

Latin Forms in Vernacular Scientific Writing: Code-Switching or Borrowing?¹

Begoña Crespo and Isabel Moskowich
Universidade da Coruña (Spain)

1. Introduction

Different cultural and linguistic layers are reflected in texts in a number of ways. One of the most obvious indicators of such linguistic layers is seen in the lexicon (Taavitsainen *et al.* 2002: 260). This has led us to examine Latin vocabulary in 19th-century mathematical texts. Latin, as the language of printed scientific books until the middle of the 17th century (Webster 1975: 267), has left its mark on English scientific discourse. The tradition of scholarly written bilingualism inevitably affected vernacular production. The prestige of Latin, as the language of a dominant culture, can be traced in the adoption and integration of borrowings and switches to Latin on the part of academic authors.

The vernacularisation process which began in the last quarter of the 14th century (Voigts 1996, Taavitsainen 2000, 2001a, 2001b, 2004) did not undermine completely the use of Latin in scientific writings. The gradual loss of classical patterns and the still pervasive influence of classical culture can be observed in the adoption of Latin expressions and in the alternating use of both languages. Borrowing and code-switching occur frequently in scientific scholarship down through the history of English. Though many authors (Romaine 1989, Scotton 1993, Rothwell 2000, Schendl 2000, Wright 2000) think that distinguishing borrowing from code-switching or code-mixing is very problematic, in this paper we will try to explore the characteristics of these separate phenomena in scientific texts other than medical. To this end, we will work with samples of mathematical texts from the 19th century as contained in the *Coruña Corpus* (CC henceforth), focusing on individual lexical units and fixed expressions and we will attempt to ascertain some of the conditions which may influence either of the phenomena under survey.

Therefore, the paper will be organised into separate sections. Section 2 will examine code-switching and borrowing from a theoretical point of view. In section 3 we will describe the corpus material selected. Section 4 will be devoted to the analysis of the data and section 5 will contain the conclusions reached in the light of previous research.

2. Code-Switching and Borrowing: Some Theoretical Issues

Though many authors investigating the enlargement of the English lexicon have dealt with the processes of code-switching and borrowing, not all of them have provided clear-cut distinctions for such phenomena (Romaine 1989, Scotton 1993, Poplack 1995, Sankoff 2002). Code-switching and borrowing are explained (Halmari 1997: 17–18, Pahta 2004: 79) as a continuum in progression in which code-switching precedes borrowing in time and is more restricted in its use (individual vs. societal). In Pahta's (2004: 79) words: 'The distinction between the two may seem straightforward in theory: switching involves the use of two languages in one utterance, whereas the term "borrowing" is used of embedded elements that have been integrated into the host language.'

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Despite the apparently natural evolution from one to the other, not all code-switches become loans (with the corresponding linguistic adaptation to the patterns of the target language). In fact, many of these switches are somehow fossilised forms, recognisable to the speaker as ‘foreign’. This is the case of expressions like *a priori*.

It has been generally assumed that code-switching entails a change of code by the speaker in a given situation. Though research on code-switching is applied mainly to conversational exchanges,² recent studies of the phenomenon in historical texts have demonstrated the validity of the application of the term to earlier periods of English (Rothwell 2000, Schendl 2000, Wright 2000, Pahta 2004).

Shifting from one linguistic code or variety to another implies a certain degree of competence in the languages involved and, therefore, requires a previous stage of bilingualism (literally speaking). In contrast, borrowing does not require complete individual bilingual competence but is a consequence of close contact. To our understanding, borrowing occurs when monolingual speakers start using forms from a donor language unaware of the fact that those forms do not belong to her/his native lexical inventory. In any case, code-switching and borrowing are seen as the outcome of language contact situations. Therefore, the social nature of both phenomena cannot be denied. However, the general consensus scholars show on this issue (Pfaff 1979, Heller 1988a, Romaine 1989, Poplack 1990, Scotton 1993, McClure 2001) is formulated on generalisations and cannot, therefore, be considered as specific linguistic criteria which may help distinguish between the two.

One of the basic ideas repeated in the literature about language alternation or language mixing (Scotton 1993) is that no distinct production devices are used in switching and borrowing; the difference lies in the fact that switches do not become integrated into the mental lexicon of the recipient language whereas loans do. This widely accepted premise is not a wholly reliable criterion as the degree of integration of loans can trigger off misleading results. In this respect two types of linguistic integration can be distinguished: phonological or morphophonemic (as stated in Gardner-Chloros 1995: 86, also mentioned as a distinctive strategy by McClure 2001) and morphosyntactic. The first can be discarded as a criterion because it has been demonstrated that both code-switching and borrowing forms may exhibit a certain degree of phonological adaptation (loans do not necessarily show complete phonological adaptation (Poplack 1990)). From a morphological point of view, both types undergo the same processes but borrowings show a greater degree of integration than switches (Scotton 1992). It is, then, a question of degree.

Another criterion mentioned by scholars working in the field of language contact phenomena is the so-called ‘Frequency Hypothesis’. Code-switching forms are considered ephemeral and non-recurrent; frequently repeated forms gradually become more or less stable loans. This is the view maintained by those who contend that the two forms occur at the beginning and end of a continuum (Scotton 1993, Gardner-Chloros 1987, 1995, Backus 2001) as mentioned earlier. Absolute and relative frequencies of occurrence are not useful in distinguishing code-switching and borrowing in all cases.

Gardner-Chloros (1995: 73–74) also proposes ‘native synonym displacement’ (both forms can fill the same lexical gaps) and grammatical category (nouns are the most common category in both cases, even though ‘all grammatical categories are potentially borrowable’) as other partially reliable criteria to differentiate both phenomena.

Other scholars such as Erica McClure (2001) emphasise the socio-political meaning of code-switches uttered in particular situations. This author suggests some strategies to explicate the differences between code-switching and borrowing forms: these strategies include the native speaker’s perception of each of these forms and the typographical devices used in writing.

To draw a line between code-switching and borrowing, Heller (1988a) also signals social conditions. We agree with Heller’s view (1988a: 11) that it is ‘unlikely that [...] codeswitching can be distinguished from borrowing or other language contact phenomena on purely formal grounds’. Therefore, it may be useful to explore some ‘social’ considerations. We contend that code-switching is a communicative resource which authors/speakers use in a conscious way whereas borrowing, precisely because it is more integrated in the language, is unconscious (in this way it favours change from below

² Cf. Labov 1972, Romaine 1989, Scotton 1992, 1993.

in the Labovian (1972) sense). Likewise, we agree with Scotton's conception (1983, 1988) of code-switching as a socially marked, in-group strategy.

From a pragmatic standpoint, Backus (2001) holds that the more specific the referential meaning of a form is, the more likely it is to be selected as a switch. A high level of specificity conveys awareness of lexical selection on the speaker/writer's part. Words or expressions that occupy certain syntactic positions (subject complement, for instance) can themselves become the focus of a communicative exchange. These semantically and pragmatically loaded forms are ideal candidates for switches. Backus also points out that in language contact situations culturally marked items or stretches of language are difficult to translate and taken directly from the source language to fill gaps, bringing with them the connotational information of their original language. In this sense, switching implies a common background knowledge which helps readers/speakers to place switch users within a particular social category (Gumperz 1982).

3. Corpus Material³

The texts we have used are part of the Mathematics sub-corpus of the *Coruña Corpus of English Scientific Writing*, a project which is being carried out in the University of A Coruña (Spain).⁴ This corpus extends from 1600 to 1900 and compiles scientific writing of various fields excluding Medicine. The samples chosen contain ca. 10,000 words each, all texts produced in the nineteenth century, belonging to the field of Mathematics. As compilation criteria we have removed all tables, formulae and graphs from the texts. Likewise, we have not included more than one text belonging to the same author in order to avoid the proliferation of idiosyncrasies. In this sense, we have followed some of the compilation principles of the *LAMPETER Corpus of Early Modern English Tracts*. We consider that the representativeness of the CC is improved by not including any translations and by resorting to first editions where available. Only English-speaking authors writing in English have been considered. However, we are conscious that many of them also knew Latin and this may have had an influence on their use of English.

For the present study we have collected samples belonging to 17 texts totalling 150,008 words. The list of texts surveyed is as follows:⁵

Year	Work	Words
1803	<i>The Principles Of Analytical Calculation</i> . By Robert Woodhouse	7,603
1811	<i>An Elementary Investigation of the Theory of Numbers, with Its Application to the Indeterminate and Diophantine Analysis, the Analytical and Geometrical Division of the Circle, and Several other Curious Algebraical and Arithmetical Problems</i> . By Peter Barlow	8,099
1815	<i>A Treatise of Plane Trigonometry. To which is Prefixed, a Summary View of the Nature and Use of Logarithms. Being the Second Part of a Course of Mathematics, Adapted to the Method of Instruction in the American Colleges</i> . By Jeremiah Day	8,598
1824	<i>An Elementary Treatise on Conic Sections, Spherical Geometry, and Spherical Trigonometry</i> . By Matthew R. Dutton	9,505
1828	<i>Application of the Preceding Results to the Theory of Electricity</i> . By George Green	9,674
1831	<i>A Treatise on Algebraic Geometry</i> . By The Rev. Dionysius Lardner	8,880
1836	<i>On The Study and Difficulties of Mathematics</i> . By Augustus De Morgan	9,426
1842	<i>An Elementary Treatise on the Differential Calculus, in which the Method of Limits is Exclusively Made Use of</i> . By The Rev. M. O'Brien	8,242
1849	<i>An Introduction to the Differential and Integral Calculus: with an Appendix, Illustrative of the Theory of Curves and Other Subjects</i> . By James Thomson	9,475

³ We are indebted to Mr. Gonzalo Camiña whose very conscientious gathering of data has helped us in the process of developing the research here reported.

⁴ The *Coruña Corpus* was first presented, together with some pilot studies, in the *Second Late Modern English Conference* held in Vigo (Spain) in November 2004.

⁵ Earlier texts show lower word-counts because they are often shorter and in bad condition and, therefore, only smaller samples could be obtained from them.

1850	<i>An Elementary Treatise on the Calculus of Variations.</i> By The Rev. John Hewitt Jellett	8,736
1855	<i>A Treatise on Trigonometry.</i> By George Biddell Airy	6,756
1863	<i>Chapters on the Modern Geometry of the Point, Line, and Circle; Being the Substance of Lectures Delivered in the University of Dublin to the Candidates for Honors of the First Year in Arts.</i> By The Rev. Richard Townsend	9,729
1876	<i>Elementary Arithmetic, With Brief Notices of its History.</i> By Robert Potts	9,812
1881	<i>The Theory of Equations: with an Introduction to the Theory of Binary Algebraic Forms.</i> By William Snow Burnside and Arthur William Panton	7,876
1889	<i>A Treatise on Spherical Trigonometry, and its Application to Geodesy and Astronomy, with Numerous Examples.</i> By John Casey	9,698
1893	<i>An Elementary Treatise on Fourier's Series and Spherical, Cylindrical, and Ellipsoidal Harmonics with Applications to Problems in Mathematical Physics.</i> By William Elwood Byerly	9,705
1897	<i>A Brief Introduction to the Infinitesimal Calculus. Designed Especially to Aid in Reading Mathematical Economics and Statistics.</i> By Irving Fisher	8,194
Total number of words		150,008

As other authors have already mentioned ‘a corpus must be suited to its intended uses’ (Johansson 1995: 246) and apparently linguistic conclusions from small corpora are as valid as those drawn from larger ones, at least for some research topics (Nurmi 2002). This is why we consider our text selection is adequate and representative enough for the purpose of the present study.

4. Analysis of Data

The number of words collected from the corpus for the present study amounts to 150,008, of which 7,605 forms⁶ are lexical categories (nouns, adjectives and verbs)⁷ and Latin prepositional phrases (*ad infinitum*). The vast majority (4,037 representing 53.1%) of these lexical items and prepositional phrases come from other languages. These originally foreign forms can be said to be distributed in such a way that, according to some of the criteria already mentioned before, only 14 occurrences of all of them have been considered code-switches (0.18%) whereas the other 4,023 (99.65%) are borrowings. These counts are not surprising if we consider that borrowings can be regarded as the final stage of a gradual process in which switches are the first step. By the time the texts under survey were produced, scientific writing had long been established in England and the above-mentioned process was well advanced.

We have selected all expressions/phrases and lexical categories of Latin provenance to create our database. Of all loans (4,023), 73.27% (corresponding to 2,948 tokens) have a Latin origin. By ‘Latin origin’ we refer to terms directly taken from the classical tongue and not to those that could come into the language via French or any other intermediate language (*similar, republic, ignoring, impropriety, neutralise*). They are distributed as shown in table 1 according to the lexical class they belong to.

Table 1. Latin loans per lexical class.

Lexical class	Occurrences	%
Nouns	2,269	76.6
Adjectives	448	15.12
Verbs	224	7.56
TOTAL	2,941	73.10

⁶ We have decided to count tokens and not types because it is our aim to describe use as an indicator of nativisation of the acquired terms.

⁷ We understand “lexical category” in the sense proposed by Huddleston (1984: 50–51) to refer to ‘classes as well as functions and systems and terms in systems’. In our particular case, adverbs have been disregarded because the number of occurrences is not significant (99 instances).

Our data show that nouns clearly outnumber the other two categories. This could be explained in two different ways. First, as Bernsten (1990: 76, quoted in Scotton 1993: 170) found in her analysis of the *Zimbabwe Corpus*, ‘nouns are typically most common, reflecting the high percentage of signifiers for new objects and concepts’. This could be precisely the case in research papers and scientific writing in general since the register/text type is directly related to the naming of new objects and the expression of ideas. Second, as Sager, Dungworth and MacDonald (1986) claim, nouns are typically found in those pieces of discourse in which not actions, but the transmission of ideas is intended (as is again the case of the scientific register). In this respect, individual lexical items may become register markers in a topically-restricted register (Biber 1995).

However, contrary to the findings of Scotton (1993) and Sager *et al.* (1986) who argue that verbs are normally second in frequency after nouns, our survey of mathematical texts reveals that the occurrence of adjectives exactly doubles that of verbs (224 verbs vs. 448 adjectives) and occupies the second position. The descriptive nature of scientific texts could account for this relatively abundant presence of adjectives. The predominance of borrowings, however, must be relativised since though we have many occurrences, they correspond to only 134 lemmata. This can be explained by the fact that we often find in 19th century mathematical texts cases of repetition like that in example (1) below with the term *hyperbola*. Probably the scarcity of pronouns and deixis in general to avoid inaccuracy is one of the causes of such repetition.

(1) Hyperbola.

(Dutton 1824: 5–7; marginal notes are not included in the example)

7. If the cutting plane makes with the base of the cone an angle greater than that made by the side of the cone, the section is called an **Hyperbola**; as ACD.

The cutting plane in this position will never meet the opposite side of the cone in the direction of V K, but it will meet it produced, on the other side of V, and if all the sides of the cone be supposed to be produced through the vertex V, forming an opposite and similar cone, and if the plane also be produced cutting this cone in the section Bcd, the two sections ACD and Bcd are called *Opposite Hyperbolas*.

8. If there be four cones, the angles at those vertices are together equal to four right angles; and if their axes be all placed in one plane and their vertices all meet in a given point V, the sides of the cones will touch each other in the right lines LVF, BVH. If a plane perpendicular to that in which the axes of the cone are placed, and parallel to O P, the axis of the two cones BVL FVH, cut these cones in the opposite **hyperbolas** AD Bd; if another plane, also perpendicular to that in which the axes of the cone are placed, pass through A or B parallel to KVM, the axes of the remaining cones, cutting opposite **hyperbolas** in these cones, these two pairs of opposite **hyperbolas** are mutually *conjugate* to each other. The two sections are commonly supposed to be placed in the same plane, the lines AB and *ab* bisecting each other, as in fig. 7.

If the angle at the vertex of each of the cones, (fig. 6) be a right angle, the cones will all be equal and similar, and the sections, being at the same distance from the vertex, will be equal and similar, and AB will be equal to *ab*; in this case they are called *Equilateral Hyperbolas*, and may be all cut by one plane, parallel to that in which the axes of the cones are placed; as represented in fig. 7.

9. As the properties of the triangle and circle are demonstrated in the Elements of Euclid, and are investigated without any reference to the sections of a cone, they are not usually reckoned among the conic sections; —this term being appropriately applied to the three remaining sections, —viz. the Parabola, Ellipse and **hyperbola**.

10. The *Vertices* of a conic section, are the points where the cutting plane meets the opposite sides of the cone; or the sides of a vertical triangular section through the axis of the cone, and perpendicular to the plane of the given section. In the Parabola, the plane does not meet the opposite side of the cone VH., This section therefore has but one vertex, as A. The Ellipse has two vertices, and opposite **hyperbolas** have two; as AB.

11. The *Transverse axis*, is the straight line which connects the vertices; as AB. This definition is applicable to the Ellipse and opposite **hyperbolas**, but not to the Parabola which has but one

vertex. The *axis* of the Parabola, may be defined, the intersection of its plane with that of the vertical triangular section to which it is perpendicular. This definition is applicable to all the conic sections, since it evidently coincides with that before given for the Ellipse and **hyperbola**. The line of their mutual intersection passes through the vertex of the Parabola and is of indeterminate length; since the section itself may be indefinitely continued.

However, this repetition can be more safely viewed as an attempt to achieve lexical cohesion in texts in which communicative conditions are more difficult (Tanskanen 1995: 537) or may be due to some other functional reasons typical of academic writing.

According to Scotton's (1993) classification, the borrowings we have found in our corpus can be divided into cultural and core borrowings: the former are widely used by speakers, the latter are commonly restricted to this genre. Whereas core borrowing forms represent apparently unnecessary loans which are adopted from other languages (despite the fact that an approximate equivalent may exist in the recipient language), and which can be found in registers other than scientific, cultural ones are those introduced into the recipient-language to designate new concepts, objects or processes. Table 2 displays the distribution of such forms in our texts so that, according to our data, 37 of the 134 lemmata that we have found can be considered core borrowing forms. These 37 different lemmata occur 303 times, that is to say 10.27 % of the total occurrences found.

Table 2. Distribution of core and cultural borrowings.

	Lemmata	Occurrences	%
Core	37	303	10.27
Cultural	97	2,645	89.73

Among all core borrowings, four deserve mentioning due to their high frequency as can be seen in table 3 below:

Table 3. Core borrowings found in the CC mathematical texts.

Lemma	Occurrences	%	Existing lemma
TRANSVERSE	56	18.48	CROSSWISE
CONTACT	51	16.83	TOUCH
INDICATE	44	14.52	POINT, SHOW
CENTRE/AL	22	7.26	CORE

In all, 89.73% of the Latin occurrences in our texts correspond to cultural borrowings, including within this group those terms that show some kind of stylistic difference. That is to say, we have considered that terms such as *curve* or *oblate* are cultural borrowings because, though certain more or less equivalent terms already existed in the English language (let us think of *bend* and *flattened*) there is a clear shade of meaning, a stylistic difference that makes us regard them as cultural (they would probably be never used in registers different from the scientific/technical one) and they are, in that sense, indexical of markedness as well.⁸

As a matter of fact, text-type or register restrictions could be operating (though not consciously) in the selection of loans and thus explain why cultural forms outnumber core ones in a very significant way.

As for code-switching, the 14 occurrences we have encountered in our survey correspond to 6 different lemmata. This low frequency may indicate that code-switching is not as integrated in the language as borrowing (it is the beginning of the process). All the cases we have considered as switches

⁸ A similar phenomenon can be traced even in languages directly descending from Latin. In Spanish, for instance, native/core vocabulary underwent all the corresponding morphological and phonological changes, whereas other items taken from Latin from the Late Middle Ages onwards are regarded as cultural and have clear specific uses (*fabular-hablar* (to tell stories-to speak); *vindicar-vengar* (vindicate-avenge); *monedero-monetario* (purse-monetary)).

are not single lexemes but phrases (*ad libitum, ad infinitum, in embryo*). This seems to be in accordance with Poplack's (1990) claim that code-switching involves more than single-lexeme forms whereas borrowing tends to prefer single lexemes. Since another criterion mentioned by scholars is related to morphological adaptation, we have considered that Latin phrases like the ones found in our samples have not undergone such an adaptation so as to call them loans as illustrated by the maintenance of *ad* in the above examples or in *reductio ad absurdum*.

The type of phrase that switches constitute may be also revealing. In our particular case, and unlike in earlier periods of the language, all the switches collected but one are prepositional phrases. This may be related to the claim that peripheral clause constituents are more amenable to be uttered as switches than central ones. This seems to coincide with Muysken's (1995: 180) view of intra-sentential code-switching as alternation, 'when the switched element is at the periphery of an utterance'. Example (2) illustrates the use of one of these prepositional phrases:

- (2) This process should be thoroughly mastered by the student, for it contains, **in embryo**, the whole of the Infinitesimal Calculus.

(Fisher 1897: 13)

One of the features that may be used to distinguish code-switching from other contact phenomena is that 'it contributes to the definition of roles and role relationships at a number of levels' (Heller 1988a: 1). Therefore, code-switching must be viewed as a social process, a communicative resource to mark social differences. In academic writing, we should specifically refer to cultural/educational level boundaries and such boundaries are established on the grounds of the linguistic conventions shared by the participants in the communicative process ('in-group strategies' in Poplack's (1980) terms).

Our survey of code-switching and borrowing from Latin in 19th century academic texts can be compared to language shift two centuries earlier. When Newton wrote his *Philosophiae naturalis principia mathematica* Latin was used as an in-group strategy. He was writing in the language of learning and culture. In the 19th century, after the abandonment of Latin as the language of academic writings, switches became one of these strategies of in-group markedness. They endowed the native language with prestige. Though his *Optiks* was written in English we can see that the language lacks all those features characteristic of a specific register and, part of which, depends on lexical selection.

5. Conclusions

Specificity is an indicator of modern scientific writing (Taavitsainen *et al.* 2002). In this sense, the lexicon plays a crucial role (2002: 263). We have seen that borrowings represent 53.1% of all the lexical forms selected, whereas code-switches represent 0.18% and Latin is the prevailing etymological origin of all borrowings (73.27%). In the same vein, the whole 14 switches found in nineteenth-century mathematical texts come from Latin and must be regarded as an indicator not only of the above-mentioned specificity but also as one of complicity between writer and reader.

There is no doubt that borrowing and code-switching have played different roles throughout the history of English. In the Middle Ages and the Renaissance Latin structures were abundantly introduced in vernacular academic writing. Each of the languages in contact had a different function and a particular value. Our data seem to prove that when Latin was dismissed as the language of scientific writings, Latin switches remained as discourse organisers in English (Schendl 2000, Pahta 2004). The gradual displacement of the classical language meant that its remnants were used in a more formulaic way until only some fossilised expressions known by academic circles were left. This in-group markedness may be independent of referential context (Scotton 1988: 152). If this is so, and considering lexicon as indexical of markedness, future research could precisely revolve around the issue of markedness and code-switching in texts of a scientific nature according to the academic level, more or less informative.

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