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Pygmalion in the classroom: a tool to draw lexicographic diachronic maps and their application to didactics

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1. Introduction

This contribution presents Pygmalion, a tool that facilitates the creation of interactive diachronic maps (Dell’Oro, 2020), and focuses on some of its possible applications to the didactics of languages and linguistics¹.

Pygmalion was conceived in the framework of the project *A world of possibilities. Modal pathways over an extra-long period of time: the diachrony of modality in the Latin language* (WoPoss). Although its initial conceptualisation was heavily influenced by the research questions of this project and, therefore, the visualisation of modality was a decisive feature, the tool was later redesigned for a

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broader use. In fact, to increase usability, we offer three different versions to better suit users' requirements.

The primary goal of Pygmalion is to provide scholars, teachers, and learners with an instrument to visually represent the heterogeneous diachronic linguistic information contained in lexicographic works. The conceptualisation of this type of resource raises a twofold objective: while we need to address the difficulties of designing a visualisation that illustrates complex concepts, such as semantic shifts and meaning relations, it is crucial to ensure the readability of the data through a user-friendly and intuitive tool.

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In the next section we outline a brief theoretical introduction to our concept of diachronic maps. In section 3 we describe Pygmalion and its applications to didactics from a methodological point of view. In section 4 we discuss different use cases to outline the versatility of the tool and its concrete applications to didactics. Finally, we draw some conclusions about Pygmalion as a lexicographic resource and its role in an educational environment (section 5).

2. Theoretical framework

A semantic map is a geometric representation of functions in the semantic space whose interconnections create a network (Haspelmath, 2003)². Semantic maps have proved their versatility to condense great amounts of information about semantic configurations, including aspects related to semantic shifts. Thus, a semantic map has an important instructional value due to its synoptic component.

Based on previous proposals (Hjelmslev, 1963; Lazard, 1981; Anderson, 1982; Traugott, 1985; Croft *et al.*, 1987; van der Auwera and Plungian, 1998; Haspelmath, 2003; François, 2008), our model manages to integrate the lexicographic aspect with the representation of the semantic relations: Pygmalion combines the traditional lexicographic practice of drawing diachronic maps with the cognitive and typological approach of drawing maps of functions. It is worth noting that our model also enables the representation of the meanings of a word or function integrating (and visually

² See Hjelmslev (1963) for a first conceptualisation.

differentiating) multiple languages.³ In fact, with respect to both the cognitive-typological and the lexicographic tradition, Pygmalion presents a number of innovative features:

1. From the point of view of the dimensions represented, our design focuses on the chronological facet. It allows the visual codification of exact years or broader time spans of the emergence and disappearance of a meaning. It also makes it possible to enrich the map with information concerning dating-related aspects such as the first preserved attestation of a meaning.
2. From the point of view of the visual representation, Pygmalion maps were conceived within the digital ecosystem. Taking advan-

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tage of this medium, our design includes visual cues that are activated by user actions. Another innovative feature of our design is that we offer two complementary visualisations of the semantic space: in one of them, the semantic space is activated from specific meanings and it becomes visible on the right side of the map (see section 3.1); in the second visualisation, the semantic space is configured thanks to a force directed algorithm (section 3.2).⁴

A diachronic map is a useful resource in historical linguistics, particularly with regard to the dissemination of results. However, this type of map can be used as well in an educational environment to transmit complex concepts in a didactic way thanks to its immediate and easy reading. We can envision linguistics students, namely from the domains of Historical linguistics and History of the language, as a target, but also L1 and L2 learners. Among other benefits, our interactive diachronic maps:

³ The combination of multiple languages in the same map is a feature also present in previous proposals; see François (2008) as an example.

⁴ Other projects concerned with visualisation and knowledge imparting have supported a double visual output as a means to better convey semantic information; see the case of seMap as an example (Nazemi et al., 2009).

1. summarise a lot of linguistic information without overwhelming the reader and by enabling the visibility of certain information by user demand;
2. lead to a faster cognition by enabling the method «learning by exploring» (Nazemi *et al.*, 2009). Thanks to the feature described above, learners can control the data they want to read at any given moment. The act of navigating and exploring the contents, requesting additional information by demand enhances the learning experience;
3. combine explicit and implicit knowledge and interpreting both types is proved to be relevant in word acquisition (Shtyrov *et al.*, 2019).

To our knowledge, there is no other tool specifically conceived for the drawing of diachronic maps. There is a noticeable scarcity of intuitive tools designed for creating the visualisation of linguistic phenomena. Nevertheless, there are noteworthy exceptions like Morfogen, devised for drawing lexical families while paying special attention to etymological information (Rodríguez-Espiñeira and López Arca, 2014).

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3. Methodology

3.1. Drawing a map with Pygmalion

Pygmalion is available in three versions: the basic version Pygmalion-simple 1.0 (Dell’Oro *et al.*, 2020a), Pygmalion-modal 1.0 (Dell’Oro *et al.*, 2020b) for the representation of modal meanings and Pygmalion-colour 1.0 (Dell’Oro *et al.*, 2021) for the representation of colour-coded analytical categories. All three versions of Pygmalion are available in open access. Pygmalion is highly flexible, and it can be applied to different concepts and teaching purposes. For instance, a map generated with Pygmalion can be used in a second language learners class, in order to illustrate the semantics of a word in a foreign language, such as the French word *carte* (see section 4.1); it can also provide a teaching support in a linguistics class, to explain how modality works, by following the semantic evolution in diachrony of a modal marker (see section 4.2); finally, it can be used to visually illustrate the semantic evolution of a Latin word into Romance languages (see section 4.3).

Pygmalion features an extremely user-friendly interface. In order to draw a map, users have to fill out two forms with the pieces of information they selected. Some fields are mandatory (M), others are optional (O). In the first form, the user indicates the etymology of the word (O); the type of chronological subdivision (M) that best fits their purposes (centuries, decades or specific years); the list of meanings or functions individuated for the word or concept to be illustrated in the map (M) and for each of them the date of emergence of that meaning or function (M); additional information about the listed meanings or functions (O). The last includes collocations and their specific meaning; the semantic group to which a meaning belongs or other types of grouping criteria that can be defined by the user; date of disappearance of a meaning or function; textual passages that attest the emergence of the meaning in question or other relevant information. Once the first form is submitted, a second one appears. This form concerns the relations between the meanings, or functions, previously added. The relation is established between pairs of meanings or functions, and it can be directed (options «from» or «to») or undirected. When the second form is submitted, the tool creates the map, which allows the visualisation of all the information entered in the two forms. It is important to underscore that the user can always encode some information as uncertain. This option applies to etymology, semantic analyses and relations between meanings. As one can see from the description of the two forms, a map can be customised and oriented according to the requirements of the user. This makes Pygmalion a valua-

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ble resource in a didactic perspective, where one has to take into account variables such as the type of content being taught, the prior knowledge of the learners, and their learning pace.

3.2. General outline of a map drawn with Pygmalion

All maps built with Pygmalion present a similar structure. We will describe in this section a general outline of a map, whereas the details of some specific examples will be illustrated in the relevant sections.

3.2.1. *An extended interactive map with chronological anchoring*

Above each map, a legend explains how to interpret the colours that are associated with the meanings/functions (if the user selected Pygmalion-colour or Pygmalion-modal). The colours refer to the analytical information included by the user on the meanings/functions illustrated in the map. In the maps described in section 4, different colours point to different base meanings for the same word (see section 4.1), types of modality (see section 4.2), or different languages (see section 4.3). However, the user can adjust this functionality to any purpose or analysis. If the user entered information about the etymology, this will result in an arrow divided in as many sections as the etymological steps encoded. Below the legend, there is a chronological bar that follows the subdivision type chosen by the user. The chronological span is defined by the dates of the first and the last attested meaning (to improve readability, the system automatically adds a further time slot to the latter). The meanings/functions individuated by the user are shown below the chronological bar, enclosed in arrows. Each arrow starts at the date of the emergence of the corresponding meaning/function. If its first attestation was included in the form, readers will be able to retrieve it by hovering over the relevant meaning/function. The visualisation of the map can be adjusted according to the needs of the reader, who can choose three sorting methods: the meanings or functions can be arranged in chronological order (option «Chronological»), by constructions or collocations (option «Constructions/Collocations»), or by a grouping criterion with the groups labelled as chosen by the user (option «Groups»). Finally, the reader can access the relations between meanings/functions by clicking on an arrow. All the arrows related to it will be selected and connected to their source or derivatives by an undirected line or an arrow that specifies the direction of the relations. If a semantic analysis or the etymology is flagged as uncertain in the first form, it will be enclosed in a dashed arrow; the same applies to relations between meanings, which will be represented by a dashed line or arrow.

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3.2.2. *A visual synthesis: the network graph*

Pygmalion offers a second visualisation: a network graph. The nodes consist of the meanings of the word and the edges are the semantic relations established between them. The background

colour of the node represents the chronological dimension (the darkest is the shade of blue, the most ancient the meaning is). The border colour of the node conveys the analytical category assigned to the meaning (e.g., type of modality). The edges can present two shapes: an arrow, if some type of direction was defined between two meanings, or a simple line, if no direction was specified.

4. Discussion of use cases

In this section we will illustrate some possible applications of Pygmalion maps to didactics. As the examples below will illustrate and as already hinted at, Pygmalion maps are interactive and meant to be actively used by learners to explore information in an autonomous way.

The use cases presented below can be applied, e.g., to L1 or L2 classes (see in particular 4.1) as well as classes on Semantics (see in particular 4.2) and Diachronic/Historical linguistics (see in particular 4.3).

*4.1. The display of semantic relations: the case of French *carte**

The bilingual map of the French word *carte* (Dell'Oro 2021a) is a pertinent example to illustrate how semantic groups can be visualised in a Pygmalion map and how they benefit L1 and, particularly, L2 learners in the acquisition of new meanings, collocations and idiomatic expressions. The map was created from a synopsis of the information contained in the etymological and historical section of the lemma *carte* as outlined in the monolingual dictionary *TLFi* (s.v. *carte*). In addition, information concerning the first attestation, as provided in the dictionary, was systematically included. Another –bilingual– version of the map is available at Dell'Oro (2021b) where the meanings are given in Spanish.

The feature that structures the map of *carte* is the classification of the meanings and uses of this word in three base meanings: «playing card», «map» and «piece of paper, cardboard». Colours are assigned to each one of these categories and, in addition, the sorting option «Groups» reorganises the map by grouping together the meanings that fall into each one of these three classes.

A map with this type of conceptualisation is especially advantageous in a language learning context. The categorisation of

the meanings in semantic groups gives the foundations upon which students can build more com-

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plex semantic relations between the different senses. For visual learners, the use of colours and spatial distribution provide cues that aid comprehension and memorisation.

Besides offering the possibility of grouping meanings, Pygmalion supports the display of semantic relations at a more granular level, as discussed in section 3. In the case of the map of *carte*, relations of derivation were included. This type of relations is helpful for learners because it conveys an intuitive way in which to organise polysemy.

Collocations and idioms are challenging for second language learners and thus their acquisition is used as an element to measure language proficiency (Yorio, 1989; Hubers *et al.*, 2020). The lemma *carte* is present in many collocations and idioms. One of the pieces of information we can retrieve from this map is whether a given collocation is associated with other meanings. For example, the meaning «restaurant menu» derives into the collocation *diner à la carte* («to eat *à la carte*, i.e. choosing from a list»). Together with this information, we can immediately see by virtue of the colour-coded categorisation that both of these meanings are grouped under the generic meaning «piece of paper, paperboard». We argue that the representation of these semantic relations based on derivation helps learners to better understand the meaning of the collocation and, consequently, to better acquire it. Another of the advantages of Pygmalion in regards to the representation of multiword expressions is the possibility to visually illustrate how a collocation becomes an idiom. Thanks to the diachronic map, we can examine how, for example, the expression *un château de cartes* goes from the metaphorical meaning «small, not very solid house» to the idiomatic meaning of «vain things».

Being a highly polysemic word, the diachronic map of *carte* covers a lot of information. However, the reader can navigate its contents and retrieve more specific and detailed information at will, which facilitates comprehension.

4.2. The outline of a modal marker and its relations with non-modal meanings: the case of Lat. *dubius*

In this section we will illustrate the map of the Latin adjective *dubius* «doubtful, uncertain» (Marongiu and Dell’Oro, 2021, 2022). *Dubius*, together with the adverbs *dubio*, *dubie*, *dubium* «doubtfully» and the noun *dubium* «doubt», can express epistemic possibility –intended here as the degree of certainty that a speaker wants to convey with regard to a state of affairs– and can be taken as an example in order to teach about the expression of

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(epistemic) modality in Latin.⁵ Modality is a complex topic and visualisation can help to introduce some of its facets.

The etymology of *dubius* is explained in a visual and intuitive way: it is represented as an arrow, divided in as many sections as the number of etymological steps. In this case, the first one is the Proto-Indo-European root **dui-bʰh₂u-o-* «double»; in Proto-Italic we encounter the form **du(i)-fwo-*; the resulting Latin form is *dubius*, -a, -um. The etymology clearly shows the basis on which the historical meaning «doubtful, uncertain» derives: what is double, it is also uncertain. All the meanings that are attested for *dubius* are then listed below the chronological bar. This type of arrangement in space is particularly valuable from a teaching perspective: it can help memorising both the various meanings of the word, and its semantic evolution along the temporal axis. *Dubius*, as many modal markers, includes both modal and non-modal meanings. Therefore, the map can be used to easily introduce the notion of polysemy. The meanings of *dubius* are in total 25, two of which have an epistemic modal value. These two meanings («it is uncertain» and «uncertain whether something exists/is true or not») are enclosed in green arrows, whereas grey arrows contain the remaining 23. The legend which precedes the map explains the use of the colours: green for epistemic modality and grey for non-modal meanings. As mentioned above, the use of colours helps to convey the information to learners, in this case to differentiate the types of modality and distinguish them from the non-modal meanings.

⁵ At the beginning of the map of *dubius*, the user is offered a direct link to the maps of the aforementioned lemmas related to it. However, for reasons of space we will concentrate here on the modal map of the adjective *dubius*.

As mentioned before, the context is extremely important in order to understand the presence or type of modality in a passage containing a modal marker. For this reason, a modal map built with Pygmalion allows the learner to access the relevant attestation for each modal or non-modal meaning.

The patterns of derivation in which the meanings participate are illustrated by the visualisation of the relations between them. This can represent an intuitive way of conveying in class a complex concept such as the semantic relations between the meanings of a modal marker, and between modal and non-modal meanings, adding the chronological perspective. For instance, when clicking on «it is uncertain», three other meanings will be selected: «anxious, concerned» (non-modal), «suspect, arous-

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ing mistrust» (non-modal), «uncertain whether something exists/is true or not» (modal, epistemic). While it is difficult to specify the relation between the meaning «it is uncertain» and the meaning «anxious, concerned», as they are attested in the same century (undirected line), the relation between the meaning «it is uncertain» and the other two meanings seem clearer (arrow).

Finally, the visualisation of the information represented in the map can be adjusted to specific learning purposes by using the aforementioned sorting methods. *Dubius* features only one collocation, *dubium est* «it is uncertain»: the epistemic meaning developed from this collocation, as it is clearly shown by the map. The reader can also choose to display the meanings according to a semantic criterion, by selecting the sorting method «Groups». This type of visualisation offers a systematisation which could facilitate the learning process, especially with a word such as *dubius*, which has a high number of meanings, compared to other modal markers. With this option, the meanings of *dubius* are organised in two semantic groups, labelled «in doubt, undetermined» and «raising uncertainty». The former includes meanings such as «anxious, concerned», «not steady, variable», «uncertain whether something exists or not»; the meanings «it is uncertain», «not to be relied on», «suspect, arousing mistrust» among others belong to the latter. All these varieties of meanings can be explored thanks to the selected passages visible in the arrows.

4.3. Comparing the semantic evolution of a Latin word into Romance languages: the case of Latin *filia* and its derivatives

The third use case outlines how Pygmalion maps can be used to illustrate and compare the evolution of cognate words inside a linguistic family (Dell'Oro *et al.*, 2021). The case in point is that of Latin *filia* and its evolution into standard French (*fille*), standard Italian (*figlia*) and standard Spanish (*hija*). We focus in particular on the fact that the French word has developed the meaning «girl, young woman», an innovation which is not shared with Italian and Spanish, as already noted in the relevant literature (e.g., FEW: s.v. *filia*, in particular p. 518). It should also be noted that the corresponding masculine French form *fils* did not follow the same semantic evolution as French *fille*. However, according to the consulted reference works, all three languages present a comparable evolution from the ancient meaning ‘daughter’ to the use of the word in vocative phrases connoted with affection towards the addressee. The history of the three Romance words has been simplified –many attested meanings are not present in

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the map and the possible influence of some Latin uses is not taken into account– in order to strictly focus on the didactic goal associated with this map. When strictly necessary, some meanings were added between square brackets.

The etymological section above the map shows that it is possible to set the basic meaning of «daughter» as common to the Italic languages (cf. the Proto-Italic thematic stems masculine *filio-* ‘son’ and feminine *filīā-* ‘daughter’), while the form can be traced back to a Proto-Indo-European adjective **d^h(e)h₁-l-* featuring a slightly broader meaning ‘suckling, child’.

The Romance derivatives of Lat. *filia* are attested at least by the x century for French (TLFi: s.v. *fille*), by the xii century for Italian (TLIO lemmario: s.v. *figlia*) and likely also for Spanish (CDH: lemma *hijo*⁶). The Pygmalion map allows us to show –e.g., to first-year learners of Romance philology– that the first meaning attested is not necessarily the base one of «daughter», while at the same time we can suppose that the later attested meaning «daughter» is the

⁶ Corominas (1984: s.v. *hijo*) has no entry for *hija* and only gives references for the most ancient attestations of the masculine form.

continuation of the Latin base meaning. The case in point here is that of the allegedly first French attestation which is associated with the meaning ‘female person considered with respect to her place of origin’ (in our map in square brackets, as not directly relevant for the semantic evolution we want to outline). This example shows that first attestations can be misleading, but the map helps to have a general overview of the diachronic facts.

The teacher (or the learner) can hover on the arrows and see under which specific form the word is attested for the first time with a certain meaning as well as the context of use (where this was available in the reference works). The teacher could use such instances, e.g., to illustrate the main phonological changes from Latin to the three Romance standard languages.

The map shows that all three languages know the extensive affective use of the word, especially in the vocative. This fact can be used to illustrate one type of semantic change: semantic broadening from a particular kind of «girl, young woman» (i.e. someone’s daughter) to a «girl, young woman» the speaker addresses in an affectionate way. When clicking inside an arrow featuring the meaning «daughter», it is possible to see a black arrow directed towards and entering the arrows associated with the

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meaning «girl, young lady (affectionate vocative)». The same can be seen in the network graph. The teacher may want to add some considerations of pragmatic nature concerning this extended use of the word⁷.

The map clearly shows that only in French the term took on the meaning of «unmarried young girl or woman». A step in this direction can be seen in the use of *fille* with the meaning «young

⁷ As is usually the case with linguistic data, however, things are not straightforward. Relying only on reference works, we weren’t able to find the first attestation of the use of French *fille* in the vocative with the meaning ‘girl, young lady’. We decided to put in the map the attestation of this use for French *fil*s (between square brackets). We suppose that the same happened for the feminine form. An early passage with a vocative phrase is attested later, though in a very specific (i.e. religious) context (therefore the use of square brackets).

girl» outside of vocative phrases. This use seems to characterise French and is attested at least from the xiv century.

The map outlines how it is possible to visualise in a clear way parallel phenomena in the diachrony of genetically-related languages as well as the complexity of some changes. It can be used in various ways in the classroom to illustrate diachronic semantics as well as to illustrate the limits and problems of the documentation.

5. Conclusions

In this chapter we outlined the conceptualisation behind the tool Pygmalion, the functionalities displayed by an interactive map drawn with it and subsequently the educational potential of Pygmalion maps by suggesting three use cases in which a teacher uses a Pygmalion map to introduce some content to the learners. However, it is important to underline two points. The first one concerns the fact that Pygmalion could also be used directly by learners –e.g., to summarise and fix what they have learnt or to present the results of an autonomous work. The second point concerns the fact that Pygmalion allows readers not only to explore the maps, but also to change and develop an already sketched map (every map can be downloaded and then uploaded again with some modifications). In fact, both the tool and the maps have been conceived to suit users with different backgrounds and requirements.

This paper certainly does not show all the functionalities of Pygmalion and we hope that its users will find other ideas to use it inside (and outside) the classroom.

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