution of the different family types, μ, as:

$$\begin{aligned} \mu(HH) &= (1-p)^2 + p(1-p)(1-\lambda) \\ \mu(LL) &= p^2 + p(1-p)(1-\lambda) \\ \mu(HL) &= 2p(1-p)\lambda \end{aligned} \qquad (1)$$

where we have defined $\lambda := 2\theta/(1+\theta)$.[12]

Once successful mating has taken place, children will be produced. The second process is the choice of language repertoire for the children. For the sake of simplicity, we assume that on average two children are produced for each family. In other words, the size of the population over time is constant. Let the fraction of *L* children from the different families be given by $\alpha(HH)$, $\alpha(HL)$, $\alpha(LL)$, respectively. We assume that:

$$0 \le \alpha(HH) < \alpha(HL) < \alpha(LL) \le 1 \qquad (2)$$

The stronger the position of the minority language in a family, the more speakers of it emerge from that type of family. In general, we assume a leakage from both the *LL* and

10. In mixed-language families, we do not distinguish between who is mother and who is father.

11. This seems to be the cause of the decline of several minority languages, see, for instance, the classic study of Dorian (1981).

12. For a derivation, see Wickström (2005).

HH families. Although there are a number of immersion programs in many parts of the world making $\alpha(HH)$ greater than zero, for the sake of simplicity we will let $\alpha(HH) = 0$ in the following analysis. This actually strengthens the results, since it is easier to show the possibility of a survival of a minority language if $\alpha(HH)$ is positive.

The size of $\alpha(HL)$ and $\alpha(LL)$ are the crucial parameters of the analysis. One can distinguish two types of factors influencing the size of these parameters, the practical usefulness of knowing a language and the emotional attachment to it as one's mother tongue and carrier of culture. In reference to the practical value, there is a huge body of literature on the value of various languages in the labour market, see, for instance, the overview in Gazzola, Grin, and Wickström (2016). This wage premium can vary with the linguistic landscape. The practical value can depend also on the visibility of the language in this landscape (see for instance Grin, 1992). The latter in addition influences the status of the language. One can further observe an insider effect in the labour market. For instance, Drinkwater and O'Leary (1997) and Rendon (2007) show that there is a positive effect on employment from being a minority speaker. All these factors can be influenced by public policy. The right to receive information in the minority language leads to a demand for speakers by the institutions providing this information, which in turn increases the value of the language in the labour market. Cultural programs, like theatres performing in the minority language, both increase the visibility and the practical value of knowing the language. Street signs and names of public institutions in the minority tongue also increase visibility. It can be assumed that such measures enhance the status of the language and thereby the pride in the language among its speakers. Our basic hypothesis is that public policy can affect the size of $\alpha(HL)$ and $\alpha(LL)$.[13]

It is a matter of simple arithmetic to find the fraction of the L group in society in a certain generation, p^{+1}, given this fraction in the previous generation, p:

$$p^{+1} = \mu(HH)\alpha(HH) + \mu(HL)\alpha(HL) + \mu(LL)\alpha(LL) \qquad (3)$$

or, letting $\alpha(HH) = 0$:

$$p^{+1} = p\,\{2(1-p)\lambda\alpha(HL) + [p + (1-p)(1-\lambda)]\,\alpha(LL)\} \qquad (4)$$

The change in p between the two generations, Δp, is then:

$$\Delta p := p^{+1} - p = p\,\{2(1-p)\lambda\alpha(HL) + [p + (1-p)(1-\lambda)]\,\alpha(LL) - 1\} \qquad (5)$$

13. The policy in the Basque country in Spain seems to be a success story. Cenoz (2008) describes how active language policy has increased the vitality of Basque in Spain. It is instructive to compare the vitality of the language in Spain and France with an active policy in Spain and, at the best, neglect in France.

We readily see that Δp is zero if $p = 0$. However, a sustainable minority exists if the expression in curly brackets is positive for small values of p. In this case, a small minority will not die out:

$$2(1 - p)\lambda\alpha(HL) + [p + (1 - p)(1 - \lambda)]\,\alpha(LL) - 1 > 0 \quad \text{as } p \to 0 \tag{6}$$

or:

$$\alpha(HL) > \frac{1-(1-\lambda)\alpha(LL)}{2\lambda} \tag{7}$$

If $\lambda = 1$, that is, if the success probability of forming a mixed-language family is as high as that of forming a unilingual one, the condition reduces to $\alpha(HL) > 1/2$, or at least 50% of the children of mixed-language families have to become type L in order for the L group to survive. The long-term size of the L group, p^* say, can be found from (5) by letting the expression in the curly brackets equal zero, giving the result:

$$p^* = 1 - \frac{1}{\lambda}\,\frac{1 - \alpha(LL)}{2\alpha(HL) - \alpha(LL)} \tag{8}$$

If condition 7 holds, $p*$ is increasing in both $\alpha(HL)$ and $\alpha(LL)$.

The feedback mechanism will, therefore, lead to a long-term steady-state equilibrium only if enough children of type L, on average, emerge from family type HL.[14] If this number is high enough, the minority language will survive. Thus, the survival of the minority language depends on whether the language policy provides strong enough incentives for mixed-language families to raise sufficient numbers of bilingual children. In the long term, the size will depend positively on the size of both $\alpha(HL)$ and $\alpha(LL)$, in other words, on the number of bilinguals in the minority language coming from both types of families. As discussed above, the size of the parameters can be expected to depend both on the practical usefulness of the language and emotional attachment to it, reflected in the pride of being a speaker. The incentives necessary for making these parameters sufficiently large is, of course, an empirical issue. Incentives basically operate through two kinds of policy measures: acquisition planning providing educational opportunities in the minority language and status planning making the language visible and useful, as well as making the speakers of the minority language proud of their language. The problem of the language planner is then to determine a policy providing appropriate incentives for the families of type HL and LL; and they cannot be determined theoretically. It is an empirical matter. However, the theory provides some general insights that are closely related to the cost structure of policy measures.

14. See also Wickström (2005) or Templin *et al.* (2016).

Once children have been socialized, the mating and child production process starts again. There is a never-ending feedback mechanism determining the distribution of types in society.

Cost Structure

In any selection of public-policy measures, costs play a decisive role. Relevant policy alternatives must be considered. The budget for public activities is always limited, which implies a choice between policy measures to be realized. The provision of bilingual street signs in a community might mean that the number of hospital beds has to be lowered, or the introduction of a bilingual school system might come at the cost of an additional F16 airplane for the air force, for instance. Also, within a given policy sector, the problem might be that the language-planning budget allows for bilingual street signs or bilingual official government publications, but not both. In short, we cannot have everything we find good and worthwhile if budgets are limited. Choices have to be made, and making the ones leading to the most desired outcome within the given budget is central.

In language planning and policy, the costs—in addition to administrative expenses—will depend on the number of individuals in the benefiting minority and on their geographical habitation patterns. The costs of some planning measures, like bilingual street signs, are independent of the size of the minority, but strongly dependent on the size of the territory where the street signs are introduced; they are spatial and nonrival. The costs of other measures, like the right to receive personal answers from public authorities in the minority language, depend on the number of inquiries received by authorities, which in turn is dependent on the number of individuals in the minority, but is largely independent of the size of the jurisdiction in question. These costs are nonspatial and rival. Public documents, like laws and decrees published in a minority language only lead to fixed costs. They are independent of both the numerical strength and geographical distribution of the members of the minority and are hence nonspatial and nonrival. Finally, many measures, like education and social services in a minority language, give rise to costs that depend both on the size of the minority and its geographical distribution; these costs have both a spatial and a rival dimension. However, at least in the case of public education, there are fixed costs in establishing a second, parallel school system; these costs do not depend on the number of beneficiaries but might have a spatial dimension if local school boards are required. This is discussed further in the next paragraph. In Table 1, we have summarized this discussion.

It is important to keep in mind that the additional (marginal) costs of providing a good or service in a minority language are net of possible savings, due to the smaller amount of the good or service in the majority language. In the case of a nonrival good, like drafting a legal document in two or more languages or putting up additional street signs in a minority

language, clearly additional costs are created in comparison to a situation with only one language, such as translation costs. In the case of a rival good, like public education, the situation is more intricate. Providing additional schools in a minority language leads to a reduction in the costs of education in the majority language, since the number of pupils learning in that language decreases by the same number as it increases in the minority language. If education costs were linear, identical, and independent of language of instruction, there would be no change in the costs to the education sector due to the introduction of minority-language schools.

However, at least three factors have to be considered. First, there are fixed costs associated with the school system in each language, for instance the provision of instruction material or the maintenance of administrative school boards. The latter might be local in which case the fixed costs have a spatial dimension. If the variable costs were the same for both school systems, the additional costs would only be the fixed costs, and we would have the same effect as that of a nonrival good. Second, if the minority is small and geographically dispersed, it is harder to achieve optimal class sizes with reasonable travel distances and the cost per pupil becomes higher in the minority-language classes than in the majority-language ones, or busing costs are higher for minority-language schools. This is a further argument for the costs of public education to have a spatial component. Third, if bilingual teachers are in short supply they might be paid higher salaries, or if the costs for educational materials are higher per capita due to low production volumes, the per-pupil variable costs in the minority-language classes will be higher than in the majority-language classes. In this case, the costs of public education in a minority language increase with the number of pupils. For a large minority language, the latter two arguments are less important and the fixed cost consideration would matter most but, for small minorities, all three arguments would be taken into consideration. Generally speaking, the net costs of providing rival services have to do with the need for bilingual (or unilingual in the minority language) staff and administrative coordination. A basic assumption is that, to employ enough bilinguals, they must be paid higher salaries than unilinguals.[15]

All policy measures discussed might increase the status of the minority language and give parents incentives to transmit their language to their children. However, the costs, both the size and structure, vary considerably. For the nonrival and nonspatial measures, the costs are the same for all types of minorities. In the case of a spatial and nonrival

15. In Vaillancourt (2018), the additional costs of providing French-language K-12 education in Canada in 2006-2007 are calculated. The annual net costs per French-language pupil range between $768 in New Brunswick and $11,224 in Newfoundland and Labrador. It is instructive to look at the types of costs, such as the information provided by Alberta. Of the per-pupil additional net costs of $6,702 in French-language classes, $3,202 is for instruction and $1,372 for transportation, reflecting the rival and spatial dimensions. In Quebec, where the English minority is strongly concentrated in the Montreal area, the annual per-pupil marginal costs of Englishlanguage education is only $32. This all seems to be in line with our discussion.

good, we have lower costs for concentrated minorities than for geographically dispersed ones. A nonspatial, rival policy measure gives rise to lower costs for small minorities than for relatively large ones. Finally, a measure characterized by spatial and rival costs implies lower costs for small, concentrated minorities than for large, dispersed ones. This leads to different optimal policies for promoting the vitality of different types of linguistic minorities and is the core observation of our analysis.

Table 1
A Classification of Language-Related Goods

Cost Structure of Different Goods	Predominately Nonspatial	Predominately Spatial
Predominately Nonrival	public decrees, law texts	street signs, public education in big minority languages
Predominately Rival	answers from authorities to individual inquiries (internal revenue office, call centres etc.)	social services (e.g., home nursing), public education in small minority languages

Policy Choices for Different Minorities

The goal is to influence the behaviour of typical *HL* and *LL* families the most, giving them incentives to socialize their children in the minority language. To achieve this, different policies need to be designed based on the characteristics of the minority community with respect to size and habitation patterns. Only in this way can a given budget be efficiently allocated. For a small and concentrated minority, relatively more funds should be allocated for spatial and rival measures, such as education and social services than for nonspatial, nonrival measures such as government publications. For a small and dispersed minority, relatively more funds should be used for nonspatial, rival measures (for example, the right to communicate with authorities in the minority language) than for nonrival and spatial measures such as bilingual street names. For a large and concentrated minority, relatively more funds should be allocated to spatial and nonrival measures like street signs than non-spatial and rival measures like receiving answers from authorities in the minority language. The relatively large and dispersed minority should receive relatively more funds for non-spatial and nonrival measures like official documents than for spatial and rival measures like social services.

The size of the budget is not relevant for the argument. We are only looking at how a given budget of any size should be divided according to the kinds of measures applied. This, therefore, does not mean that the amount of funds allocated to a large minority for social services or education in the minority language should be lower than for a smaller minority,

only that the fraction of the budget that is used for social services and education should be lower than the fraction allocated to these measures in the budget of a smaller minority. Only in relation to other measures should the relative size be lower than for a smaller minority. The like–mutatis mutandis–will apply for all other cases.

The budget is not fixed and can vary with the size of the minority or any other variable. In general, the amounts of funds used for any given minority is a political issue and would, in most cases, depend on its size. However, given the budget for a certain minority, the distribution of funds for different policy categories should be determined by the demographic characteristics of the minority. One structure does not fit all.

An Example

We illustrate this by using a basic example. Assume that there are four types of language policy categories under consideration and the policymaker has to determine the size of a measure for each category. The four measures are: a nonspatial and nonrival measure the amount x of which is available to each individual; a nonspatial, rival measure of which the amount y is provided to each individual; a spatial, nonrival measure, with each individual consuming the amount z; and a spatial and rival measure for which each individual receives w. Each of these measures results in costs. The first measure is nonspatial and nonrival and, therefore, jointly consumed by all individuals at a cost of $p_x x$ to the government, where p_x is the price the government has to pay to provide the measure. The second measure is rival; to provide every individual with the amount y, an amount ny is needed, where n is the number of individuals in the minority; the cost to the government is $p_y ny$. The third measure is spatial and nonrival, and to provide the amount z to everyone in the territory under consideration the amount az is required, where a is the size of the territory. The cost to the government is $p_z az$. Finally, the fourth measure being both rival and spatial will result in costs proportional to both n and a. We assume the relative importance of the spatial dimension in relation to the rival one to be given by ε. Thus, the government cost of providing the amount w to all individuals in the territory is $p_w w(n + \varepsilon a)$. The total cost to the policymaker is then:

$$C = p_x x + p_y ny + p_z az + p_w w(n + \varepsilon a) \qquad (9)$$

Without any loss of generality, we can normalize all prices to one:

$$C = x + ny + az + w(n + \varepsilon a) \qquad (10)$$

The goal of the policymaker is to determine the size of the different policy measures to achieve the greatest impact of the policy on minority families and maximize the number of type *L* children emerging from *HL* and *LL* families for any size of the total costs. We assume

that all four measures positively influence the decisions of families to raise their children as type L individuals. That is, $\alpha(HL)$ and $\alpha(LL)$ both increase in all four variables. Let them be proportional to a function $f(x, y, z, w)$, increasing in its arguments. The function f has to be empirically determined, measuring the impact of the four measures on family behaviour. It is simply a measure of individual behaviour.[16]

The goal of the policymaker is now to choose the amounts of the four measures such that f is maximized, given the cost limitations. We simplify this problem as much as possible without sacrificing its basic structure by specifying f:

$$f(x, y, z, w) = x + \beta y + \gamma z + \delta w \qquad (11)$$

Due to the linearity, the problem will have pure solutions.[17] Thus, the planner will provide a measure from only one of the categories, depending on the values of n and a in the jurisdiction, or he or she will be indifferent between two or more categories.

To find the solution we will only have to compare the impact of all pairs of policy categories, considering the trade-off in costs between the budgets for each pair. For instance, comparing the impact of increasing the amount x or the amount y, we note that the direct impact of y in comparison to x is β:1; on the other hand, to keep costs constant, an increase of y by one unit should result in a decrease of x by n units. Thus, we have to compare β and n, and it makes sense to increase y if $\beta > n$ or, vice versa, increase x if $n > \beta$. Comparing the impact of x with that of all other category costs, we find that x is the better choice if:

$$n > \beta \qquad (12)$$

$$a > \gamma \qquad (13)$$

$$n + \varepsilon a > \delta \qquad (14)$$

If $\delta < \beta + \varepsilon\gamma$, the third inequality is implied by the two first ones, and only the nonspatial and nonrival measure, x, should be provided if the first two inequalities are satisfied.

16. In deciding which measures to include in a policy category, the planner will presumably first choose the most cost-effective measure and then, as the acceptable costs are allowed to increase, add new measures to the category according to their cost effectiveness. This implies that the impact of increasing costs on the margin decreases, and the function f will be a concave function.

17. If the function is concave, we will get a smooth transition from one category to another. Resources will be transferred from one category to another continuously as the area or size of its minority changes, reducing the amount of a measure continuously in one category and increasing the amount of some other measure in the other category. By choosing a linear structure for f, this change is abrupt from one category to the next. With the more realistic assumption of specifying f as a concave function in its arguments, the sharp division lines in the diagrams in Figure 2 would be replaced by fuzzy divisions making the transition from one policy category to another gradual with less of one policy category and more of another as the demographic characteristics of a jurisdiction change. In our specification, there is one or the other policy that is optimal for any combination of the parameters characterizing the minority in the jurisdiction and indifference for the values on the dividing lines. The advantage of our specification is that we get clear answers, albeit at the cost of realism.

In other words, it is sensible to provide only the nonspatial and nonrival measure if the minority is sufficiently large (n is big enough) and is spread over a sufficiently large area (a is big enough). If $\delta > \beta + \varepsilon\gamma$, that is, if spatial and rival measures have a sufficiently high impact on the behaviour of the families, the third constraint also becomes effective.

The same arguments can be used to find the combinations of the size of the minority, n, and its area of habitation, a, for which only one of the measures should be positive. For y we find:

$$n < \beta \tag{15}$$

$$n < \frac{\beta}{\gamma} a \tag{16}$$

$$\frac{\beta}{\delta} (n + \varepsilon a) > n \tag{17}$$

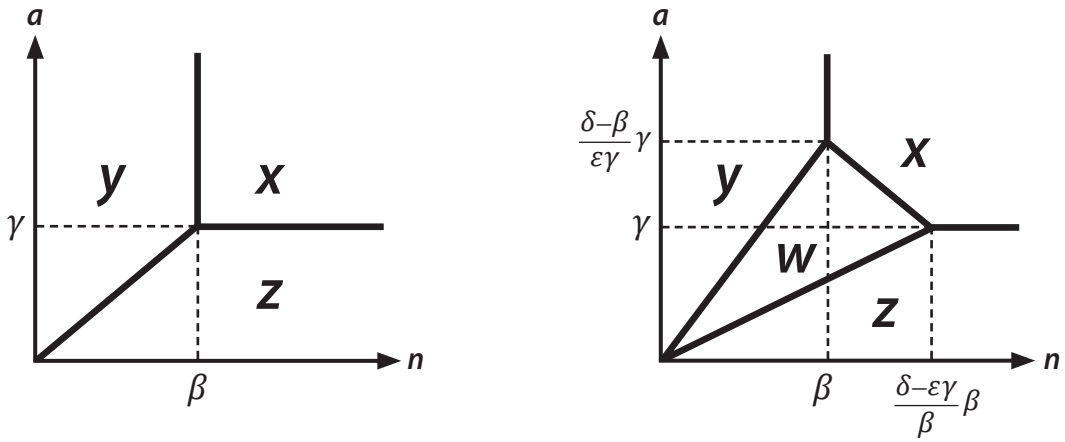
If $\delta < \beta + \varepsilon\gamma$, the third inequality is implied by the second one. If not, it implies the second inequality. For z we find correspondingly:

$$a < \gamma \tag{18}$$

$$n > \frac{\beta}{\gamma} a \tag{19}$$

$$\frac{\gamma}{\delta} (n + \varepsilon a) > a \tag{20}$$

Figure 2
Characteristics of Jurisdictions and Optimal Policy Categories



(a) $\delta < \beta + \varepsilon\gamma$ (b) $\delta > \beta + \varepsilon\gamma$

Again, if $\delta < \beta + \varepsilon\gamma$, the third inequality is implied by the second one. If not, it implies the second inequality. Finally, for w we find:

$$\delta > n + \varepsilon a \quad (21)$$

$$n > \beta/\delta\,(n+\varepsilon a) \quad (22)$$

$$a > \gamma/\delta\,(n+\varepsilon a) \quad (23)$$

If $\delta < \beta + \varepsilon\gamma$, the two last inequalities contradict one another and there are no values of n and a for which it is optimal to let w be positive.

We illustrate these results in Figure 2. We have drawn the figure for the two cases of a big and a small δ; in other words, for the case that the impact of a spatial and rival good is important enough or not for the status of the language in the family. Generally, we can see that for small (n small) and extended minorities (a big), a rival and nonspatial measure, for example the right to communicate with authorities in the minority language, is preferred ($y > 0$); whereas for a concentrated (a small), but sufficiently large minority (n big), a spatial but nonrival measure, like bilingual street signs, is best ($z > 0$). Finally, for an extended (a large) and large minority (n big), nonspatial and nonrival measures ($x > 0$), like publishing official documents in the minority language, are most effective. If the impact of spatial and rival measures is strong enough (δ big), we also get a region with combinations of the size of the jurisdiction (a) and the size of its minority (n), for which spatial and rival measures, like providing ambulatory social services in the minority language, are effective for reaching the goal of the policymaker ($w > 0$).

We also see that the relative impact of the measures on the behaviour of the family, captured by the function f, influence when the different types of measures are most effective. If the nonspatial and rival measures are unimportant (β is small) the budget for these types of measures should be positive only if the jurisdiction has a small enough minority. For a jurisdiction with a bigger minority, nonrival measures (x and z) or spatial and rival ones (w) should then be implemented. Of course, if β is big the opposite holds. Similarly, if γ is small, spatial and nonrival measures have low impact, and these measures should be positive only if the area of the jurisdiction in question is small enough. For a jurisdiction with a bigger area, nonspatial measures (x and y) or spatial and rival ones (w) should be chosen. If γ is big the opposite holds.

If the impact of spatial and rival planning measures is too low in comparison to nonspatial and rival as well as to spatial and nonrival ones ($\delta < \beta + \varepsilon\gamma$), such measures should not be introduced. If the impact (δ) is strong enough, the density of the minority population in the jurisdiction (n/a) is between $\beta\varepsilon/(\delta - \beta)$ and $(\delta - \varepsilon\gamma)/\gamma$, and its size not too big, spatial and rival measures are most effective. The greater the δ, the wider the ranges of

the size of the area (a) and minority population (n) of the jurisdiction for which the spatial and rival measures are effective. The range of values for which the other types of measures are most effective is correspondingly smaller.

We finally note that the range of values of the parameters describing the jurisdiction (a and n) that imply a positive size of nonspatial and nonrival planning measures ($x > 0$) increases with a decrease in any of the parameters β, γ, and δ (as long as $\delta > \beta + \varepsilon\gamma$, if the inequality is not satisfied δ has no influence).[18]

Conclusion

To preserve and increase the vitality of a minority language, there have to be incentives for *HL* and *LL* families to transfer the language to their children. Public policy is at least partially responsible for creating such incentives. Policy measures differ in their costs, not only in terms of their magnitude, but also the way in which costs depend on the habitation patterns of the minority and its numerical strength. We have argued in this article that this requires a flexible language policy. A sine qua non condition for such a policy, however, is reliable data. Unfortunately, very little is known about how families react to different policy measures. Frequently, policies are determined in negotiations between the government and representatives of the linguistic minority. It cannot be excluded that the policies chosen are more a reflection of the short-term interests of an elite than that of promoting the long-term vitality of the language. Good data and reliable empirical studies are the only solution.

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18. Note that the slope of the northeast segment of the triangle describing the area with positive w in the diagram is $-1/\varepsilon$. Hence, it is independent of all the intensity parameters β, γ, and δ. An increase in β, γ, or δ will, thus, increase the area marked by w in the diagram.

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