



Electronic lexicography in the 21st century: Smart lexicography

Proceedings of the eLex 2019 conference

edited by

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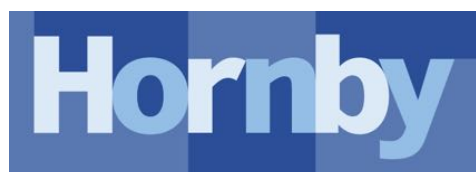
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How Can App Design Improve Lexicographic Outcomes? Examples from an Italian Idiom Dictionary

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Abstract

Despite the growing number of smartphone apps used in everyday tasks, lexicographic applications are still rarely discussed. Studies focus mainly on the usability of available tools, but contributions concerning the development of dictionary apps are almost non-existent.

In this paper, three different design solutions are presented to implement a dictionary app for Italian idioms, having foreign learners as prospective users. Prototypes were sketched according to *Human-centred design* principles and by applying a participatory approach in which users contribute to the design process.

To offer a trustworthy tool, special attention was also paid to the lexicographic data provided. To this end, the *OWID Sprichwörterbuch* model was enriched with specific information to support foreign speakers, whose communicative needs had been tested in a production task with Italian idioms.

The presentation of three prototypes is specifically addressed to highlight design solutions which can guarantee descriptive richness.

Keywords: dictionary Apps; electronic lexicography; *Human-centred design*; lexicographical functions; interactive systems

1. Introduction

This paper reports on the main features of a dictionary app prototype of Italian idioms for learners. The report will focus on the design concept and app features highlighting the interdisciplinarity of the project and the hybrid methodology used to investigate the best solutions to the challenges of the new media, i.e. smartphones.

Theoretical issues will be discussed throughout the paper while presenting the different stages of the app design: i) a post-consultation study (Fuertes-Olivera & Tarp, 2014) on the ability of target users to extract information from existing dictionaries; ii) a co-design protocol to merge experts' point of view with users' expectations and needs; iii) a final discussion on the best dictionary prototype to be tested with real users in the next research step.

It is worth noticing that the contribution deals with electronic dictionaries released as

smartphone applications. For this reason, we call them dictionary apps in place of “pocket electronic dictionaries” (or PED)¹, which was in common use before the smartphone revolution occurred to refer to “a small hand-held calculator-type reference work containing basic vocabulary in one or more languages” (Hartmann & James, 1998).

Nowadays, however, smartphones have evolved dramatically from the calculator format, and exploration of lexicographic applications for these devices is still in its infancy. In this paper possible contributions from the field of ergonomic design will be shown, with the hope that they could stimulate further debates and experiments.

1.1 The future of dictionaries and the dictionary apps of the future

In his vision about the future of dictionaries, Rundell (2012: 29) emphasizes that these tools will morph into services integrated into other software and stand-alone-products will decrease dramatically in number. However, if we focus on specific tasks that specific users might be interested to perform, one could also foresee different scenarios for the future implementations of dictionaries. For example, learners might profit from tools designed to increase specific skills, and the more we focus on single abilities, the more mobile apps can provide valuable assistance. Two options could guarantee, in fact, a future for dictionaries, as Amsler (cited in Lew & de Schryver, 2014) notes: “It’s a matter of either having lexical knowledge that nobody else has or displaying lexical knowledge in ways that are so convenient that other means of access are less attractive”. Essentially, this paper deals with the second option, focusing on key features of mobile applications. As IT experts and coders generally maintain, screen constraints and hardware limitations demand simple software in mobile devices, but simplicity is a more general concern for smartphones that deserves special attention.

In the years 2004-2008, smartphone apps contributed significantly to the process of the ‘eversion’ of cyberspace, as novelist William Gibson (2010) calls it, “a shift from virtual reality to mixed reality” (Jones, 2014). Today’s media tend in fact “to move out of the box and overlay virtual information and functionalities onto physical locations [thus creating] environments in which physical and virtual realms merge in fluid and seamless ways” (Hayles cit. in Jones, 2014). Focusing on smartphone users, Simonsen (2014: 260) notes that they navigate “in both the physical world and in the user interface of the mobile device at the same time”. This overlapping works as long as virtual data fit real-world issues, and the way data are provided is paramount. Different electronic devices – e.g. PCs, tablets, smartphones – can assist with different types of situations, as well as for different tasks. In particular, task complexity affects the type of device adopted by users, as reported by Simonsen (2014: 253): websites on PC screens to acquire extensive knowledge, smartphones to get a piece of missing information.

¹ The term was introduced by Taylor & Chan (1994).

1.1.1 Narrowing the scope

Restricting the scope of activities is a key feature which can make for valuable mobile apps. Tailoring information is important not only with respect to the type of task to be performed, but also for the amount of data to be managed by the electronic tool, as is also underlined by Simonsen (2015: 88): “The empirical data [...] show that different tasks call for different data sets and different access methods are required when using a dictionary app”.

Dictionaries with restricted macrostructure, e.g. collocation or idiom dictionaries, can be compiled more easily for mobile apps, since the scope of consultation is restricted from the beginning to a specific type of linguistic data. This reduces information overload and helps lexicographers accomplish some requirements of lexicographic description more easily, such as the need for a microstructural organization to comply with the lexicological properties of words.

Different word types – such as phrasal verbs and fixed phrases, or pragmatic markers and conjunctions – require different descriptions (Wiegand & Smit, 2013), which can be provided using specific data types within the dictionary articles. As an example, in the next sections (§ 3) we briefly report on some information needs related to idiomatic expressions that general language dictionaries are not able to fulfil when the user is an L2 speaker. We collected evidence by administering a test on the use of Italian idioms by foreign learners. The dictionary app described in this paper is instead particularly consistent at the “presentation level” (Müller-Spitzer, 2013), because all articles have the same microstructure which, however, can be split in different views, accessible by several actions.

2. Dictionary apps in the literature

The current debate on electronic lexicography is focused on complex tools developed as PC software, but research on dictionaries for handheld devices is still rare. However, the concept of an electronic dictionary is extremely broad and wide-ranging: “collections of structured electronic data that can be accessed with multiple tools, enhanced with a wide range of functionalities, and used in various environments” (de Schryver, 2003a: 146). Under this respect, dictionary apps should figure among the key concerns of this field, and debates should cover usability issues as well as technological solutions to fill information voids.

Existing research on dictionary apps has instead explored i) common features of available resources (e.g. Gao, 2013; Vitayapirak, 2013), ii) business models in the publishing market (Winestock & Jeong, 2014), iii) users’ interactions with these tools (Curcio, 2014; Marelllo, 2014; Simonsen, 2014, 2015; Vitayapirak, 2013). Marelllo and Simonsen, for example, adopt interesting methodologies and protocols to study the way users interact with mobile dictionaries, but the apps they have tested are rather

conventional, offering just a couple of smart features such as all-text-searches and a bar code reader in the medical tool used by Simonsen (2014, 2015). Some of the apps' shortcomings are also underlined in the papers. For example, Marelló suggests microstructural implementations, while Simonsen complains about the interactional constraints of mobile devices which "drastically" reduce "information access success", thus urging that "mobile lexicography [...] reinvent itself" (Simonsen, 2014: 259).

Unfortunately, the revolution will not take place unless editors change their business model, which consists of developing one app "for one print dictionary", as Winestock and Jeong (2014) note, describing the app market. For the future implementations of dictionary apps, these authors suggest app aggregators, in which one initial dictionary can be implemented with special 'adds-on': different component parts addressing specific skills or features. A simplified version of this model is already available in the Chinese-English dictionary app released by Pleco. It is possible to suggest that similar tools are implemented in the future with search masks to access the different component parts of the app where each type of lexical unit is described according to its features.

This vision goes not very far from the segmentation of knowledge that *Lexicographical Function Theory* (Tarp, 2008) has claimed for electronic dictionaries, thus creating monofunctional tools (Tarp, 2012) in which users find different dictionaries addressing a specific lexicographic topic (e.g. general language, specialized language, collocations or idioms) from the perspective of different tasks to be performed with the dictionaries. Following this theory, Kwary (2013) outlines two different app concepts for the target users of Indonesian business people, who need to acquire news from the international market very quickly. The first software has the same functions that ebook readers implemented around the time of Kwary's paper: text-integrated dictionaries offering word meanings or translations as tooltips. The other tool goes in the opposite direction, listing the latest business headlines and giving access to a dictionary through a search bar where words can be typed or drag-and-dropped directly from the headlines.

In the current research, the same assumptions on lexicographic functions have been followed to define an app concept suited to the target users of advanced foreign speakers of Italian who wish to improve their language proficiency. For this reason, the app deals exclusively with idiomatic expressions, which are among the target skills of advanced levels (from B2 onwards) of linguistic certifications in CEFR (Common European Framework of Reference for Languages).

3. Monitoring users' needs in language tasks with idioms

To better support users' needs, a preliminary study of available dictionaries was carried out (Caruso, 2016). Idioms are in fact demanding for their semantics as well as for their morphosyntactic properties, since they are "fixed in their lexical structure (however, this does not exclude a certain limited variation), and they must be, at the same time, semantically reinterpreted units (i.e. they do not point to the target concept directly

but via a source concept) and/or semantically opaque” (Dobrovol’skij & Piirainen, 2005: 40). In Italian, for example, *dare la mano* (‘shake hands’) and *dare una mano* (‘help someone’) have different semantic and pragmatic meanings, despite the single variation in the noun determiner (a definite, *la*, or an indefinite article, *una*). *Darsela a gambe* (en. ‘to escape, running fast, from a complicate situation’) is instead extremely difficult to inflect (e.g. *Maria se l’è data a gambe*) and even to be searched for in the dictionary, because the lemma form is given in the infinite tense with agglutinated placeholder pronouns.

Ten Chinese and eight Vietnamese university students learning Italian in Naples were administered a test to assess their ability to extract information on idioms when using an authoritative general language dictionary, such as the *Vocabolario Treccani* (VT) online. The participants had been living in Italy for six months when the test was administered, and eight of them had a B2 certificate of proficiency, the others a C1 certification. The majority (55%) had been studying Italian for three years, others (28%) for two, and a smaller group for four years.

In a pre-test homework activity, students were asked to search for all the idioms listed in the *VT* articles for the words *testa* (‘head’) and *mano* (‘hand’) after having attended a lesson on the concept and features of idiomatic expressions, illustrated through Italian examples. After three days they were given a gap-filling exercise with missing idioms, having *testa* or *mano* as their “key constituents” and presenting an “image component”: “a specific conceptual structure mediating between the lexical structure and the actual meaning of figurative units” (Dobrovol’skij & Piirainen, 2005: 14). During the test, students had to choose the right idiom from a list which provided the explanations contained in the *VT* dictionary.

The results prove the inability of this type of users to extract information from the general language dictionary (Caruso, 2016). Only 56% of their answers were correct, since they either failed to select a semantically suitable expression (56%) or a correct inflectional form (43%). In correlating the type of explanation to students’ scores, the analysis showed that positive scores correlate with full-sentence explanations, written in a natural language style, as well as with those illustrating shifts from literal to abstract meaning. Concerning mistakes related to the inflectional form, they are caused by a lack of awareness about how idiom constituents inflect or do not change. Students’ proficiency level and years of study of the language do not correlate with better performance (Caruso, 2016).

4. Data types and lexicographic organization

In line with other studies on the role of imagery in idiom learning (see Szczepaniak & Lew, 2011), our data demonstrate the relevance of etymology in understanding figurative idioms, since it explains the shift from the literal to the metaphorical meaning and helps speakers build the “mental image” of the expression (see Dobrovol’skij, 2016:

23; Dobrovolskij & Piirainen, 2005). Another key concern for foreign speakers is the morphosyntactic explanation, thus inflexion tables should display paradigmatic declension exhaustively and remark unadmitted forms. For example, *Mettersi le mani nei capelli* (lit. ‘to put one’s hand in the hair’) conveys the idea of ‘despair’ by depicting² the conventional gesture of putting one’s hand in the hair (*capelli*) and is not used at the imperative form, nor can it convey all type of speech acts, such as giving advice or reproach someone.

Therefore, having as reference the lexicographic data types contained in the *OWID Sprichwörterbuch* (Steyer & Ďurčo, 2013), we added some features to support foreign learners more effectively. In particular, semantics is illustrated along with the etymology and literal meaning, whilst participants and valency structure are specifically addressed for verbal idioms, to explain the event the idiom describes thoroughly. This type of annotation is inspired by Frame Semantics (Fillmore, 1985), although Frames or Frame Elements listed within FrameNet (Fillmore et al., 2003) are not maintained within the app. Intuitive descriptors are used in their place to help users understand idiom syntax and semantics more accurately. The participants and valency structure, labelled “struttura linguistica” (en. ‘linguistic structure’), is annotated as follows:

	Mettere le corna	[a qualcuno]	[con qualcuno]
Maria	ha messo le corna	al suo fidanzato	con Fabrizio
[il traditore]		[la persona tradita]	[l’amante] ³

Additionally, in order to improve app effectiveness we highlighted unattested uses and word forms. For example, in *Mettere le corna* (en. ‘to cheat on someone’): “Parte non modificabile: le corna, non si può cambiare il genere, il numero e l’articolo. SBAGLIATO: mettere ~~il corno~~, mettere ~~la corna~~, mettere ~~un corno~~, mettere ~~una corna~~, mettere ~~i corni~~”⁴.

4.1 Lexicographical functions to create tripartite access to data: one

dictionary for writing, one for understanding and one for learning

To reduce information overload, we sketched a provisional microstructural organization for three different monofunctional app dictionaries of idioms addressing the

² According to Burger (2010: 63-64) it is a *Kinegramm*.

³ En.

	Cheat	[on someone]	[with somebody]
Maria	cheated	on his boyfriend	with Fabrizio
[the betrayer]		[the one who is betrayed]	[the lover]

⁴ English: “Unmodifiable word constituents: *le corna* (lit. ‘the horns’), article, gender, and number variation are not allowed. WRONG FORMS: mettere ~~il corno~~, mettere ~~la corna~~, mettere ~~un corno~~, mettere ~~una corna~~, mettere ~~i corni~~”

corresponding functions:

- dictionary for idiom understanding, type of data included:
 - Meaning (describing the idiom meaning and emphasizing the ‘image component’)
 - Literal meaning
 - [Participants and valency structure]⁵
 - Affective meaning
 - Stylistic meaning
 - Pragmatic and social meaning
- dictionary for using idioms:
 - Meaning
 - Unadmitted lexical variations
 - Affective meaning
 - Stylistic meaning
 - Pragmatic and social meaning
 - Contexts of use
 - Texts genera
 - [Connectors]
 - Typical modifiers
 - [Negative transformations]
 - [Syntactic transformations]
- dictionary for leaning idioms:
 - Meaning
 - Literal meaning
 - etymology
 - [Inflectional forms (active, passive, pronominal/impersonal/reciprocal voice)]
 - Lexical variations

Being useful for different functions, some data are displayed in more than one dictionary, as this is one of the main concerns in building monofunctional dictionaries: avoiding data redundancies whilst preserving descriptive adequacy. In the next section, the focus on usability required by the design protocols will prove its effectiveness in solving similar issues.

5. Design protocols to enhance dictionary usability

The idiom dictionary prototype developed so far has been released following the *Design thinking* (Plattner et al., 2014) protocol introduced by Hasso Plattner at the Stanford Institute of Design. This approach guides design processes to meet the standards of

⁵ Square brackets include data types used only for verbal idioms licensing a syntactic structure.

Ergonomics of human-system interaction, classified by the International Organization for Standardization (ISO) as 9242-210 in the *Standards catalogue*, which is specifically addressed to *Human-centred design for interactive systems*.

5.1 General principles of *Human-centred design*

The guidelines provided for *Human-centred design* aim at making computer-based interactive systems more usable “by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, and usability knowledge and techniques” (ISO 9241-210: vi). The paradigm seems to be particularly promising in the field of electronic lexicography, especially when the dictionary moves into the handy format of a smartphone app. This approach lays down four key principles for design:

- encourage users’ active involvement in the design process to better understand their needs and task requirements;
- evaluate the distribution of functions to be performed by the user and by the technology he/she uses;
- iterate design solutions;
- adopt a multi-disciplinary approach to systems design.

The involvement of Human Factors (hence, HF) in the development of interactive systems is paramount. They work side by side with project stakeholders and technical implementers to guarantee that ergonomics principles concerning people’s capabilities, user experience and usability are covered from the beginning to the end of the project: from the concept outline to its prototyping and testing sessions with real users, followed by a re-design process of the tool. It is worth noting that in the field of electronic lexicography, the iteration of development phases has also been applied by de Schryver (2013) in his *Simultaneous feedback* protocol for dictionary compilation, where “user behaviour influence the presentation of lexicographic data through a direct feedback loop” (Lew & de Schryver, 2014).

Another key component of *Human-centered design* is the “context of use” (ISO 9241: 210), which is defined by the users, tasks and environments in which the system works. HF specialists employ social science techniques to define specific features of each “context of use” of the interactive system, i.e. contextual inquiries, interviews, focus groups, brainstorming, questionnaires, and co-design workshops with adequate stakeholders are common tools for this type of investigation.

5.2 Design methodology

The development framework used for the dictionary app is a well-known design protocol in five stages known as *Design thinking* (Platter et al., 2014). It is based on the active collaboration and involvement of stakeholders, i.e. the dictionary users and the

lexicographers (or “subject matter experts”), in a design process guided by HF specialists during co-design sessions, where participants work in pairs through the following time-constrained phases:

- Empathize: the participant acting as a designer (afterwards “designer”) poses questions to the participant acting as a user (afterwards “user”) to understand his needs and expectations about the system to be designed;
- Define: the user’s characteristics and his needs are the focus when outlining core features of the interactive system;
- Ideate: a range of possible solutions are sketched by the designer and, afterwards, are evaluated with the user to assess if they meet his/her needs;
- Prototype: after having selected the best ideas from the sketched solutions, the designer outlines a single proposal;
- Test: the prototype is evaluated together with the user to identify strengths and weaknesses.

For the current research, the *Design thinking* model was implemented by a co-design workshop (Halloran et al., 2009) which allows the relevant stakeholders to take part in the design process: thus dictionary users and lexicographers (or “subject matter experts”) have been working side by side with the designers, sketching dictionary prototypes on paper. Designers (or HF specialists in charge of the system design) were researchers from the University of Naples Suor Orsola Benincasa, and stakeholders were lexicographers from the University of Naples ‘L’Orientale’ and 14 Chinese learners of the Italian language. The ideational process started with a preliminary interview of lexicographers, by which HF specialists could gather insights from the experts’ point of view regarding dictionary features, shortcomings during consultation, state-of-the-art electronic tools and lexicographic theory.

5.3 The co-design workshop

Twenty-four people participated in a co-design session: four Italian lexicographers, six Italian designers and 14 Chinese students learning Italian at the University of Naples ‘L’Orientale’, having a B2 or C1 certification of proficiency in this language.

To make users more aware about the tasks to be performed with the app, an introductory presentation was made, and users were assigned reading, writing, and learning tasks in which idioms were involved. In the same session, idiom features were briefly explained together with the lexicographic data (those listed in § 4.1) that dictionaries can provide to assist users with these demanding lexical units.

The co-design session aims to collect information about users’ ideas and expectations as well as their needs when consulting a monolingual idiomatic dictionary, i.e. the way they approach lexicographic tasks and the type of expectations they have about a dictionary compiled as a mobile application. This is done by letting users “empathize”

with designers in sessions of role-playing activities, during which the user acts as a designer and is in charge of prototyping the interactive system with the designers' tools, following the steps of a design framework. Participants annotate their findings, needs, ideas and even draw prototype sketches of their solution proposals on paper sheets that are collected at the end of the co-design session. These materials contain meaningful insights, inspirations and well-focused needs coming from the community of project stakeholders (i.e. learners, lexicographers and designers as well) and are used to design the first prototype.

However, this is only the first stage of the iterative cycle of *Human-centred design*, consisting of a proposal of a first set of prototypes to be used as test materials with prospective users. After a first testing session, an improved solution is re-designed and new design cycles, typically two or three, will take place before the final tool is released.

5.4 Output of the co-design workshop

From the analysis of the co-design session materials it emerged that users' needs were focused both on the content and functional requirements of the tool. Fig. 1 presents the results of this, showing the percentage of participants who responded with each need.

Afterwards, users' needs were arranged and classified into three types:

- (i) goals: the aims for which the user wants to use the app;
- (ii) generic features: what the user expects to find in the app, because of the standard features of many other apps he/she uses;
- (iii) specific features: functionalities and content that are specific for the idiom dictionary app. Content is related to social and motivational aspects, while functionalities are linked to cognitive and epistemic aspects (Buccini & Padovani, 2007).

5.4.1 Goals

What mostly motivates students in using the app is the desire to be able to master idiomatic expression in conversations (**Communication** in Fig.1) and in real-life situations. The other goal-related needs are:

- **Learning**, an important objective for language certifications;
- **Culture**, a type of knowledge which can be improved through a deeper understanding of the origins of idiomatic expressions;
- **Teaching**, a key concern of lexicographers who wish to rely on apps for teaching purposes during class hours;
- Finally, **Entertainment**, because participants acknowledged that the stories behind idiomatic expressions are often surprising and entertaining.

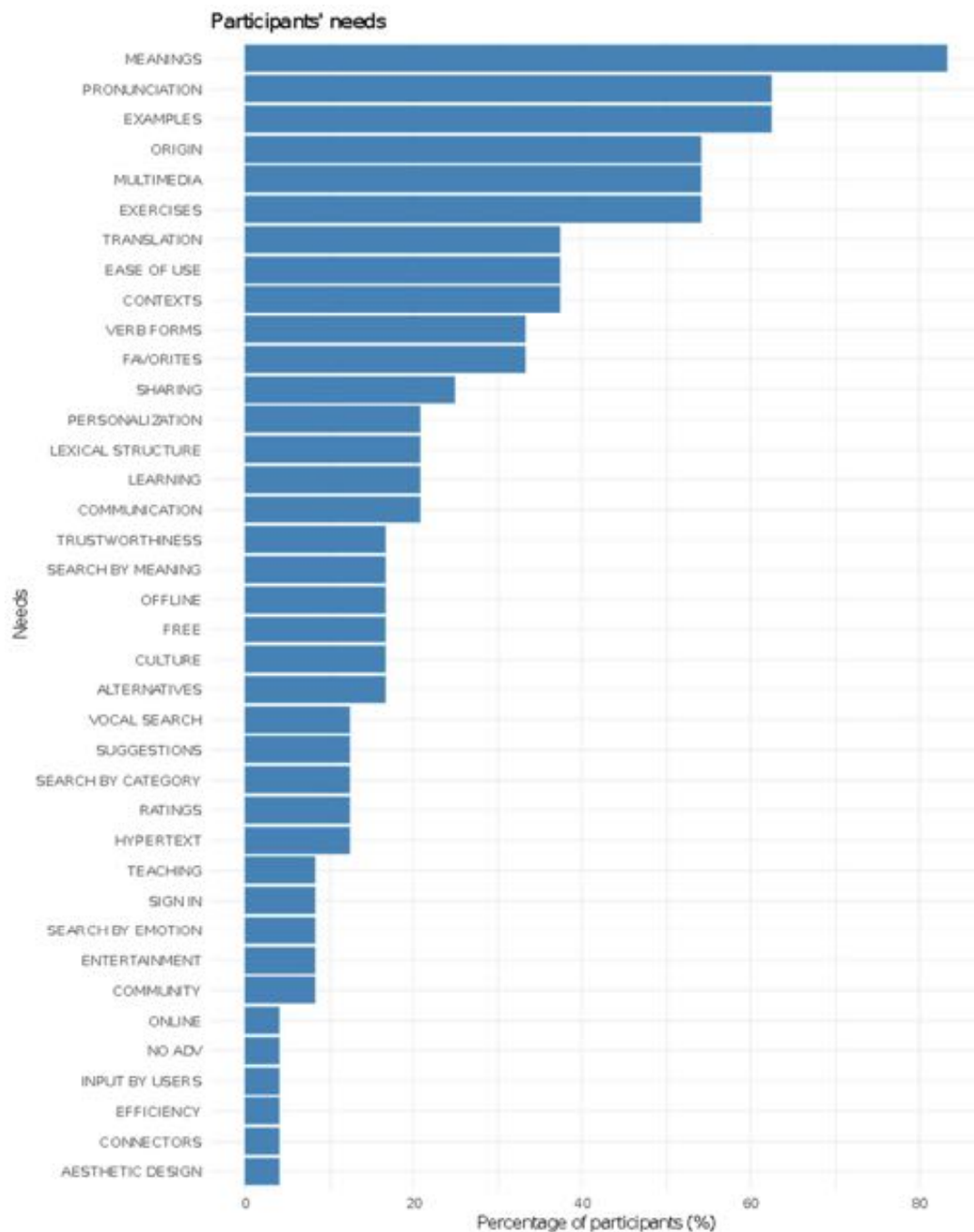


Figure 1: The complete listing of users' needs extracted from the co-design session

5.4.2 Generic features

Generic features are apps' standard features not specifically relevant for dictionaries. Some of them are related to social and motivational needs, and in particular to the possibility that the users will rate and produce content, thus inheriting interaction models typical of social networks:

- **Ratings:** users can rate the quality of the app content for each idiomatic expression;

- **Community:** the app has a forum for discussion with other users;
- **Production:** users can add content, for instance new examples.

Users also declared that they were interested in selecting and sharing (**Sharing**) favourite content (**Favorites**) and creating a community via the **Sign up** features.

5.4.3 Specific features

It is worth noting that all participants expressed their wish to understand the various different shades of idiomatic meaning (**Meanings**), with a particular interest in the main stylistic, affective and literal components. Also in line with the primary goal of improving communication and conversational skills, **Pronunciation** and examples of use (**Examples**) were considered as must-have features in the app, together with **Exercises** to fulfil learning goals.

Further requirements concerned **Multimedia** content and notes on idiom **Origin**, which fulfils cultural, learning and entertainment needs, because the story behind the idiom is typically easily memorable and nice to know. **Translation** is one of the top needs, too, even if it was presented as off the topic, because we wanted to focus on a monolingual dictionary. A related need is having an integrated term dictionary (**Hypertext**) that enables users to search for the meaning of single words appearing in an idiom. Other features addressed search options, i. e. **Vocal search**, and the **Search by meanings, emotions, and context/categories**, which are alternative ways of retrieving idiomatic expressions by selecting a group of tags.

The list of requirements also included a clear explanation about the **Context of use**, **Inflection**, the **Lexical structure**, or the idiom invariant constituents, the **Connectors** which typically introduce idioms in the discourse, and **Alternatives**, or other idioms to be used in place of the one under consideration. Finally, usability features were included as these are essential for a valuable design (Blythe & Monk, 2018): i.e. **Ease of use**, addressing readability and understandability, **Effectiveness**, **Trustworthiness** of data, and the **Aesthetic design**, meaning that the interface is expected to look modern and not overwhelm users with information.

6. Designing prototypes

Based on the priorities that emerged from the co-design session, a first app prototype was sketched to summarize the needs and priorities related to a monolingual idiom dictionary to develop an artefact that could be used in testing sessions with real users.

The prototype is developed for iOS devices, following the Apple *Human Interface Guidelines* and using the software *Sketch*, which allows for dynamic linking of the user interface views by tapping on the envisioned interactive components, and can be easily used in testing sessions with real users.

In this first stage of prototyping, we focus mainly on the app structure and its content, leaving aesthetic details for a second round of prototyping after having collected users' feedback. The challenge to meet is to combine information access efficiency with content completeness, thus merging expert knowledge with users' desires, prioritized with the co-design experiment (§ 5.4).

The Home interface (fig. 2) shows a tab bar (at the bottom of the app screen) giving access to the main app sections related to the main goals identified by users:

- **Search view**⁶: (corresponding to the book icon in the tab bar) is a rather traditional search interface;
- **Idiom categories view**: (multiple squares icon) allows users to search idioms by tags, thus making search options more advanced than in traditional electronic dictionaries;
- **Practice view**: (graduate cap icon) gives access to an exercise section;
- **Favourites view**: (star icon) collects the user's preferred content;
- **Settings view**: (human figure icon) gives access to setting options.

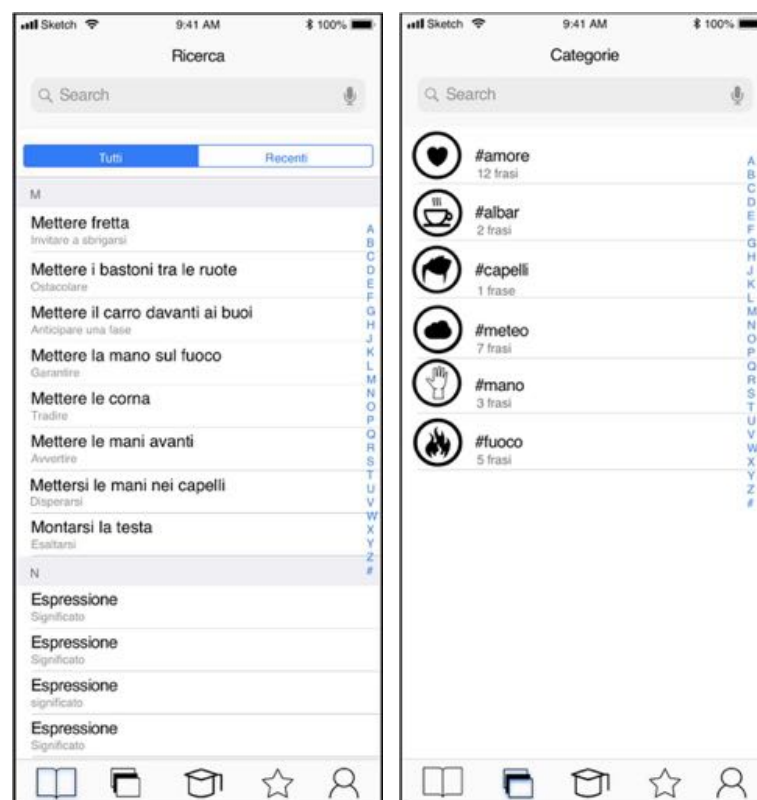


Figure 2: Home/Search interface and Home/Search by categories

⁶ Speaking about apps, we adopt the current terminology in use to address their component parts. The 'view' is what the user sees displayed on the screen. For these terms, please refer to Human Interface Guidelines provided by operating systems developers, such as iOS or Android.

The first tab bar buttons address search sections specifically developed for fast comprehension and production tasks. Indeed, the Home Search interface ('Ricerca', first button, book icon) allows for searching by idiom forms and meanings as well: by typing a word in the search bar, or pronouncing the desired expression, the app returns the idioms related to the word, which is included in the idiom or represents its meaning. The Idiom Categories View (Categorie), on the other hand, enables the search of the idiom by “tags” (e.g., #meteo, #love, #school, #fear, ...): a tag can express a topic, a situation, a place, an emotion, and other. Each idiom can have multiple tags, thus allowing the user to make searches by emotions and contexts of use, as they were desiderata coming from the co-design session. Practice view (Pratica) answers to the need for mastering idiomatic expressions and addresses the ‘learning function’ which, therefore, is not devised in the form of a separate dictionary, as proposed before the design process began (see § 4.1). **Favourites** allows for rapid access to those idioms that users have already gone through, and **Settings** allows for the personalization of the app from the aesthetics and content perspectives, e.g. interface colour modes, configuration of exercises, and so on.

The core of the design effort is the **Home view**, because it should give access to lexicographic data in a way that can be successfully used by a mobile application user: synthetically and in a recognizable form, because of the limited display space and interaction time constraints of mobile apps. Users, in fact, expect more rapid interactions with these devices than with paper books and other electronic devices (see also Simonsen, 2014). With this in mind, the priority list from the co-design session was rescheduled by the designers and lexicographers to develop a more consistent arrangement of data, and the priorities were set as follows:

- **Meanings:** main, literal, affective and stylistic meaning. For each meaning type, explanations and examples are provided.
- **Origin:** etymology has a storytelling power which is useful to understand and memorize idiomatic expressions, whilst enhancing the app entertainment dimension.
- **Contexts of use:** provides attested uses in different situations, places, text typologies or registers.
- **Inflexion, Lexical Structure, Connectors, and Alternatives** are described in § 5.4.3.

Directives from the experts provide meaningful hints along two dimensions: the provision of different data types according to the tasks the user is about to perform (e.g. inflectional information for production tasks); and the ordering of these data (e.g. pronunciation and morphological transformations near the lemma sign).

Given this overview, access to lexicographic data is discussed using three different possible approaches to prototyping the dictionary.

6.1 Prototyping approach A

The first approach (Fig. 3) is the most straightforward, displaying lexicographic data in different *search zones* (Wiegand et al., 2013), labelled with the name of the data types therein contained, which are accessible in a scrollable way. This solution allows the user to access the main information immediately, without having to tap other interactive components, like buttons. Moreover, interested users can read lexicographic data by scrolling the view, which is a quite natural gesture, and this could facilitate in understanding the labels (or *data-identifying entries*, Gouws, 2014), such as “emotive meaning” (it.: ‘significato emotivo’), thanks to the data provided under each heading.

On the other hand, users have to scroll the view in order to find information that might be useful for their tasks, and more experienced users might get frustrated in navigating the entire view and its contents each time.



Mettere le corna SIGNIFICATO Tradire il proprio fidanzato o fidanzata con un amante. <i>Es.: Maria ha messo le corna al suo fidanzato con Fabrizio.</i> Varianti: fare le corna. ORIGINE Nel Medioevo si appendevano le corna degli animali fuori alla porta di una casa in cui viveva una moglie o un marito che aveva un amante. SIGNIFICATO LETTERALE Appendere (o mettere) le corna di un animale fuori alla porta di una casa in cui viveva una moglie o un marito che aveva un amante. SIGNIFICATO EMOTIVO Da parte del traditore, mettere le corna esprime derisione e scherno nei confronti della persona che viene tradita. Per la persona che viene tradita, mettere le corna esprime irritazione e rabbia nei confronti del traditore. <i>Es.: Zitto tu, che tua moglie ti mette le corna!</i> SIGNIFICATO STILISTICO Espressione colloquiale, usata tra amici, sconsigliata quando si parla in contesti formali. SIGNIFICATO SOCIALE O PRAGMATICO	Cheat on someone MEANING To betray one's boyfriend or girlfriend with a lover. <i>Ex.: Maria has cheated on her boyfriend with Fabrizio.</i> Admitted lexical substitutions: fare le corna (instead of 'mettere le corna') ORIGIN In Medieval age, people used to hang horns at the front door of houses where unfaithful wives or husbands lived LITERAL MEANING To hang animals' horns at the front door of houses where unfaithful wives or husbands lived EMOTIVE MEANING Used by the traitor, 'mettere le corna' (en. 'cheat on someone') expresses scorn and derision for the betrayed person. Used by the betrayed person, 'mettere le corna' expresses anger towards the betrayer. <i>Ex. You shouldn't say a word, as long as your wife cheats on you!</i> STYLISTIC MEANING Colloquial expression, used with friends, not recommended in formal contexts. SOCIAL OR PRAGMATIC MEANING
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Figure 3: Prototyping approach A on the left, English translation on the right

6.2 Prototyping approach B

A second possibility is a scenario in which each type of lexicographic data is provided by accessing a dedicated row of a table view, like the one in Fig. 4. This solution has the advantage of simplifying the view by showing exclusively data-identifying entries, or lexicographic labels. This minimalist approach has the obvious disadvantage of increasing the time needed to access data, and the number of actions needed for task completion. Besides, less experienced users might be not familiar with lexicographic labels and could get confused to the point of quitting the app.

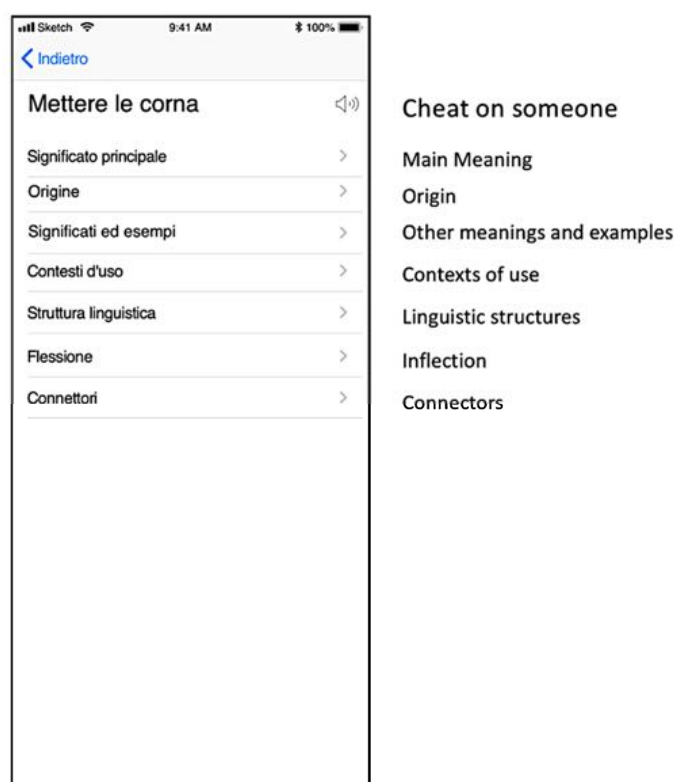


Figure 4: Prototyping approach B, English translation on the right

6.3 Prototyping approach C

A third prototyping solution is the result of a hybrid design, providing in a single view the idiom's general meaning and different ways to access other data. To achieve the aim of consulting more explanations about the idiom, two possible design solutions have been sketched, prototypes C1 and C2, which guarantee that users find general information quickly, and can then decide to acquire more data using specific lexicographic assistance if needed.

6.3.1 Prototype C1

In prototype C1, a segmentation bar⁷ allows the user to choose the situation of use, thus accessing different data types, as happens in the monofunctional dictionaries discussed before. Choosing between one of the available options in the segmentation bar, i.e. **Comprensione** (en. comprehension) and **Produzione** (en. production), the app filters data suited for comprehension (meanings, origin, context of use) from that suited for production (lexical structure, verb forms, connectors, see Fig. 5). In this way, for example, users who need to perform a comprehension task are provided only with the necessary lexicographic content in a scrollable way.

The advantage of such a solution is that users are fluently guided through the data types better suited to the different tasks, as advocated by the *Lexicographical Function Theory*, while inheriting the strengths and weaknesses of approach A.

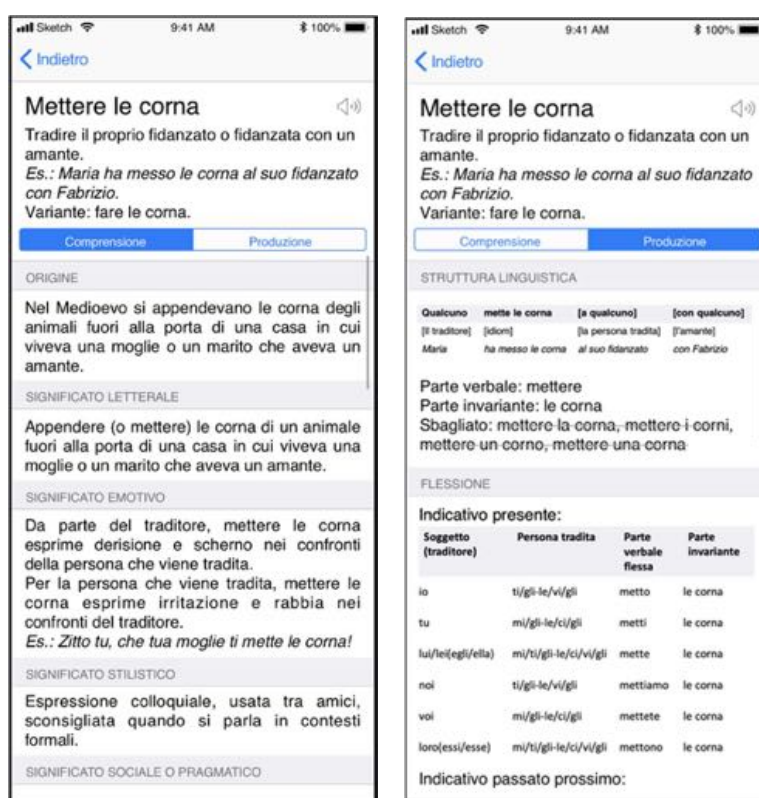


Figure 5: Prototype C1 – On the left: comprehension-oriented task view; on the right: production-oriented task view

⁷ See “Segmented controls”: <https://developer.apple.com/design/human-interface-guidelines/ios/controls/segmented-controls/>.

6.3.2 Prototype C2

The second prototype inherits the structure of approach C with a clearer indication of what is recommended for comprehension and production tasks (Fig. 6).

Users are provided at a glance with the list of the app contents divided per task ('Informazioni per la comprensione', eng: Information for understanding; 'Informazioni per la produzione', eng.: Information for production), thus helping them in constructing a mental model of what is needed for comprehension and production activities. Lexicographic data can be accessed instead by tapping on the labels and opening a new view, thus the space available for lexicographic descriptions is larger than in prototype C1, which is particularly valuable to manage inflexion tables (compare the corresponding views in prototypes C1 and C2, in Figs. 5 and 7).

To sum up, while the access to lexicographic content in C2 is pushed one tap forward in comparison with prototype C1, such a structure conveys more information to the user in an easier way. The table view structure inherits the advantages highlighted in the B approach, while it reduces the disadvantages by employing *structural indicators* that suggest the type of data better suited for specific task completion, as happens in monofunctional dictionaries.

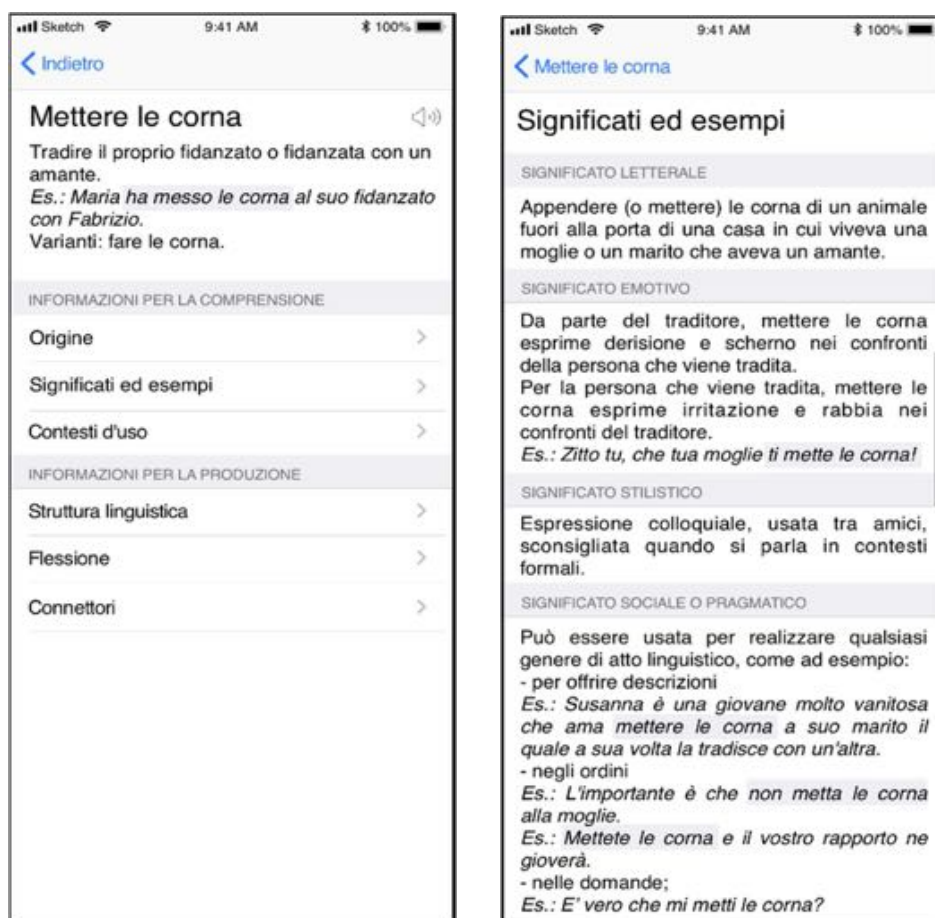


Figure 6: Prototype C2 – Examples of meanings details

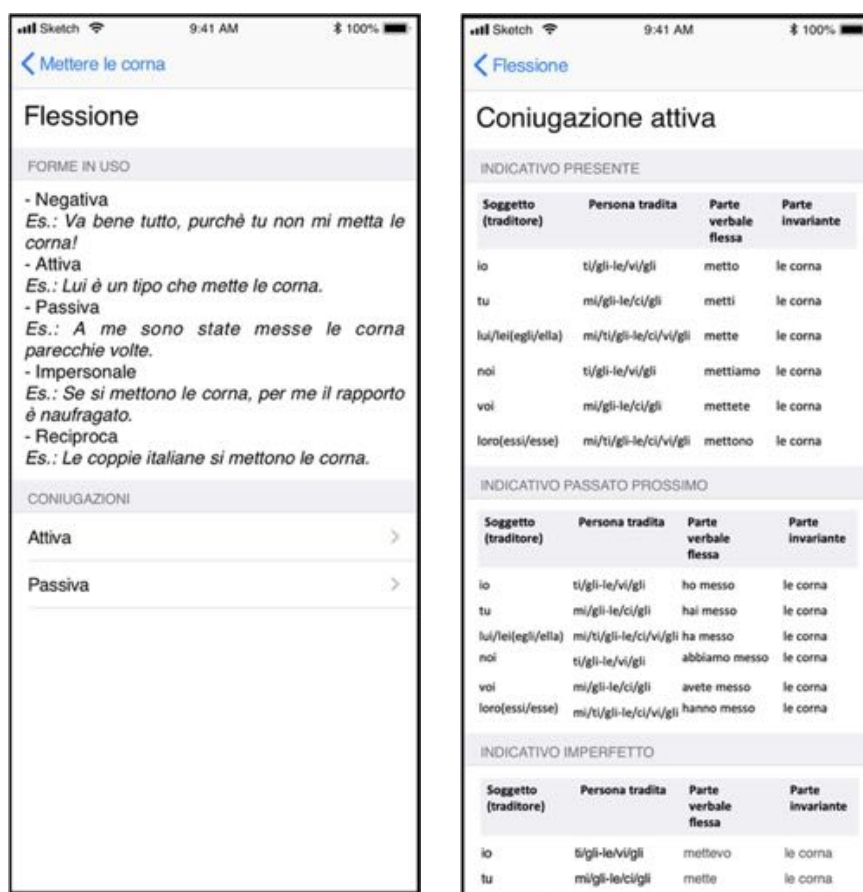


Figure 7: Prototype C2 – Examples of verb forms details

7. Conclusions and future work

This paper has pointed out key features of the recent digital revolution to introduce basic principles of app design for smartphones. With the “eversion of cyberspace” (Gibson, 2010) information has become ubiquitous, but the way users access data – whether through PCs, tablets or smartphones – makes for completely different knowledge experiences. With regard to smartphones, the focus should be on how data can fit real-life situations at a glance, displayed on small screen views, and reachable by a few, fluid actions.

The discussion on possible design solutions in Section 6 has shown how *Lexicographical Function Theory* can contribute to dictionary app design, offering valuable criteria for data arrangement. For example, using *structural indicators* (i.e. labels) to suggest data for the tasks to be performed, prototype C2 guides users through data consultation whilst preserving a minimalist interface, because the information is displayed in separate views. At the same time, recommending data for specific tasks, instead of building separate monofunctional dictionaries, gives users the option of selecting data autonomously, thus customizing their consultations. This solution also avoids repetitions that may occur in compiling separate, monofunctional dictionaries (see §4.1),

since the same type of information may be beneficial for different actions performed with the dictionary support.

On the other hand, *Human-centred design* offers new protocols, which put users and usability issues on the centre stage. To increase data accessibility, for example, the ‘learning dictionary’ has been transformed into a training section provided only with exercises. The learning component is, in fact, a more general function that is fulfilled by all the dictionary component parts: from the advanced search functionalities (e.g. searches by tags), to the rich semantic descriptions (literal, stylistic, pragmatic meaning) and morpho-syntactic explanations (inflexion tables, linguistic structure, connectors). Assuming this point of view, data selection becomes easier, because dictionary functions are reduced to production and reception tasks, while the co-design workshop offers other valuable insights for compiling the dictionary. In contrast to what one might expect, for example, etymology proved to be among the users’ top-rated features, therefore this data type should be displayed not only to improve idiom comprehension and learning, but also to fulfil an entertainment function.

In the next research step, the prototype solutions presented so far will be assessed with real users to implement a re-design cycle based on users’ feedback. Evaluation criteria will deal with prototype usability for different lexicographic tasks (comprehension, production, learning) and according to objective and subjective measurements (e.g., the time for task completion, user satisfaction, and so on).

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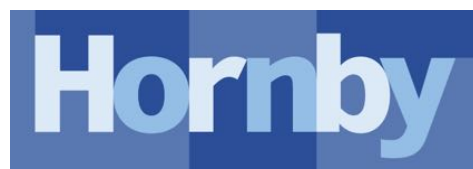


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