

## Morphological Objects

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The inflectional component of the morphology of Irish verbs, as expressed in various grammar books, is modelled using the methods of the object-oriented paradigm. These methods facilitate the creation of the inflected form of the verb and the generation of a computer assisted language learning (CALL) system. In this CALL system the methods are a vehicle for generating exercises and explanations of how to determine inflected forms.

### KEYWORDS

morphology, object-oriented technology, computer assisted language learning, Irish language

### INTRODUCTION

A morphological analysis identifies the set of minimal meaningful units called morphemes which constitute words and specifies the constraints on the relative order of morphemes in a word. Bloomfield (1933) defined a morpheme as "a linguistic form which bears no partial phonetic-semantic resemblance to any other form."

Object orientation, or the object oriented approach, views the world as a set of autonomous agents termed objects, rather than procedures, that collaborate to perform some higher level behaviour (Tello, 1989). The object oriented approach utilises encapsulation, classification, and inheritance (Booch, 1991).

An object has state (static and dynamic), behaviour (respond to actions), and can be uniquely identified. Objects that have similar structure and behaviour are defined in a common class. The actions that are defined for an object or class are termed methods (Booch, 1991), for example, the operations or methods that may be applied to the class called *file* include *open*, *close*, and *delete*. Objects communicate by passing messages which are requests to execute a method, such communication can be unidirectional or bi-directional.

Object oriented technology concepts were adopted in determining the structure for the electronic version of a monolingual Irish dictionary (McElligott and Ó Néill, 1993). The dictionary at the core of this work was *An Foclóir Beag* (Roinn Oideachais, 1991). The work presented here was prompted by the fact that this dictionary contains very limited information pertaining to verbs.

This analysis of regular verbs involves determining for each root form its conjugation, assigning it a class, and applying the rules pertaining to this class, in order to generate the various forms for each tense and mood where appropriate. The morphological rules are a combination of the concatenation of morphemes and other operations. The representation method chosen for these rules facilitates: (a) the separation of linguistic knowledge from program detail, (b) the explanation of word-formation and word-variation principles and (c) the generation of answers to exercises together with an explanation of these suggested solutions.

### MORPHOLOGICAL CONSIDERATIONS

Morphology can be subdivided into two primary fields: inflectional morphology and derivational morphology. The primary concern of this work is the inflectional aspect that studies the manner in which words vary to express grammatical contrasts in sentences (Anderson, 1988).

Generally, inflecting a word does not change its syntactic category. The inflections of a word are dependent on the category. Typically, inflections are subgrouped into what are known as morphological classes. In some languages some parts of speech are put into subgroups, for example, nouns are grouped into declensions and verbs are grouped into conjugations. In Irish verbs inflect for number, person, mood, tense, and voice. There exists a root morpheme for each verb followed by a conjugational marker referred to as a theme or extension. The purpose of the theme is to establish a base on which to attach the inflectional desinences and to define the separate morphological classes. A paradigm in this domain of linguistics is the term given to a set of grammatically conditioned forms all derived from a single root or stem (Spencer, 1991).

There are two consonantal groups, broad and slender. Changing the quality of the ending consonantal cluster is used extensively for inflection in Irish. Replacing a broad consonantal cluster with a slender one is termed attenuation (*caolú*), for example, in *bád* the *d* is broad unlike *báid* where the *d* is slender, indicated by the addition of the slender vowel *i* (see Notes 1 and 2). Attenuation is represented in various ways, primarily, by placing the slender vowel *i* between the broad vowel and the consonant, for example, *bás* → *báis*. Another means is by removing the broad vowel that precedes the consonant and assigning a slender vowel to its place, for example, *éan* → *éin*. Replacing a slender consonantal cluster with a broad one is called broadening (*leathnú*), for example, *cuir* → *cur* (see Note 2). Syncopation (*coimníú*) is the omission of one or more letters from the body of a word, for example, *imir* → *imríim*. "More technically, the terms velarised and palatalised are used for broad and slender respectively" (Roinn Oideachais, 1986).

The rules that will be described below demonstrate the inflectional component of morphology. An attempt is made to show how these rules can be used to process

regular verb forms thus illustrating the inflectional aspect of morphology.

## CHARACTERISTICS OF VERBS

As previously stated, verbs in Irish are inflected for number, person, mood, tense, and voice. There are three persons singular and three persons plural. The conjugations in Irish are achieved by a combination of synthetic and analytic verb forms. Synthetic verb forms are those which express action + person + number in one word, for example, *bhrisfinn* (*I would break*). Analytic verb forms are those which need personal pronouns to express person and number, for example, *bhris sé* (*he broke*). Generally, in modern Irish, there are four tenses and three moods as follows:

| Tenses   | Moods  |
|--|--|
| - present tense ( <i>aimsir láithreach</i> )   | - conditional mood ( <i>modh coinníollach</i> )                      |
| - past tense ( <i>aimsir chaite</i> )          | - imperative mood ( <i>modh ordaitheach</i> )                        |
| - habitual past ( <i>aimsir ghnáthchaite</i> ) | - present subjunctive mood<br>( <i>modh foshuiteach láithreach</i> ) |
| - future tense ( <i>aimsir fháistineach</i> )  |  |

There are two voices to be considered, active and passive, in the former the subject does the acting whereas the subject is acted on in the latter. The passive form, usually referred to as the autonomous form in Irish grammar, is the verb form that expresses the verbal action without any mention of subject, person, or number, for example, *tógтар* (*it is taken*).

A special form of the verb that is declined and treated in every way like a noun is called the verbal noun (Mac Giolla Phádraig, 1953). The verbal adjective describes a state resulting from an action, for example, *Tá an bord briste* (*The table is broken*).

In an inflectional system verbs may be classified into regular, irregular, and defective. A verb is regular if it retains the same root in all tenses and moods. Regular verbs are categorised into two conjugations, first conjugation and second conjugation. The general attributes pertaining to first and second conjugation verbs are as follows: (Ó Murchú and Ó Murchú, 1990)

#### First Conjugation

- polysyllabic roots ending in *áil*
- those with monosyllabic roots, for example, *bris*, *dún*
- some other polysyllabic verbs

#### Second Conjugation

- polysyllabic roots ending in *(a)igh*
- polysyllabic roots ending in *(a)íl*, *(a)in*, *(a)ír*, and *(a)is*
- some other verbs

Regardless of conjugation, the initial consonant of all forms of regular verbs is lenited in the past tense, in the conditional mood, and in the imperfect tense with the exception of the autonomous form in the past tense. A verb whose initial letter is a vowel is prefixed with *d'* and a verb whose initial letter is *f* is lenited (see Note 3) and prefixed with *d'*, for example, the past tense first person singular of *ól* (*drink*) is *d'ól mé* (*I drank*) and for *fág* (*leave*) is *d'fhág mé* (*I left*).

Another trait of commonality regarding these conjugations is in their formation of the first, second, and third persons singular and plural in the past tense together with the second person singular in the imperative mood. The analytic form has added to it the pronouns *mé/tú/sé/sí/sibh/siad* once the initial consonant has been lenited in the past tense, whereas the second person imperative is the same as the root form (*fréamh*) (McGonagle, 1991).

## CLASS AND RULE STRUCTURES

In the approach taken here classes have been applied to words. A word is a class and its associated parts of speech are subclasses. Classes and subclasses may have methods associated with them. Methods at the lower levels of a subclass override the methods previously specified at the class or subclass level, for example, the class word contains the subclasses noun, verb, and so forth. Each subclass is further subdivided to allow for the morphological classes within a part of speech, for example, the morphological classes for regular verbs are termed conjugations (cf. figure 1).

*class: word*

*methods: applicable to all words*

...

*subclass: verb*

*methods: applicable to all verbs*

*subclass: regular verbs*

*methods: applicable to all regular verbs*

*subclass: first conjugation verbs*

*methods: applicable to all first conjugation verbs*

...

Figure 1 Application of Object-Oriented Terminology to Words

Desinences for regular verbs usually depend on whether the root form ends in a broad or slender consonant and on the associated conjugation of the verb, for example, the desinences of first conjugation verbs in the present tense where the root ends in a broad consonant or a slender consonant are as follows:

| Uatha/Ioira<br>Singular/Plural | Broad<br>Consonant | Slender<br>Consonant |
|--------------------------------|--------------------|----------------------|
| 1u:                            | aim                | im                   |
| 2u: 3u: 2i: 3i                 | ann                | eann                 |
| 1i:                            | aimid              | imid                 |
| sb:                            | tar                | tear                 |

Some characteristics exist for all parts of speech whereas others are common to a specific part of speech or to a subclass therein. In relation to regular verbs the characteristics common to all classes are specified as follows:

**subclass:** regular verbs

**methods:** Past Tense

|                                |                               |
|--------------------------------|-------------------------------|
| 1st person singular:           | <i>fréamh, séimhiú + mé</i>   |
| 2nd person singular:           | <i>fréamh, séimhiú + tú</i>   |
| 3rd person singular masculine: | <i>fréamh, séimhiú + sé</i>   |
| 3rd person singular feminine:  | <i>fréamh, séimhiú + sí</i>   |
| 2nd person plural:             | <i>fréamh, séimhiú + sibh</i> |
| 3rd person plural:             | <i>fréamh, séimhiú + siad</i> |

**Imperative Mood**

|                    |               |
|--------------------|---------------|
| 2nd person plural: | <i>fréamh</i> |
|--------------------|---------------|

...

**subclass:** first conjugation verbs

**methods:** applicable to all first conjugation verbs

...

Figure 2 Methods Common to the Subclass of Regular Verbs

Since regular verbs take on various desinences, the subclass of first conjugation and second conjugation verbs have been further subclassified. Some of these subclassifications are explicitly enumerated. This analysis resulted in eighteen subclasses for first conjugation regular verbs and seven subclasses for second conjugation regular verbs (cf. Figure 3a and Figure 3b). It is possible to combine some classes, for example, the subclasses 1 and 2 of second conjugation verbs only differ in whether the root form has a broad or slender ending, that which in turn determines whether the desinence is broad or slender.

The methods pertaining to the rules are: attenuation, broadening, lenition, syncopation as previously stated, and another to deal with the notion of words ending in *th* or *t*. A general rule pertaining to verbs regardless of class is that when a verb ending in *t* or *th* takes on a desinence that begins with *t* the combinations *tt* or *tht* become *t*, for example, *ith + tear* → *itear* (The Christian Brothers, 1990). As well as methods the rules contain the

mathematical operators + and - for the addition and deletion of one or more characters respectively. A rule is interpreted from left to right, for example, the rule *fréamh, séimhiú - igh + íodh* translates to:

|                |   |  |
|----------------|---|--|
| <i>fréamh</i>  | : | get the root form of the verb                      |
| ,              | : | is a delimiter, no changes resulting               |
| <i>séimhiú</i> | : | apply the method for lenition                      |
| <i>-igh</i>    | : | remove <i>igh</i> from the end of the lenited form |
| <i>+íodh</i>   | : | concatenate the ending <i>íodh</i>                 |

| Sub-class      | Attributes            | Ending                                  | Examples  |
|----------------|-----------------------|---|---|
| 1              | verbs of one syllable | <i>áigh/eoigh/iaigh/uaigh/óigh/úigh</i> | <i>báigh/reoigh/iaigh/uaigh/clóigh/úigh</i>   |
| 2              | verbs of one syllable | <i>éigh</i>                             | <i>pléigh</i>   |
| 3              | verbs of one syllable | <i>igh</i>                              | <i>maigh</i>  |
| 4              | verbs of one syllable | <i>igh</i>                              | <i>nigh</i>   |
| 5              |                       | <i>áil</i>                              | <i>sabháil</i>  |
| 6 <sup>1</sup> |                       |   | <i>adhlaic, argóin, ceiliúir, dí-adhlaic, diúraic, eisachaid, fóin, gearáin, fothraig, iomlasc, seachaid, síúil, stúir, taispeáin, tloaic, tionlaic, tionóil, tochais, tuaslaig, urlaic</i> |
| 7              | monosyllabic          | broad vowel                             | <i>dún</i>  |
| 8              | monosyllabic          | slender vowel                           | <i>bris</i>   |
| 9              |                       |   | <i>adhain, adhair, gleadhair, leadhair</i>  |
| 10             |                       |   | <i>deighil, faighid, feighil</i>  |
| 11             |                       |   | <i>fuirsih</i>  |
| 12             |                       |   | <i>agail, bailc, braich, buain, comhail, maidhm, teasairg, tiomairg, tuiin</i>  |
| 13             |                       |   | <i>aisig</i>  |
| 14             |                       |   | <i>sleabhaic</i>  |
| 15             |                       |   | <i>diongaibh</i>  |
| 16             |                       |   | <i>innil</i>  |
| 17             |                       |   | <i>tadhail</i>  |
| 18             |                       |   | <i>tafainn</i>  |

Figure 3a Subclasses of First Conjugation Verbs<sup>2</sup>

<sup>1</sup> Subclasses 6, 9-18 of the first conjugation and subclasses 5 - 7 of the second conjugation are explicitly enumerated subclasses.

| Sub-class | Attributes   | Ending                    | Examples  |
|-----------|--------------|---------------------------|---|
| 1         | polysyllabic | <i>aigh</i>               | <i>tosaigh</i>  |
| 2         | polysyllabic | <i>igh</i>                | <i>dúisigh</i>  |
| 3         |              | <i>il/in/liris</i>        | <i>coigil/aithin/aifirinis</i>  |
| 4         |              | <i>aill/aillt/ain/air</i> | <i>codail, oscailt, cogain, agair</i>                                     |
| 5         |              |                           | <i>aithris, díolaim, foghlaim, fulaing, tarraing, tharraing, tuirling</i> |
| 6         |              |                           | <i>lorg</i>   |
| 7         |              |                           | <i>freastail, taistil</i>   |

Figure 3b Subclasses of Second Conjugation Verbs<sup>2</sup>

The rules as specified for the future tense of subclass 1 of first conjugation verbs are as follows:

#### Aimsir Fháistineach (Future Tense):

##### subclass1:

1u/2u/3uf/3ub/2i/3i: fréamh - igh + faidh + mé/tú/sé/sí/sibh/siad  
 1i: fréamh - igh + faimid  
 sb: fréamh - igh + far

From section 4, an example of a verb in this classification is *dóigh*. Applying these rules to this root form yields the following:

**Rule:** 1u/2u/3uf/3ub/2i/3i: fréamh - igh + faidh + mé/tú/sé/sí/sibh/siad  
**Application:** *dóigh - igh + faidh + mé/tú/sé/sí/sibh/siad*  
*dófaidh mé/tú/sé/sí/sibh/siad*

**Rule:** 1i:  
**Application:** *fréamh - igh + faimid*  
*dóigh - igh + faimid*  
*dófaimid*

**Rule:** sb:  
**Application:** *fréamh - igh + far*  
*dóigh - igh + far*  
*dófar*

<sup>2</sup> Subclasses represent variations in inflected forms in one or more of the tenses or moods.

## EXPLANATION OF WORD-FORMATION AND WORD-VARIATION PRINCIPLES

As well as illustrating word-formation and word-variation principles these rules are used to explain suggested solutions to exercises.

|   |   |   |            |
|---|---|---|------------|
| <b>Ainm Briathartha/<br/>Verbal Noun:</b>           | tógáil                                  | <b>Fréamh/Root:</b>                                   | tóg / take |
| <b>Aidiacht Bhriathartha/<br/>Verbal Adjective:</b> | tógtha                                  | <b>Réimniú/Conjugation:</b>                           | 1          |
| <b>Aimsir Fháistineach/<br/>Future Tense</b>        | <b>Cabhair/Help</b>                     |   |            |
|   | Faigh an fhreamh tóg / get the root tóg |   |            |
| 1u:   | tógfaidh mé                             | Cuir leis an fhoirm thuas an fhoirceann 'faidh'       |            |
| 2u:   | tógfaidh tú                             | Úsáidtear an fhoirm seo le: mé tú sé sí sibh siad     |            |
| 3uf:  | tógfaidh sé                             | / append the ending 'faidh' for mé tú sé sí sibh siad |            |
| 3ub:  | tógfaidh sí                             |   |            |
| 1i:   | tógfaimid                               | Cuir leis an fhoirm thuas an fhoirceann 'faimid'      |            |
| 2i:   | tógfaidh sibh                           | Úsáidtear an fhoirm seo don chéad phearsa iolra       |            |
| 3i:   | tógfaidh siad                           | / append 'faimid' for 1st pers. plural                |            |
| sb:   | tóghfar                                 | Cuir leis an fhoirm thuas an fhoirceann 'far'         |            |
|   |   | Úsáidtear an fhoirm seo don saorbhriathar             |            |
|   |   | / append 'far' for the passive                        |            |

Figure 4 Example of Exercise and Explanation Facility

The student can choose which verb, tense and so on to work on or get the system to do the selecting. Usually, the verbal noun, verbal adjective, the root form and conjugational class are displayed. The user may choose to complete the exercise on her or his own or have the system automatically complete the task. If the former option is taken the individual enters the first, second, and third persons singular and plural together with the autonomous form of the verb or if a form is unknown the enter key is pressed. The system alerts the student to any errors in the exercise. The system can give an explanation (in Irish or English) of how the task at hand should be completed (cf. figure 4).

## SUMMARY

In this work knowledge about morphological constituents is expressed in the form of objects and the inflectional processes are viewed as methods. The relationships that hold between these methods are represented as rules covering the morphology of regular verbs. The approach presented here allows for the naming of methods which assists with illustrating the inflectional aspects of morphology together with the generation of a CALL system.

In this instance the rules were applied to regular verbs but the approach could be applied to other parts of speech, syntactic constructs, and possibly other natural languages.

## Notes

1. Vowels in Irish are classified into broad and slender. The elements of the broad set include the letters *a*, *o*, and *u* with the slender set having the members *e* and *i*. The elements of these sets may be accented or unaccented. In Irish an accented character is denoted with a stroke or length accent over the particular letter which is termed a *síneadh fada* giving *á*, *é*, *í*, *ó*, and *ú* appearing in lowercase and uppercase. In addition, the combination *ae* is considered to be a member of the set of broad vowels.

2. Consonants may have a broad or slender quality. A consonant or group of consonants are broad if the neighbouring vowel is broad, for example, in *doras* the consonants are all broad. Similarly, a consonant or group of consonants are slender if the neighbouring vowel is a slender vowel, for example, in *deifir* all consonants are slender. If a consonant or any combination of consonants comes between two vowels they are usually either slender or broad, for example, in *so/as* the *o* and *a* are broad and in *tinneas* the *i* and *e* are slender. This forms the basis for a generally accepted rule in Irish orthography that is stated as *caol le caol agus leathan le leathan* (*slender with slender*

and broad with broad). In order to comply with this rule changes must be made in order to achieve agreement that can be summarised as:

- \* the broad vowel is made agree with the slender vowel
- \* the slender vowel is made agree with the broad vowel
- \* the vowel before the consonant is changed
- \* the vowel after the consonant is changed (Joyce, 1920)

3. Lenition, commonly termed aspiration in grammar books on Irish written in English, is a system that modifies the sound of consonants. The consonants *b*, *c*, *d*, *f*, *g*, *m*, *p*, *s*, and *t* are subject to lenition and are called the mutable or aspirable consonants. Lenition is marked in Gaelic type by placing a dot (·) over the lenited consonant and in Roman type by placing *h* after the aspirated consonant, for example, *bh*. If *s* is directly followed by any of the letters *c*, *f*, *m*, *p*, *t*, or *v* no lenition occurs (Ó Murchú and Ó Murchú, 1990). Eclipsis is similar to lenition in that certain letters are suppressed and other analogous sounds substituted. The characters *b*, *c*, *d*, *f*, *g*, *p*, *s*, and *t* are eclipsed by *m*, *g*, *n*, *bh*, *n*, *b*, *t*, and *d* respectively. Vowels may be prefixed by *n*, *h* or *t*. While the letter being eclipsed and the letter forming the actual eclipsis are written it is only the eclipsing letter that is sounded, for example, *a mbád* is pronounced a *mád*.

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## The Status of Scottish Gaelic in Scotland\*

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Although it is too early to predict a permanent resurgence for Scottish Gaelic, recent developments have been encouraging. Employment opportunities for Gaelic speakers are better; government support for more Gaelic television, radio, and the arts has increased; and, most important of all, there has been an increase in the last two years in the number of Gaelic learners, including the number of Gaelic-medium playgroups and elementary schools and the overall number of young adults and teenagers claiming some level of Gaelic skill. Although absolute numbers are still relatively small, percentages of increase are very large (doubling in some cases), and the enthusiasm of participants is quite high.

"Tha Gàidhlig beo!" ('Gaelic lives!')—motto, *An Comunn Gàidhlig*

### AN OVERVIEW<sup>1</sup>

The bad news is that only 1.45% of the population of Scotland spoke Gaelic at the time of the 1991 census, many (not surprisingly) elderly. The number of fluent speakers was still decreasing, and some long-standing, negative social and linguistic stereotypes still existed.

\* A shorter version of this paper was presented at the 1995 Annual Meeting of the Linguistic Society of America. The information contained in this paper may usefully be compared with similar earlier surveys (for example, Mackinnon, 1993; Thomson, 1981).