To Translate or To Learn Languages? An evaluation of social efficiency

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An evaluation of social efficiency

JOSEP M. COLOMER

Abstract

In a multilingual community persons face two alternatives: (a) to organize a system for translating messages, (b) to acquire additional languages personally. These two alternatives are compared with regard to their collective benefits and costs. In order to do so, first, the probability that two different multilingual persons communicating randomly have a common language is calculated. This calculation allows us to expect increasing communication efficacy for the members of the community from a policy inducing the learning of additional languages, even if this policy does not promote a single common language (as usually happens with English in Europe) but proportional or random choices of the languages to be learned. Second, an estimation of the social benefits and costs of learning languages, evaluated in time units, is presented. Finally, the social utility of learning foreign languages weighed by their communication efficacy is compared with the utility of translating. It appears that learning one foreign language is more efficient than translating in communities with up to five languages, while learning two foreign languages is more efficient than translating in communities with ten languages or more. This conclusion could support a policy inducing the learning of different foreign languages in a proportional manner, without reducing the variety of the linguistic environment.

Introduction

Identifying favorable conditions for socially efficient communications in multilingual communities is a relevant issue, especially in a world of increasing international communications and individual mobility. It is particularly pertinent for the prospects of multilingual communities, such as the European Union, as well as for many European States themselves.
In general, it seems reasonable to state that persons with different first languages (or mother tongues) who wish to understand each other in conversations and other linguistic exchanges face two basic alternatives: (a) to organize a system for translating or interpreting messages; (b) to acquire additional languages personally. These two alternatives will be compared here with regard to their collective benefits and costs. The conclusion will be reached that in many cases learning languages is collectively more efficient than translating conversations among individuals without common languages; the superiority of this solution increases as people become more multilingual.

The style or reasoning presented in this paper should be placed within "the economics of language," an expanding field that contains about 100 academic publications at this time (Grin 1992, 1994). Specifically, and following the path of some of my former publications (Colomer 1990a, 1990b, 1991, 1992), I try to build a formal, deductive model of linguistic interaction among individuals who have different skills and preferences for using languages. The collective results are presented as aggregations of individual behaviors, and some measurements of the social utility of different linguistic strategies as aggregations of individual utilities are attempted.

Any formal model implies a trade-off between the number of relevant variables that can be incorporated and its capability to produce general explanations and interesting inferences. If it is successful, parsimony allows separation of what appears to be important from what turns out to be less relevant for understanding the main factors of real processes. Therefore, the reader of the present exercise in formal modeling should not expect a factual, detailed description of the problem to be studied, but rather a process starting with some simplified assumptions, followed by logical reasoning, and the reaching of some deductive implications, which should be submitted to empirical tests.

Here language is basically conceived as a tool for communication. In principle, any language is considered equally suitable for meeting the requirement of human communication in contemporary societies and, therefore, no specific distinction for the validity of the model for different languages is made. However, other dimensions of language, such as expression and its value as an element of cultural environment, should be considered as a crucial complement of my evaluation, as I will suggest below.

In the model, equal levels of communication among members of the different linguistic groups, or linguistic "foreigners," are assumed. In the context of the European Union, for instance, this would mean that a French-speaker communicating with "foreigners" would have the occa-
sion to communicate with an English-speaker, a German-speaker, a
Spanish-speaker, etc., a number of times proportional to the real number
of English-speakers, German-speakers, Spanish-speakers who communi-
cate with "foreigners" in the community. This assumption of communica-
tivity is not always realistic, but it works as an ideal model (analogous
to the assumptions of mobility in some economic models) able to produce
theoretical explanations that, in applied analyses, are adaptable to distinct
levels of communication proper to each real case.

A relevant assumption in the model is that all languages are learned
at the same proportion by nonnatives. This would mean, for example,
that, in a community with ten languages, each language group is divided
up into nine subgroups of equal size, characterized by the different second
language of their members. This assumption does not prevent language
groups from having different sizes, that is, the community may include
relatively large and relatively small language groups.

This proportionality is not likely to be a result of unconstrained indivi-
dual choices. On the contrary, if foreign language learning is conceived
as a strategic decision in which individuals choose combinations of lin-
guistic skills that maximize communicative utility, learning a dominant
language — such as English in Europe, for example — may be more
rewarding than any other alternative. However, a policy promoting the
acquisition of foreign languages in a proportional or random manner —
as in my assumption — might achieve other goals, such as the preserva-
tion of linguistic variety and pluralism. In a highly multilingual com-


nity, such as the European Union, it does not seem viable to ground
a language policy exclusively on communication efficacy, and therefore
it appears interesting to estimate the costs of possible loss in communica-
tion that could be expected in return for that goal in favor of pluralism.
(For elements of this discussion, see Carr 1985; King and Church 1993;
criticized by Grin 1994; for a theoretical model of strategic decisions,

Finally, as mentioned, social utility is estimated as an aggregation of
individual utilities of the members of the society, according to the egalitar-
ian and standard principle that each individual counts for one and no
one for more than one.

The plan of the paper is as follows. First, I shall calculate the proba-


ability that two differently multilingual persons communicating randomly
have a common language and can therefore communicate with success.
This will give us specific proportions of expected successful and failed
exchanges in multilingual communities. Second, a proposal for estimating
the social benefits and costs of learning foreign languages will be pre-
sented. Third, the social benefits and costs of translating communications
among persons without a common language will also be estimated. Finally, the utility of learning languages weighed by their communication efficacy will be compared with the utility of translating; as stated, certain advantages will be found in the former over the latter.

The model

The variables of the model are the following.

First, we have the number of languages in the community, equivalent to the number of persons with different first languages or linguistic groups, N. It is thus assumed that every person has a first language (or mother tongue) and that all other languages are considered “foreign” languages. Those persons with different first languages will be called “foreigners.” It is not the absolute number of persons in the community that matters, but rather its linguistic diversity. In the present paper, calculations will be presented for values of N from 1 to 10. This range allows us to interpret the model as valid for spaces from bilingualism — such as that of Brussels, for instance — to higher multilingualism — such as that of the European Union, where the number of relevant languages should include at least its working languages English, French, German, Italian, Spanish, Dutch, Portuguese, Greek, Danish, and perhaps Swedish.

Second, we have the number of languages that any individual can “speak”, M (M ≤ N). In the following, I will use the ability to “speak” a language in a very relaxed sense, which basically means that the person can understand the stream of speech and achieve an understandable production of it (situations of mere passive understanding in which the persons involved in a conversation prefer to adopt a behavior of passive bi- or multilingualism could also be included). Calculations will be presented for bilingual and trilingual persons, that is, M = 2 and M = 3, the latter coinciding with the recommendation of the European Ministers of Education for acquiring two foreign languages at compulsory school (European Council Committee 1986).

Third, we have the number of individuals communicating at the same time, j. In the following model, calculations are presented for j = 2, but extensions to higher values of j could be added in further work.

Fourth, using the above-presented variables, N, M, we can calculate the number of types of individual multilingualism in the community, I. This variable is relevant because the model focuses on exchanges among “foreigners,” putting aside exchanges among linguistically homogeneous individuals who will obviously always have a common language and will maintain the use of their own first language.
If, for instance, the number of languages in a community is three (N = 3) — say French, German, and Italian — and every individual speaks two languages (M = 2), then the number of differently multilingual individuals is six:

1. the linguistic group of people who speak French (as first language) and German (as second language);
2. those who speak French and Italian;
3. those who speak German and Italian;
4. those who speak German and French;
5. those who speak Italian and French; and
6. those who speak Italian and German (always as first and second languages, respectively).

In other terms, if N = 3, M = 2, we have I = 6.

In general, the number of differently multilingual individuals is equal to the variations of the number of languages in the community in groups of the number of languages spoken per individual, or variations of N languages in groups of M.

In other terms:

\[ I = V_N^M \]

(See the Appendix for this and another formula drawn from probability theory used in this paper.)

Fifth, we can also calculate the number of different communication groups between "foreigners" (or persons with different first languages), C. I am using "communication" in a wide sense meaning all those oral, but also written, exchanges between more or less "symmetric" interlocutors that require some knowledge of the other's language (think, for example, of correspondence).

The number of different communication groups is equal to the total number of different communications minus the number of communications between persons speaking the same first language. If, as in the above example, the number of languages is three and every person speaks two languages, the members of the six differently multilingual groups can form 15 different communication groups. In other terms, they can form 15 combinations of six elements in groups of two, \( C_6^2 = 15 \) (see again the Appendix for this formula). From this total number of communication groups we will subtract those three communication groups formed by persons with the same first language (the communications between the members of the groups above numbered 1 and 2 both of whom have French as their first language; between the members of the groups 3 and 4, who have German as their first language; and between the members
of the groups 5 and 6, who have Italian as their first language). In other terms, $C = C_2^6 - 3 = 15 - 3 = 12$.

In general,

$$C = C_2^I - \left\lceil \frac{I}{N} - 1 \right\rceil + \left\lceil \frac{I}{N} - 2 \right\rceil + \ldots + 1 \right\rceil \cdot N$$

where:
- $C$: number of different communication groups between "foreigners'';
- $C_2^I$: combinations of different multilingual individuals, $I$, in groups of 2;
- $N$: number of languages in the community;
- $I$: number of types of individual multilingualism in the community ($I = V_M^N$).

The probability of successful communications between foreigners

Once the variables are presented, the first step in the analysis is to estimate, according to the assumptions presented above, the proportions of successful and failed communications between two multilingual persons with different first languages.

I shall start by searching for the probability of a failed communication. We can approach the number of different communication groups in which the participants do not have a common language as the product of the number of types of individual multilingualism multiplied by the number of different combinations of languages that an individual does not speak (or, in other words, the individual combinations of unknown languages).

The first factor, the number of different individual multilingualism, has previously been presented as $I = V_M^N$. The second factor, the number of different combinations of languages that an individual does not speak, equals combinations of the number of nonspoken languages per individual, $N - M$, in groups of his number of spoken languages, $M$; that is, $C_M^{N-M}$. Thus the number of failed communications $F = V_M^N \cdot C_M^{N-M}$.

The probability of a failed conversation between two "foreigners," $P_F$, will be a proportion of the failed communications, $F$, in relation to the total number of communication groups, previously found as $C$. In other terms $P_F = F/C$.

The inverse proportion of failed communications is, obviously, the proportion of successful conversations: $P = 1 - P_F$. Thus, the probability that two random participants in a conversation have a common language is

$$P = 1 - V_M^N \cdot C_M^{N-M} / C$$
where:

P: probability that 2 random persons with different first languages have a common language;
N: number of languages in the community;
M: number of languages that any individual speaks;
C: number of different communication groups between "foreigners" (according to formula [1]).

Table 1 contains the values of the variables presented above and the results of the formula for expected successful communications (according to formula 2) in communities with 1 to 10 languages and persons speaking 2 or 3 languages (including their first languages, that is, speaking respectively 1 or 2 "foreign" languages).

As we can see, the probability of a successful communication between two foreign and bilingual persons meeting at random is 100 percent in communities with up to three languages. It is obvious that two bilingual persons will always share any of three languages, whatever their combinations of two spoken languages. But it is not sure that two bilingual persons meeting at random will always have a common language in a community with four or more languages. According to Table 1, the probability of a successful communication decreases slightly less than proportionally in communities with a higher number of languages and moves down to a little more than 30 percent in a community with 10 languages.

In contrast, the probability of having a common language with a random interlocutor is much higher when each person speaks three languages (a first language and two "foreign" languages): a successful communication is then guaranteed in communities with up to five languages; its probability decreases very slightly in communities with a higher number of languages and remains at almost 90 percent in a community with 10 languages.

Figure 1 reflects the formal findings for bilingual and trilingual persons. As we can see, it is possible to expect increasing communication chances for the members of the community from a policy inducing the learning of additional languages.

From the trends of the formal calculations, one would not expect serious communication problems to exist, for example, in any trilingual community where every person spoke two languages. With similar reasoning, it should be expected that if everybody spoke three largely diffused languages — say, for instance, English, Spanish and French — this would give anyone high probabilities of communicating successfully with some interlocutor even in a highly multilingual world.
<table>
<thead>
<tr>
<th>No. of languages in the community</th>
<th>No. of languages per individual</th>
<th>Linguistically different individuals</th>
<th>Different conversation groups of 2</th>
<th>No. of failed conversations between foreigners</th>
<th>Probability of successful conversations between foreigners</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>M</td>
<td>I</td>
<td>C</td>
<td>F</td>
<td>P</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>12</td>
<td>54</td>
<td>12</td>
<td>0.778</td>
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<td>20</td>
<td>160</td>
<td>60</td>
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</tr>
<tr>
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<td>2</td>
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<td>375</td>
<td>180</td>
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<td>420</td>
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<tr>
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<td>2</td>
<td>56</td>
<td>1,372</td>
<td>840</td>
<td>0.388</td>
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<tr>
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<td>72</td>
<td>2,304</td>
<td>1,512</td>
<td>0.344</td>
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<tr>
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<td>2</td>
<td>90</td>
<td>3,645</td>
<td>2,520</td>
<td>0.309</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>3</td>
<td>120</td>
<td>120</td>
<td>0.980</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>3</td>
<td>210</td>
<td>840</td>
<td>0.956</td>
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<tr>
<td>8</td>
<td>3</td>
<td>3</td>
<td>336</td>
<td>3,360</td>
<td>0.932</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>3</td>
<td>504</td>
<td>10,080</td>
<td>0.911</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>3</td>
<td>720</td>
<td>25,200</td>
<td>0.892</td>
</tr>
</tbody>
</table>

Formulæ:
\[
I = V_m^N
\]
\[
C = C_2^N - [(1/N - 1) + (1/N - 2) + \ldots + 1] \cdot N
\]
\[
F = V_m^N \cdot C_N^{N-M}
\]
\[
P = 1 - F/C
\]
To confirm other quantitative inferences we should take into account, as I have mentioned, that many real situations do not fit with certain assumptions of the model, especially the proportionality of learning each of the foreign languages. Disproportions in learning different foreign languages will only increase the probabilities of successful communications among "foreigners" in comparison with those found in the model. In the particular context of the European Union real data show that, although German is the first language of the largest number of persons, English has become the preferred additional language in all linguistic groups. Specifically, "the [linguistic] repertoire of more than three out of four multilingual speakers [of the EC] contains English, the most central language by far" (De Swaan 1993: 250; for data about increasing multilingualism among young people in Europe, see Eurobarometer 1991). It seems almost unnecessary to say that, with this disproportion of additional languages in favor of one of them, the probability of a successful communication between two bilingual persons meeting at random is even higher than in our previous assumption. Yet the point to be stressed here is that even a policy promoting proportional or random choices of the languages to be learned produces very high expectations of successful communications. The relative advantage of this policy is that it avoids any reduction of the variety of the linguistic environment. Therefore, it
seems that very few losses in communication should be expected from a policy that aims at preserving the variety of languages by way of inducing individual multilingualism.

The utility of learning languages

The next step is to calculate the benefits and costs of learning "foreign" languages. They will be evaluated in time units (for an alternative attempt to calculate costs of multilingualism in money, see Coulmas 1992: 90–152). Specifically, they will be evaluated as proportions of the total communication time that the members of the community spend in communicating with "foreigners," which I will call T. Consistent with the egalitarian and individualistic approach sketched above, the same value is given to any person's time, and therefore T is proportional to the number of members of the community communicating with "foreigners."

The benefits of learning "foreign" languages, \( B_L \), are equal to the time spent in communication, T, multiplied by the rates of communicational efficacy in speaking several languages, P, found by formula (2). That is, \( B_L = P \cdot T \)

On the other hand, the cost of learning languages is the proportion of communication time that all persons communicating with "foreigners" spend in learning new languages.

The time needed for learning a language may vary depending on many factors (for a discussion, see Ellis 1985; Klein 1986; Perdue 1993). However, one might argue that in many multilingual communities this time is not significantly different for different individuals. The experience of the United States, for example, shows that any immigrant, once motivated to communicate with the rest of the members of the community, spends about the same amount of time learning English. It does not seem unreasonable to assume that an average of two years of linguistic immersion in a foreign language — for example, living in a foreign country — is an appropriate period for reaching a satisfactory level of communication. Therefore if a person learns through an intensive experience such as this, or by a slower process, the total amount of time spent in learning a new language can be estimated to be about 5 percent of an individual adult worklife of 40 years (to be exact, 5% of the time spent on conversations with "foreigners" during the course of those years). This is the sensible proposal presented by Jonathan Pool (1991: 501), which appears to be compatible with several empirical observations.¹ Yet, since this estimated learning time may indeed vary, the quantitative findings of the present paper should be accepted only in qualitative terms.
Thus, the cost of learning "foreign" languages, $C_L$, is equal to the product of the proportion of communication time spent on learning languages times the number of "foreign" languages learned per person. The first factor has been found to be $0.05 \, T$ per language. The second factor is equal to $M - 1$, since it is assumed that every person speaks one first language not included in the calculus. Therefore: $$C_L = 0.05 \, T \, (M - 1)$$

The social utility of learning foreign languages, $U_L$, is the difference between its benefits and costs, thus:

$$U_L = B_L - c_L = P \cdot T - 0.05 \, T \, (M - 1) = T \, [P - 0.05 \, (M - 1)]$$

where:

$U_L$: utility of learning "foreign" languages;

$T$: total communication time spent on communicating with "foreigners";

$P$: probability that 2 random persons with different first languages have a common language (according to formula [2]);

0.05: proportion of time spent on learning a foreign language (2 out of 40 adult years);

$M$: number of languages that any individual speaks.

Table 2 contains the results of formula (3) in communities with one to ten languages and persons speaking two or three languages, consistent with earlier calculations. Because the utility of learning foreign languages is a function of the probability of successful communications, $P$, it is easy to see that the social utility values of learning languages follow a path similar to the values of $P$ presented previously in Table 1 and Figure 1. For bilingual persons, the utility of learning a second language is very high in communities with up to three languages. It is lower the higher the number of languages in the community, but the utility decreases less than proportionally in relation to the number of languages. For trilingual persons, the utility of learning foreign languages is very high in communities with up to five languages. It is lower the higher the number of languages in the community, but in this case the utility decreases at a much lower rate.

**The utility of translating**

The final step of this analysis is to calculate the benefits and costs of translating conversations between persons with different first languages.

On the one hand, the benefits of translating, $B_t$, are, like those of learning languages, equal to the communication time, $T$, multiplied by the rates of its communicational efficacy, $P$. However, while the rates of
Table 2. Benefits and costs of learning languages and translating

<table>
<thead>
<tr>
<th>No. of languages in the community</th>
<th>Learning 1 foreign language (M = 2)</th>
<th>Learning 2 foreign languages (M = 3)</th>
<th>Translating Bt - ct = T - 0.5 T</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Benefits BL = PT Costs CL = 0.05 T(M - 1) Utility BL - CL</td>
<td>Benefits BL = PT Costs CL = 0.05 T(M - 1) Utility BL - CL</td>
<td>Benefits BL = PT Costs CL = 0.05 T(M - 1) Utility BL - CL</td>
</tr>
<tr>
<td>1</td>
<td>T 0.05 T 0.95 T</td>
<td>T 0.1 T</td>
<td>0.9 T 0.5 T</td>
</tr>
<tr>
<td>2</td>
<td>T 0.05 T 0.95 T</td>
<td>T 0.1 T</td>
<td>0.9 T 0.5 T</td>
</tr>
<tr>
<td>3</td>
<td>T 0.05 T 0.95 T</td>
<td>T 0.1 T</td>
<td>0.9 T 0.5 T</td>
</tr>
<tr>
<td>4</td>
<td>0.778 T 0.05 T 0.728 T</td>
<td>T 0.1 T</td>
<td>0.9 T 0.5 T</td>
</tr>
<tr>
<td>5</td>
<td>0.625 T 0.05 T 0.575 T</td>
<td>T 0.1 T</td>
<td>0.9 T 0.5 T</td>
</tr>
<tr>
<td>6</td>
<td>0.520 T 0.05 T 0.470 T</td>
<td>0.980 T 0.1 T</td>
<td>0.880 T 0.5 T</td>
</tr>
<tr>
<td>7</td>
<td>0.444 T 0.05 T 0.394 T</td>
<td>0.956 T 0.1 T</td>
<td>0.856 T 0.5 T</td>
</tr>
<tr>
<td>8</td>
<td>0.388 T 0.05 T 0.338 T</td>
<td>0.932 T 0.1 T</td>
<td>0.832 T 0.5 T</td>
</tr>
<tr>
<td>9</td>
<td>0.344 T 0.05 T 0.294 T</td>
<td>0.911 T 0.1 T</td>
<td>0.811 T 0.5 T</td>
</tr>
<tr>
<td>10</td>
<td>0.309 T 0.05 T 0.259 T</td>
<td>0.892 T 0.1 T</td>
<td>0.792 T 0.5 T</td>
</tr>
</tbody>
</table>

T: Total time spent on conversations with "foreigners".
P: Probability of successful conversations between "foreigners".
M: Number of languages spoken per individual.
the communicational efficacy of speaking several languages have different values in different multilingual communities (as expressed by formula [2]), the efficacy of translating (technical problems aside) is always 100 percent. In principle, any unilingual person having access to a system for translating or interpreting his or her messages to foreigners can be sure of having successful communications. In other words, the benefits of translating evaluated in time are equal to the time spent in communication; that is, \( B_t = T \).

On the other hand, the cost of translating, \( c_t \), is the worktime of translators, or all the time that these persons spend on communicating with “foreigners” (not taking into account the time spent by translators in learning foreign languages). If a translator or interpreter has to repeat in another language all the messages emitted by the participants in a multilingual communication — as is usually the case, for example, in some international conferences — this means that one-half of the time that the members of the community spend in communicating with foreigners is spent on translating. Note that, since the same value is given to any person’s time, the total worktime of translators counts for the same value as the total time spent by unilingual persons in (indirectly) communicating with foreigners. In this case, the periods of time that the two different groups of persons — unilingual speakers and translators — spend on communicating with foreigners stand for different proportions of their individual communication time. But in collective terms the translation-time costs of the community amount to half of the total time that the members of the community spend on communicating with foreigners.

In other terms, \( c_t = 0.5 \cdot T \).

We can now state that the social utility of translating multilingual conversations, \( U_t \), is the difference between its benefits and costs, thus:

\[
(4) \quad U_t = B_t - c_t = T - 0.5 \cdot T = 0.5 \cdot T
\]

where:

- \( U_t \): utility of translating multilingual conversations;
- \( T \): total conversation time spent in speaking with “foreigners.”

**Comparing learning and translating**

Now it should be clear that in many cases the social utility of learning foreign languages is higher than the social utility of translating multilingual communications between unilingual persons: \( U_L > U_t \).

Looking at the corresponding columns in Table 2, it is possible to compare the respective values for different multilingual communities
under the assumptions outlined above. It appears that, for a given level of individual linguistic exchanges with "foreigners," learning one foreign language is more efficient than translating in communities with up to five languages \((0.575 \text{ T} > 0.5 \text{ T})\), while learning two foreign languages is more efficient than translating in communities with ten languages \((0.792\text{ T} > 0.5\text{ T})\), and likely in communities with many more languages (calculations are not made for \(N > 10\)).

**Conclusions**

A formal model of linguistic exchanges in multilingual communities has been built, assuming equal levels of communication among members of the different linguistic groups and equal proportions in learning each of the foreign languages by the members of each linguistic group, presumably as a result of a language policy aiming at preserving the linguistic variety of the community.

It has been found that the probability that two randomly selected individuals with different first languages have a common language, or the probability of successful communications between "foreigners," increases more than proportionally when people learn new foreign languages. More specifically, and within the restrictions of the model, the probability that two randomly selected bilinguals have a common language is 100 percent in communities with up to three languages. Decreasing values are found in more multilingual communities, down to around 30 percent in communities with ten languages. For trilingual persons the probability of successful communication is 100 percent in communities with up to five languages, and it remains very high in more multilingual communities — still around 90 percent in communities with ten languages. It is thus possible to expect that a policy promoting the acquisition of additional languages would give increasing communication chances to the members of different linguistic groups.

Having compared the social benefits and costs of learning foreign languages, and of translating the conversations between unilingual persons, clear advantages of the former over the latter have been found. The model specifically states that in communities with up to five languages, learning one foreign language is more efficient than translating. Learning two foreign languages is more efficient than translating in communities with ten and even more languages.

It is rather obvious that when not all languages are learned in the same proportion, that is, when one of them enjoys some higher preference among the members of all linguistic groups — as it is happening with
English in Europe — the probability of successful communications between multilingual foreigners is even higher than in the above-mentioned assumptions. However, the analysis presented here allows to state that, even if individuals learn the languages of the community at random, the social efficiency of learning languages is quite high, often higher than translating, and it has the advantage of not reducing the variety of the linguistic environment.

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Appendix

In the paper two formulas drawn from probability theory at high-school mathematics level are used: variations and combinations.

The number of variations in a set of elements — languages in our case — is the number of possible subsets in which no element is repeated and order counts.

For example, in the set \( n = \{1, 2, 3, 4\} \) there are 12 variations in groups of \( k = 2 \) elements: \((1,2), (2,1), (1,3), (3,1), (1,4), (4,1), (2,3), (3,2), (2,4), (4,2), (3,4), (4,3)\). The general formula is

\[
V^n_k = \frac{n!}{(n-k)!}
\]

where \( V^n_k \) means variations of \( n \) elements in groups of \( k \); \( n! \) is read “\( n \) factorial” and is calculated as follows:

\( n! = (n) \times (n-1) \times (n-2) \ldots (2) \times (1) \).

In the example thus:

\[
V^4_2 = \frac{4!}{(4-2)!} = \frac{4 \times 3 \times 2 \times 1}{2 \times 1} = 12
\]

This is an appropriate formula for calculating the number of differently multilingual individuals in a community because we assume that a difference exists between the first and the second language and therefore the order counts: for example, a person who speaks German as first language and French as second language is considered different from a person who speaks French as first language and German as second language.

The number of combinations in a set of elements is the number of possible subsets in which no element is repeated and order does not count.

For example, in the same set \( n = \{1, 2, 3, 4\} \) there are 6 combinations in groups of \( k = 2 \) elements: \((1,2), (1,3), (1,4), (2,3), (2,4), (3,4)\). The general formula is

\[
C^n_k = \frac{n!}{k!(n-k)!}
\]

where \( C^n_k \) means combinations of \( n \) elements in groups of \( k \).
In the example thus:

\[ C_2^4 = \frac{4!}{2!(4-2)!} = \frac{4 \times 3 \times 2 \times 1}{2 \times 1 \times 2 \times 1} = 6 \]

This is an appropriate formula for calculating the number of different conversation groups between persons with different first languages because we do not assume any order between the two interlocutors: for example, a conversation between a person speaking German and French and another person speaking French and Italian is identical to the conversation between a person speaking French and Italian and another person speaking German and French.

Notes

1. In a descriptive framework for modeling the acquisition process of a second language, Felixed (1980) assumed four different periods of duration of learning up to 24 months. If we assume an average exposure of five hours per day to the foreign language, this would amount for 3,650 hours, which seems to be an intermediate duration in several immersion programs: 1,300 hours in the Army Language School of California for an adult to attain near-native competence in Vietnamese (Burke 1974, cited in McLaughlin 1984: 53); between 1,000 and 3,500 hours for French as a second language (Harley 1984); 4,500 hours for French in Canada; 3,000 hours for Hebrew in bilingual education in Hebrew and French in Canada; 1,500 hours for non-French-speaking pupils in the European School of Brussels, according to several sources reported by Spolsky (1989: 211–212).

2. I made a practical application of one of the possible analyses allowed by this model during my presentation of a first version of this paper to an international Round Table on European Economic Spaces and Linguistic Development, organized by the Commission of the European Communities and the Valencian Government (Morella, 25–28 May 1994). The Round Table was formed by 14 persons belonging to eight different linguistic groups (Catalan–Valencian, Basque — with Spanish as first language, Galician, Occitan, Italian, French, Dutch, Welsh, and Irish — the two latter with English as first language). If these persons had been monolinguals, it would have been necessary to implement 56 different translations between pairs of languages to make communications successful. Thanks to the fact that some of the participants used a “foreign” language shared by other members of the audience, only four languages were used in the formal meeting and, therefore, the necessary translations were dramatically reduced to 12 (in fact, for practical reasons and given the multilingualism of most participants, four interpreters in turns of two did only eight of those translations). As I remarked then, it was a good example of the efficiency of individual multilingualism, since it allowed a visible reduction in translation costs.

References


