Alma Mater Studiorum · Università di Bologna

Dottorato di ricerca in
Culture Letterarie e Filologiche

Ciclo XXXIV

Settore Concorsuale: 10/G1 - GLOTTOLOGIA E LINGUISTICA

Settore Scientifico Disciplinare: L-LIN/01 - GLOTTOLOGIA E LINGUISTICA

Developing a large scale FrameNet for Italian - The IFrameNet Experience

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Esame Finale anno 2022

Questa pagina è lasciata intenzionalmente bianca.

Keywords:

Frame Semantics

FrameNet

Emotions

IFrameNet

Fear, Worry, and Anxiety

Questa pagina è lasciata intenzionalmente bianca.

Al papà, alla mamma, a Andrea
e a Luca

Abstract

In this thesis we present the development and the current status of the IFrameNet project, aimed at the construction of a large-scale lexical semantic resource for the Italian language based on Frame Semantics theories. We will begin by contextualizing our work in the wider context of Frame Semantics and of the FrameNet project, which, since 1997, has attempted to apply these theories to lexicography. We will then analyse and discuss the applicability of the structure of the American resource to Italian and more specifically we will focus on the domain of fear, worry, and anxiety. We will finally propose some modifications aimed at improving this domain of the resource in relation to its coherence, its ability to accurately represent the linguistic reality and in particular in order to make it possible to apply it to Italian.

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Acknowledgements

This work was made possible by the help of many people who supported me both academically and on a personal level. First of all I want to thank prof. Fabio Tamburini who introduced me to FrameNet and guided me along the whole process, starting from my MA thesis research in 2016, until the present day. Thanks to him I was able to approach and become passionate about Computational Linguistics, subject in which I finally found the humanistic and scientific coexistence that I had been looking for for years.

Then, I would like to express my deepest gratitude to Danilo Croce and Roberto Basili of the University of Rome Tor Vergata for the invaluable support and the precious work. Without them, the IFN project would not exist. Their immense passion and dedication to work have been an example and a stimulus, especially in the most intense periods of collaboration.

I would also thank the Digital Humanities group of FBK, in particular Sara Tonelli, Alessio Palmero Aprosio and Stefano Menini, for welcoming me and guiding me, especially in a difficult time. They showed me the beauty of research and the importance of collaboration.

I would like to extend my sincere thanks to Malvina Nissim and the University of Groningen. Unfortunately, the pandemic has prevented me from collaborating with them as I would have liked and I hope there will be more opportunities in the future.

I am particularly grateful for my PhD colleagues of the University of Bologna, who made this journey richer academically and personally. Most of all I want to thank Laura Occhipinti who helped me in revising the thesis and encouraged me throughout the way.

Many other people have played a fundamental role also outside the academic environment, my friends and my family most of all, and it will be impossible to thank all of them by name. First of all I would thank Teresa and her beautiful family, Laura, Chiara for the sensitivity and depth of their closeness. I am also grateful for my friends from San Luigi who showed me the importance of true friendship and the beauty in simplicity. I do also want to thank all of the people that I got to know thanks to H.o.t. minds and that are now an essential part of my life. They are too many to be mentioned by name, but I am deeply grateful for everyone. In particular, I would thank Francesca and Sara who helped me both to revise the thesis

and to stay focused without losing heart.

Words cannot express the gratitude for my family, my father, my mother and my brother Andrea first of all. Thanks for encouraging me and for being close to me with patience and understanding.

Finally, I would thank Luca, with whom I wish to spend the rest of my life. Our relationship has grown closer throughout this research and has given me invaluable support. Thank you for always pushing me to do better and anchoring me in the things that matter.

Chapter 1

Introduction

FrameNet (Ruppenhofer and Scheffczyk, 2016) is a lexical-semantic resource, developed since 1997 by the University of Berkeley (California) and represents an application of the Fillmore's Frame Semantics theories (Fillmore, 1977a, 1982, 1985) to lexicography. Frame semantics theories claim that words' meaning can be understood on the basis of the semantic frame they evoke, i.e. the schematic situation, entity or relation that the word recalls to the speaker's mind. This project aims to extract information on the semantic and syntactic properties of English words from vast corpora, using manual and automatic procedures. The FrameNet database is structured as a network of frames, interconnected through different types of relationships. Each frame is evoked by a group of words (or multi-word expressions) which are called Lexical Units (LUs), and is presented together with the list of participants and frame properties (called Frame Elements (FEs)), and a list of sentences sampled from large corpora that exemplify the semantic and syntactic combinatorial possibilities of the different LUs and the linguistic realizations of the FE (Sample Sentences, SSs). The project product, which is conceived as a work-in-progress, is a lexical-semantic database designed to be both machine and human readable, that is, both directly accessible and consultable by users, and usable for computational applications. Over the years, FN has proved useful for numerous computational tasks, for example the development of virtual travel assistants (da Costa et al., 2018), polysemy disambiguation tasks (Malm et al., 2018) and text difficulty assessement (Lee et al., 2020). Given the many possible applications of the resource it has been extended to many languages such as Chinese, German, French, Spanish, Brazilian Portuguese etc.

For these reasons, in 2016, jointly in the Universities of Bologna and Rome, Tor Vergata it began the IFrameNet project aimed at developing a large scale FrameNet-like resource for the Italian language. The project aims to create a broad-coverage lexical-semantic database combining manual and (semi-)automatic methods. It starts from FrameNet's structure, i.e. it maintain its frames, FEs and frame-to-frame relationships, and repopulates it with Italian LUs and SSs extracted from the CORIS corpus of written

Italian (Rossini Favretti et al., 2002). The reason of this choice is that, once language-specific information has been cut away, the structure of the FrameNet database can be applied to new languages, especially with regards to those frames that represent common experiences that tend to be more stable across languages and cultures (Gilardi and Baker, 2018). However, even if, for the most part, the structure of the American resource can be applied to new languages other than English, small changes are often necessary to adapt it to the particularities of the individual languages. For this reason, projects were born at the universities of Bologna and Rome La Sapienza to analyze, in relation to specific domains, to what extent the structure of Berkeley database was able to represent the situation of the Italian language.

The goal of this thesis is twofold: on the one hand it aims to present the achievements of the IFrameNet project, on the other hand it aims to illustrate the work we conducted on the fear domain in order to verify the suitability of the FrameNet model when applied to the that domain in Italian. We will try to describe how the lexicon of fear for the Italian language can be described at the level of semantic frames.

We choose to focus on the concepts of fear, worry and anxiety because of many reasons. First of all the extreme topicality of these concepts (due to many aspects such as the climate crisis, the economical crisis and the current pandemic situation) and the existence of many psychological disorders that are related to fear and anxiety. In fact, as of today, fear and anxiety in humans can be analyzed and assessed mainly based on individuals' self-reports (LeDoux and Hofmann, 2018; Raber et al., 2019). Having instruments to linguistically analyze this domain could provide valuable tools both for the study of pathologies related to anxiety and fear, and for the improvement of the treatment of these pathologies in patients.

Another motive is linked to the current status of fear-related frames, and more generally of emotive frames, in FrameNet. In fact, these are often problematic and their boundaries tend to be unclear so as to make annotation difficult. Moreover, the fear domain is an interesting field of research also because of its nature. Despite many scholars consider the emotion of fear as a universal experience, its expression is also strongly linked to cultural aspects (Bordin, 2011; Maalej, 2007). For these reasons, on the one hand we could presume that, given that fear is a shared and basic experience, also its frame representation will be stable. On the other hand, since the expression of fear is culture dependent we can expect to encounter frame-level variations.

For this reason we find it particularly interesting to study this domain in relation to the applicability of FrameNet to Italian. In fact, we can expect that some interventions will be necessary to adapt FrameNet's structure to Italian.

The thesis is structured as follows:

Chapter 2 In this chapter we will present Frame Semantics theories starting from Fillmore's early work *The Case for Case* (1968) up to the proposal to apply them to lexicography.

Chapter 3 In this chapter we will describe the FrameNet database. We will start from the story of the project and of the creation of the database and then we will proceed to illustrate the structure and the status of the resource.

Chapter 4 In this chapter we will present the IFrameNet project. We will first retrace the history of the project and the various steps of the development process. Then, we will describe the current situation and state of the resource.

Chapter 5 In this chapter we will introduce the concepts of emotions and of fear, worry and anxiety from a psychological point of view. In particular we will focus on the theories of Ortony et al. (1990) since they have been central in the development of emotion frames in FrameNet. Then we will present the fear-related frames in Berkeley's database underlining also the problematic aspects.

Chapter 6 In this chapter we will explain the research we conducted over the Italian fear lexicon and its frame representation. We will describe the methodology we exploited in the investigation process and the results we obtained. Finally, we will discuss the results and the problems that emerged during the investigation and present some possible solutions.

Chapter 7 In this chapter we will draw some final considerations based on the results and experimental data presented in Chapter 6. Moreover, we will present some possible paths that could be followed in the future to improve both the Italian and the American resources.

Typographical notes. For the sake of clarity, we will use different fonts to represent frames, FEs, frame-to-frame relationships, and LUs in the SSs. In particular: the typewriter font to represent frames (e.g. `Arriving`, `Getting`), the small caps font for FEs, as in Ruppenhofer and Scheffczyk (2016) (e.g. Theme, Agent, Buyer), the slanted font for frame-to-frame relationships (e.g. *Inheritance*, *Causative_of*), and the bold font to identify target words in sentences.

Chapter 2

Frame Semantics

The research that led to the development of the FrameNet (FN) project and the FN database grounds its roots in the Cognitive Linguistic studies and more precisely in Cognitive Semantic theories and traces back to the researches of Fillmore (Fillmore, 1963, 1968, 1971, 1975a,b, 1977a,b, 1982, 1985) who proposed the theory of Frame Semantics.

Building on that theories, Fillmore and colleagues came up with the FN project that represents the application of the FS theories to the study of the lexicon and to the lexicography (Fillmore and Atkins, 1992).

In this chapter we will firstly and briefly present the broad field of Cognitive Linguistics and in particular Cognitive Semantics, field that comprises the Frame Semantics theory (FS). Then we will present the research of Charles J. Fillmore, starting from his seminal work *The Case for Case* (1968) and his first formulations of Frame Semantics theory until the proposals to apply the theory to lexicography.

2.1 Cognitive Semantics

The term Cognitive Linguistics was born in the 1980s around the seminal works of Lakoff and Langaker (Lakoff, 1987; Langacker, 1987) to indicate an heterogeneous group of approaches. The term describes a great number of different and sometimes contrasting theories, that share two key commitments: first they claim that the language is not a separate and peculiar capacity with its specific dedicated brain circuits but that it is a part of the cognitive abilities and second that there is no neat separation between the various areas of the language, thus there is no separation between syntax, semantics etc.

Within the panorama of Cognitive Linguistics there are mainly two research fields:

1. Cognitive approaches to grammar which are primarily interested in the principles that guide the construction of a grammar (e.g. Cognitive

Grammar (Langacker, 1987, 1991, 2008) and Construction Grammar (Fillmore et al., 1988; Goldberg, 1995));

2. Cognitive Semantics which is primarily interested in how the speakers construct and shape meaning.

Within this last research field, which began in the 1970s as a reaction to formal linguistics and truth-semantics theories, flourished many different theories which converge on 4 guiding principles (as outlined by Evans and Green (2006, p.157)):

1. Conceptual structure is embodied (Embodied Cognition thesis) - This principle holds that bodily experience is the grounding of cognition and categorization. This implies that also the way in which language is structured and the construal of meaning in the language depends primarily on how we experience the reality. The focus here is on the physical experience and the Embodied Cognition thesis refers specifically to the physical embodiment which means that we structure and construe language depending on the bodily experiences we can make. This principle has been subsequently enriched with the concept of Cultural Embodiment which holds that language does not only rely on the physical experiences but also on the cultural and social experiences.

2. Semantic structure is a conceptual structure - It means that language does not reflect objects as they are in the real world but it rather reflects the mental representation that the the speaker has of the reality.

3. Meaning representation is encyclopaedic - Alongside with the compositional view is also rejected the dictionary view and is adopted an encyclopaedic view which holds that "words serve as "points of access" to vast repositories of knowledge relating to a particular concept or conceptual domain" (Evans and Green, 2006, p.160).

4. Meaning construction is conceptualisation - According to this principle, which rejects a compositional view of sentence meaning in favour of a constructional view: "linguistic units serve as prompts for an array of conceptual operations and the recruitment of background knowledge [...] (and) meaning is a process rather than a discrete 'thing' that can be 'packaged' by language" (Evans and Green, 2006, p.162).

Some of the most important theories born within the field of Cognitive Semantics are Johnson's theory of Image Schemas (1987), Lakoff's theory of Idealised Conceptual Models (1987), Langacker's theory of Domains (1987) and Fillmore's theory of Frame Semantics.

Image Schemas are "abstract conceptual representations" (Evans and Green, 2006, p.176) that arise from what we observe and from the concrete experiences and interactions we have in our everyday life. This means that, according to this theory, we interpret the reality through the categories we can abstract from physical experience. For example we can understand the concepts of "up" and "down" thanks to the fact that we have a body that is subject to gravity and that we usually stand upright. These Image Schemas function as very schematic pre-concepts which may give rise to more complex concepts.

In his book, published in 1987, Lakoff starts from the concepts of prototype and basic level category and develops a theory called Idealised Cognitive Models (ICMs). ICMs are abstract mental representations which correspond to specific visions of the world or theories about the world. This representations serve, according to the theory, as a guide for cognitive processes (such as categorization and reasoning).

The last two theories, the theory of Domains and the Frame Semantics theory, converge on some points: both of them in fact are based on the central assumptions that meaning is encyclopaedic and that words are understood in relation to "larger knowledge structures"(Evans and Green, 2006, p.230). Domains are "necessarily cognitive entities: mental experiences, representational spaces, concepts or conceptual complexes" (Langacker, 1987, p.147). The main difference between this theory and the Frame Semantics theory, which we will extensively present later in the chapter, is that while Fillmore's theory is also interested in the study of frames in relation to their grammatical realizations, Langacker is more interested in the analysis of the organization of knowledge, aiming at creating a conceptual ontology.

2.2 Fillmore and *The Case for Case*

In his research work, Fillmore starts from the Chomskian paradigm, which is the basis for his first works on transformational cycles (Fillmore, 1963).

Having come into contact with Tesniere's work on valence, and in particular after participating in his seminar: *Eléments de Syntaxe Structurale* (Elements of Structural Syntax) in 1959, Fillmore begins his work on "cases", deep semantic structures that transcend the positions of the various predicates in the sentence and allow for a better representation of the functional relationships between the words in a sentence. This research is published in 1968 with the title *The Case for Case* within a collection of essays on linguistic universals (testifying his adherence to Generative theories).

In this article he accepts the Chomskian assumption that "each grammar has a base component capable of characterizing the underlying syntactic structure of just the sentences in the language at hand".(Fillmore, 1968, p.21) and draws attention to the importance of two concepts: the centrality of syntax, and the importance of covered categories, i.e. grammatical properties

that lack a direct morphemic realization but identifiable through selectional constraint and transformational properties (for example the distinction between *effectum* and *affectum* in sentences such as *John builds/breaks a table* cfr. Fillmore (1968, p.24)).
In line with the work of Tesniere (1959) he holds that:

> the subject/predicate division is an importation into linguistic theory from formal logic of a concept which is not supported by the facts of language and, furthermore, that the division actually obscures the many structural parallels between "subjects" and "objects". (Fillmore, 1968, p.3)

He claims that the predicate/subject traditional division pertains only to the surface structure and that the apparent non-comparability of different languages and of their traditional case systems has to be seen as a consequence of the fact that what has been traditionally taken into account is the surface structure of languages.

According to his view, instead, what is conceived as basic and primitive are those "case" relationships that pertain the deep structure of sentences. He uses the term "case" in a deep-structure sense to identify relationships relatively stable and comparable across languages (from this point on we will always refer to deep-structure cases simply as cases and to traditional cases as case forms). For each language Fillmore claims that it can be outlined a set of case categories with various syntactic, lexical and semantic consequences, i.e. he suggests that surface syntactic structures may be expected on the basis of the occurring cases in a sentence.

Fillmore proposes a list of 6 cases: Agentive (A); Instrumental (I); Dative (D); Factitive (F); Locative (L); Objective (O). These cases are presented as a starting point that may need to be expanded. They are in defined in Fillmore (1968, p.46) as:

> Agentive (A), the case of the typically animate perceived instigator of the action identified by the verb.
>
> Instrumental (I), the case of the inanimate force or object causally involved in the action or state identified by the verb.
>
> Dative (D), the case of the animate being affected by the state or action identified by the verb.
>
> Factitive (F), the case of the object or being resulting from the action or state identified by the verb, or understood as a part of the meaning of the verb.
>
> Locative (L), the case which identifies the location or spatial orientation of the state or action identified by the verb.
>
> Objective (O), the semantically most neutral case, the case of anything representable by a noun whose role in the action

> or state identified by the verb is identified by the semantic interpretation of the verb itself; conceivably the concept should be limited to things which are affected by the action or state identified by the verb. The term is not to be confused with the notion of direct object, nor with the name of the surface case synonymous with accusative.

According to the theory of Case Grammar, presented in the article, the different arrays of possible occurring cases - i.e. the possible case frames - in a sentence determine the sentence type which (such as the cases themselves) is supposed to be universal and what is variable is the surface realization. In fact, the same deep structure may correspond, in different languages and also within the same language, to different surface realizations as we can see in the examples given in Marmo (2017, p.9) which show the different possible realization in English, Italian and Latin of the same deep structure graphically shown in Figure 2.1:

1. John gave the books to my brother *(John ha dato i libri a mio fratello, Johannes dedit illos libros fratri meo)*;
2. John gave my brother the books *(John ha dato a mio fratello i libri, Johannes dedit fratri meo illos libros)*;
3. The books were given to my brother by John *(I libri sono stati dati a mio fratello da John, Illi libri dati fuerunt fratri meo a Johanne)*;
4. My brother was given the books by John *(A mio fratello i libri sono stati dati da John, Meo fratri illi libri dati fuerunt a Johanne)*.

The deep structure of a sentence can be graphically represented through a tree graph as shown in the example in the Figure 2.1 below taken from Fillmore (1968).

The different case frames in which a verb may be inserted, alongside with its transformational properties, allow the description of their possible multiple meanings.
To summarize we may say, using Fillmore words that:

> [...]the deep structure of (the propositional component of) every simple sentence is an array consisting of a V plus a number of NPs holding special labeled relations (cases) to the sentence. These relations, which are provided for categorially, include such concepts as Agentive, Instrumental, Objective, Factitive, Locative, Benefactive, and perhaps several others. Complex sentences involve recursion through the category Sentence under the case category Objective. Verbs are subclassified according to the case environments which accept them, and the semantic

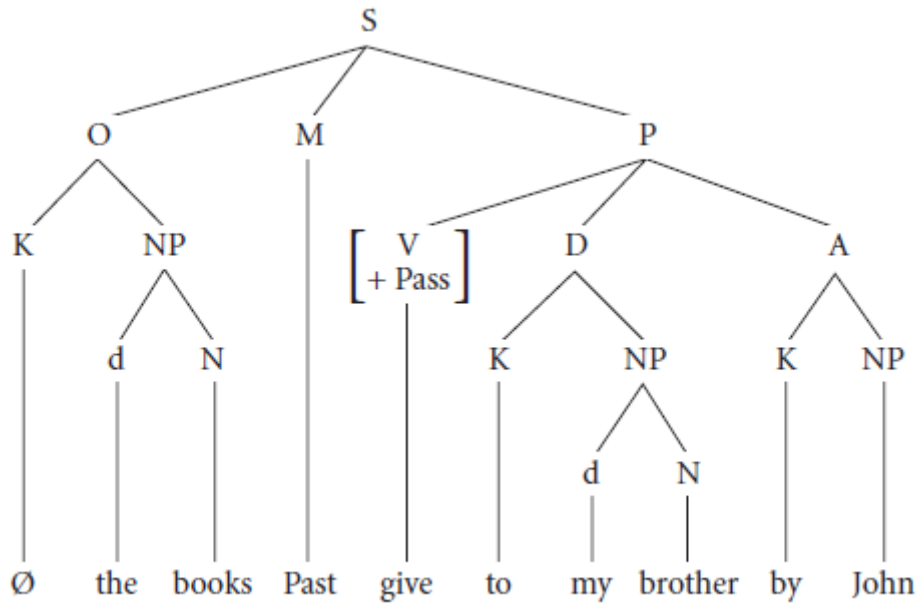


Figure 2.1: Graphical representation of the sentence "The books were given to my brother by John" (Fillmore, 1968, p.61)

> characterizations of verbs relate them either to specific case elements in the environment or to elements containing features (such as animateness) introduced as obligatory accompaniments of particular cases.

2.3 From Case Grammar to the concept of Frame

After the publication of the article *The Case for Case* 1968 Fillmore continues his research over case frames and on the lexicon. In his article *Types of lexical information*, published in 1969, he proposes what lexical information to include in order to semantically describe the lexical units. He presents the analysis of several verbs including the sell-buy and rob-steal pair (that will be central to many of his other future works) and describes them according to the arguments they require and to the role they have in the case frame they appear in. Here for the first time he uses specific names to label arguments (such as Victim, Thief, ecc), nevertheless this high specification is still perceived as superfluous (contrary to what we can see in future theorizations) since more generic and general labels appear to be better in the "Case Grammar" approach.

As noted by Marmo (2017, p.12), it is from his article on verbs of judging (1971), that Fillmore begins to feel the need to use specific terminology to

describe the "role structure". For this reason he enriches the list of cases with more specific roles such as "Situation" or "Affected" (Fillmore, 1971, 278). In in this article we can see the prodromes of a new concept of frame, which no longer corresponds to a schematization of case structures but to a schematization of situations or concepts presupposed by the sentence.

Starting from this article, we see a gradual distancing of Fillmore from the generativist paradigm, whose fundamental ideas continue to be accepted but whose lack of attention to experience and context is criticized. In fact, Fillmore believes that:

> First, the meanings of words may, more than we are used to thinking, depend on contexted experiences; that is, the contexts within which we have experienced the objects, properties or feelings that provide the perceptual or experiential base of our knowledge of the meaning of a word (or phrase, or grammatical category) may be inseparable parts of those experiences. Second, the process of interpreting an utterance may depend, more than we are used to thinking, on our perception of the context in which the utterance is produced and our memories of the contexts for earlier experiences with the utterance or its constituent parts (Fillmore, 1976, p.24).

In his article *An alternative to checklist theories of meaning* (1975a) he takes up two concepts that he considers important for the development of his theory: a) the concept of "prototype" (Rosch, 1973) and b) the concept of "frame" as presented within psychology and Artificial Intelligence studies (Minsky, 1974).

The proposal from Fillmore theory arises, as well as the Prototype Theory, as an alternative to the theories that claimed to be able to describe the meaning as a checklist of necessary and sufficient components. From the Prototype Theory Fillmore incorporates some concepts:

- In the description of meaning there are traits that are more important and central than others (e.g. if we consider "mug" we may agree that its property of being a container is more central than the material out of which it is made);

- To be a part of a category does not equals to be a good representative of that category (e.g. "kiwis" and "penguins" are indeed birds but they are not good representatives of the category since for example they do not fly);

- The boundaries between categories are fuzzy (e.g. it is not as easy as it may seem to clearly define and delineate the boundaries between for example "mug" and "glass").

As for the concept of frame, Fillmore traces it back to the notion of schema in Bartelett and to Minsky's theories 1974. It is a cognitive structure which makes it possible to categorise and understand the reality. [1]

Fillmore takes up these concepts and applies them to his field of investigation: semantics. He suggests that linguistic constructions and linguistic structures recall certain images or conceptualizations to the speakers'minds and that at the same time different images or conceptualizations need, in order to be linguistically expressed, different linguistic structures. In order to refer to these cognitive structures Fillmore uses, in his 1975 article, the term scene and uses the term frame to indicate "systems of linguistic choices":

> I would like to say that people associate certain scenes with certain linguistic frames. I use the word scene in a maximally general sense, including not only visual scenes but also familiar kinds of interpersonal transactions, standard scenarios defined by the culture, institutional structures, enactive experiences, body image and, in general, any kind of coherent segment of human beliefs, actions, experiences or imagings. I use the word frame for any system of linguistic chioces [...] that can get associated with prototypical instances of scenes. Borrowing from the language of artificial intelligence and cognitive psychology, and recognizing that what I say may sound like extremely naive psychology, I would like to say that frames and scenes, in the mind of a person who has learned the associations between them, activate each other; and that furthermore frames are associated with other scenes by virtue of sameness or similarity of the entities or relations or substances in them, or their context of occurrence (Fillmore, 1975a, p.124).

The scene-frame model is then presented as potentially useful and applicable to other areas and other issues such as discourse analysis, the study of coherence in texts, the study of the acquisition of words' meaning, the study of synonymy etc.

Birth of a new concept of frame As already illustrated above, the concept of frame and scene as presented in 1975 by Fillmore is not new, but makes some concepts expressed and theorized in various fields its own. One problem that Fillmore has to face is that of the use of terminology. In fact, different terms were used over time to refer to the same general concept. To the distinction proposed in 1975a between frame and scene he substitutes a tripartite distinction by adding a third element which he calls "schema" (Fillmore, 1977a). According to this new distinction, "scene"

[1] For an overview of the story of the concept of frame see Tannen's article *What's in a frame?*

refers to elements and objects from the real world and experiences, "schema" refers to the conceptual framework linked to the categorizations of the scenes and "frame" refers to the resources used to represent at a linguistic level scenes and schemes.

It is in one of his most famous articles in 1982 that he reaches the definition of frame that will be the basis for developing the theory of Frame Semantics. He chooses to adopt the term "frame" broadly, to indicate all those concepts vaguely defined by a multitude of different terms. As explained by Fillmore:

> By the term frame I have in mind any system of concepts related in such a way that to understand any one of them you have to understand the whole structure in which it fits; when one of the things in such a structure is introduced into a text, or into a conversation, all of the others are automatically made available. I intend the word 'frame' as used here to be a general cover term for the set of concepts variously known, in the literature on natural language understanding, as 'schema', 'scenario', 'ideational scaffolding', 'cognitive model' or 'folk theory' (Fillmore, 1982, p.111).

2.4 Frame Semantics

The name "Frame Semantics", given to Fillmore's theory, is taken from the title of one of his best known works: the article *Frame Semantics* published in 1985. Here, with this name, he indicates the research program in empirical semantics based on the central notion of frame (cfr. supra) and interested in the study of words', phrases' and texts' meaning.

In his 1976 article Fillmore argues that the link between a word and its meaning can be of 3 types (1976, p.27):

- Functional - we can identify a word through the function of what it denotes (e.g. we can identify a ball as "something you play with");
- Criterial - we can identify a word through the properties of what it denotes (e.g. we can identify a ball as "something round, light weighted etc");
- Associational - we can identify a word through the collection of "things" that are usually linked with it (e.g. we can identify the breakfast with the food that is usually eaten).

He also believes that the process of understanding the meaning of a word "requires us to call on out memories of experiences - selected, filtered, and generalized - through which we have learned the words in their labeling or describing functions."(Fillmore, 1976, p.27). In other words, we may say

that the meaning of words can be understood only recalling and invoking a particular frame (using the definition of "frame" in Fillmore (1982) - cfr. supra). The meanings can therefore be shared only between people who share the frame necessary for their understanding.

Words are then interpreted as footholds for rebuild certain scenes or situations. In Fillmore (1977c) we find two examples (that are recurrent in Fillmore works) used to clarify this assumption.

The first example involves the words "land" and "ground". These words denote the same "thing", but do not offer the same perspective on reality and implies different scenarios. When we hear someone saying "we reached the ground" we call out in our mind a certain scene in which the speakers reach the surface of the earth after a flight and when we hear someone saying "we reached the land" we imagine a certain scene in which the speakers reach the dry surface of the earth after being in the sea or in the middle of a lake.

In the second example he reflects on the difference between "sit up" and "sit down". Also in this case the scenarios that are recalled in our mind are different. If we say for example "He managed to sit up" we are depicting a situation where someone who was previously lying down and was unable to pull himself up has finally managed to do so. Instead, if we say "He managed to sit down" the protagonist of our scene is no longer someone unable to get up from a lying position, but to sit down from a standing position.

An important distinction that Fillmore brings to light in his 1982 paper is that between invoked and evoked cognitive frames (Fillmore, 1982, p.124). This difference concerns the different ways in which frames enter the interpretative process: on the one hand a piece of text *evokes* a frame in the mind of the interpreter, on the other the intepreter *invokes* a frame to understand a piece of text:

> On the one hand, we have cases in which the lexical and grammatical material observable in the text 'evokes' the relevant frames in the mind of the interpreter by virtue of the fact that these lexical forms or these grammatical structures or categories exist as indices of these frames; on the other hand we have cases in which the interpreter assigns coherence to a text by 'invoking' a particular interpretative frame.

The Frame Semantics theory rejects the clear distinction between what is "linguistic" and what is "non-linguistic" and opposes a Semantic of Understanding (U-Semantics) to the Truth-Conditional Semantics (T-Semantics). While T-Semantics argues that the meaning can be reduced to the truth conditions of an utterance, and that therefore knowing the truth conditions of a sentence is equivalent to knowing its meaning, the theory proposed by Fillmore aims to

> uncover the nature of the relationship between linguistic texts and the interpreter's full understanding of the texts in their contexts. It is 'empirical' rather than 'formal' in that it seeks to find the detailed ways in which specific expressions fit their situations. (Fillmore, 1985, p.231)

U-semantics does not separate language neither from how, for what purposes and in what circumstances it is used (Pragmatics) nor from the so-called extra-linguistic world. Regarding this last point Fillmore 1985 argues with the structuralist theory of semantic fields and proposes a model that is no longer based, for the description of meaning, on the relationships that words have with other words belonging to the same semantic field. He argues that for the description of meaning it is necessary to leave the purely intralinguistic world and therefore abandon the dictionary model for an encyclopaedic one. The encyclopaedic model does not eliminate the distinctions between the linguistic and extra-linguistic world, but relies on the second for the understanding of the former. Using Fillmore's words:

> Semantic theories founded on the notion of *cognitive frames* or *knowledge schemata* [...] approach the description of lexical meaning in a quite different way. In such theories, a word's meaning can be understood only with reference to a structured background of experience, beliefs, or practices, constituting a kind of conceptual prerequisite for understanding the meaning. Speakers can be said to know the meaning of a word only by first understanding the background frames that motivate the concept that the word encodes. Within such approach, words or word senses are not related to each other directly, word to word, but only by way of their links to common background frames and indications of the manner in which their meanings highlight particular elements of such frames. (Fillmore and Atkins, 1992, p.76-77)

2.5 Frame Semantics and lexicography

Starting from the 1990s Fillmore, in collaboration with the computational lexicographer B. Atkins, investigates the possibility of applying frame semantics to lexicography in particular through the use of new technologies. The progress in computer science and computational linguistics makes it possible to pass from the analysis of a few examples or intuitions of native speakers to the analysis of large corpora of texts.

Fillmore and Atkins already from their 1992 article and more fully in that of 1994 show how, thanks to the work on large corpora, it is possible to notice an evident limitation of traditional dictionaries. To overcome this limitation Fillmore and Atkins propose the idea of an online dictionary

based on frames. In this dictionary "individual word senses, relationships among the senses of polysemous words, and relationships between (senses of) semantically related words will be linked with the cognitive structures (or "frames"), knowledge of which is presupposed for the concepts encoded by the words" (Fillmore and Atkins, 1992, p.75). Here we see the founding idea of what will be the FrameNet database.

The type of lexicon description that the analysis of Fillmore and Atkins, as explained in 1992's article, aims to do integrates Grammar and Semantics. Each lexical unit is presented with its "valency description" which specifies which context is required by the lexical unit, both semantically and syntactically and what is the contribution of this to the structure in which it appears.

In this article (and in the article published in 1994) they describe the RISK frames and the "categories" typical to the risk scenario.

More specifically, the categories they identify are the following (Fillmore and Atkins, 1992, p.81-84):

- Chance - "the uncertainty about the future";
- Harm - "a potential unwelcome development";
- Victim - the one who may suffer from the Harm;
- Valued Object - "a valued possession of the Victim, seen as potentially endangered";
- (Risky) Situation - "the state of affairs within which someone might be said to be at risk";
- Deed - "the act that brings about a risky situation";
- Actor - "the person who performs the Deed";
- (Intended) Gain - "the Actor's hoped-for gain in taking a risk";
- Purpose - the goal of the Actor when performing the Deed;
- Beneficiary - "the person for whose benefit something is done";
- Motivation - "the psychological source of the Actor's behevior".

In this categories we can see how the "deep cases" of the first theories of Fillmore have evolved gaining a much greater specificity, this categories will be presented in FN as "Frame Elements" (FEs) (cfr.infra).

The analysis of the lexicon based on frames and a lexicography based on frames also make possible a new interpretation of the concept of polysemy.

Traditional lexicography for defining two senses of a word as separate is based on the periphrases that could be used to replace it. Different periphrases would, according to these approaches, correspond to separate

senses. The frame approach to lexicography, instead, considers as separate senses not the ones that need different periphrases in order to be replaced, but rather those that are interpreted in the light of different frames. This representation of polysemy could not be reported by standard dictionaries and is one of the reasons why Fillmore and Atkins believe it is important to create a frame-based lexical resource.

The project of creating such a resource began to take shape in 1997 at the International Computer Science Institute with the start of FrameNet project, which we will better discuss in the next chapter.

Chapter 3

FrameNet

The FrameNet project is a computational lexicography project which grounds its roots in the studies of Fillmore and Atkins *(cf. supra)* and represents the application of Frame Semantics theories to lexicography. It "extracts information about the linked semantic and syntactic properties of English words from large corpora, using both manual and automatic procedures and presents this in a variety of web-based reports" (Fillmore et al., 2003, p. 235). The product of the project, that is conceived as and it is still a work in progress, is a lexical-semantic database which is both machine and human readable. It aims at describing lexical items providing for each item its valence description and a rich semantic description according to FS. It is useful for a huge number of computational purposes and it has been enlarged to new languages. It is an open source project, freely available online[1]. As for today, the latest version released is the 1.7.

In this chapter we will present the FN project and the FN database. we will review its structure and present an outline of its applications. Finally, we will illustrate the research conducted on the possibility of expanding FN to new languages and we will present the Multilingual FrameNet project and the Global FrameNet initiative.

3.1 Background and early development

The researches of Fillmore and Atkins on the possibilities of applying Frame Semantics to lexicography *(cfr. supra)* are concretized for the first time in 1993 with the European Union funded international project DELIS (DEscriptive Linguistic Specifications). This project had three main objectives: "to contribute to a methodology of dictionary development based on corpus evidence; to produce parallel dictionary fragments in five languages, and to produce software tools supporting this kind of lexicographic work" (CORDIS, 1993).

The participants of the project included Fillmore alongside with Heid,

[1] https://framenet.icsi.berkeley.edu/fndrupal/

Atkins, Nicoletta Calzolari (ILC Pisa), Anna Braasch (CST Copenhagen), the late Ole Norling Christensen (Danish National Dictionary), Nicholas Ostler (Linguacubun Ltd.), Annie Zaenen (Xerox) and Willy Martin (Free University, Amsterdam).

The group focused on verbs of communication and perception in five languages (Danish, Dutch, English, French and Italian) and produced a contrastive lexicon. They grounded their research and their work on FS and on the notions of frames and Frame Elements (FEs) and used the FEs configurations as an interlingua (Fillmore et al., 2003, p.241-242).

The DELIS experience (1993-1995) served as a starting point for the FrameNet project. The first proposal of the FN lexicographic work was written in 1997 by Fillmore, Atkins, Heid and J.B. Lowe and the project began in 1997 as a three years funded project at the International Computer Science institute at the University of Berkeley, California.

The initial work can be divided into two phases: a first phase (between 1997 and 2000, corresponding to the first funded project) which aimed at developing the tools for building the database and at beginning the development process and a second phase (from 2000) which aimed at increasing the word coverage and at annotating example sentences (Fillmore et al., 2003, p.242).

The purpose of the project as conceived by C. F. Baker, C. J. Fillmore and J. B. Lowe was to be able to produce, in machine readable form, a description of the lexicon, that is the "encoding, by humans, of semantic knowledge in machine readable form". The description of the lexicon, collected in a database, is based on frames and for each word (or lexical item) it highlights its own valence both from a semantic and a syntactic point of view (1998, p.86), that is it provides a description of the elements with which that word must appear in a given language to produce an acceptable sentence in that language. As specified by Fillmore et al. (2003, p.236) in fact:

> In FrameNet, information about valence must be specified in both semantic and syntactic terms; the semantic roles that complements play with respect to the meaning of the word must be accounted for, and the grammatical properties of the possible complements of a word must be identified. Semantic valence information is often recorded in a notation that is similar to logic, and referred to as argument structure. Syntactic valence information is usually specified in terms of the phrase types (e.g. noun phrase, prepositional phrase, etc.) of the possible complements, and in terms of the grammatical functions (e.g. subject, object, etc.) that the complements bear with respect to the word.

The key features of the project were, in addition to being rooted in the FS:

> a - a commitment to corpus evidence for semantic and syntactic generalizations, and b - the representation of the valences of its target words (mostly nouns, adjectives, and verbs) in which the semantic portion makes use of frame semantics. (Baker et al., 1998, p.86)

The commitment to corpus evidence causes the description of the lexicon to be grounded in real texts, that is, not created *ad hoc* for research, and proceed by generalization starting from the phenomena observed. The database is intended to be built bottom-up, emerging from the empirical evidence.

3.2 FrameNet structure

The FrameNet database is structured as a net of frames, interrelated through different kinds of relations. Each frame is evoked by a group of words (or multiword expressions, MWEs) that are called Lexical Units (LUs). In FN each frame is presented alongside with the list of its frame evoking elements (FEEs), i.e. its LUs, the participants or properties of the frame, i.e. its FEs, and a list of sentences sampled from wide corpora that exemplify the linguistic realizations of frames, i.e. its sample sentences (SSs).

3.2.1 FrameNet status

Currently the resource contains:

- 1,224 frames, of which 1,075 are Lexical and 149 Non-Lexical (*cfr.infra*);
- 10,478 FEs in Lexical Frames, with a mean of 9.7 FEs/Lexical Frame;
- 13,685 LUs with different PoS (part f speech) and different level of completion, where "Finished" is the highest degree;
- 202,978 Annotation Sets roughly corresponding to annotated sentences and relative both to lexicographic and full-text annotation.

3.2.2 Frames

In the previous sections we have already analysed and investigated the concept of frame as the structure that allows the understanding and the interpretation of words, which is evoked by words and invoked by the speakers in order to understand words and sentences.

Frames may refer to:

1. **Events** - for example: `Being_born`, `Giving_birth`, `Death`;

Lexical Units	In FN	Finished	>10 Annotation Sets
Nouns	5575	2698	2225
Verbs	5213	2852	2300
Adjectives	2407	1368	1063
Other POS	490	67	134
Total	13685	6985	5722

Figure 3.1: Status of LUs in FN, FrameNet website, retrieved Nov., 02, 2021, from https://framenet.icsi.berkeley.edu/fndrupal/current_status .

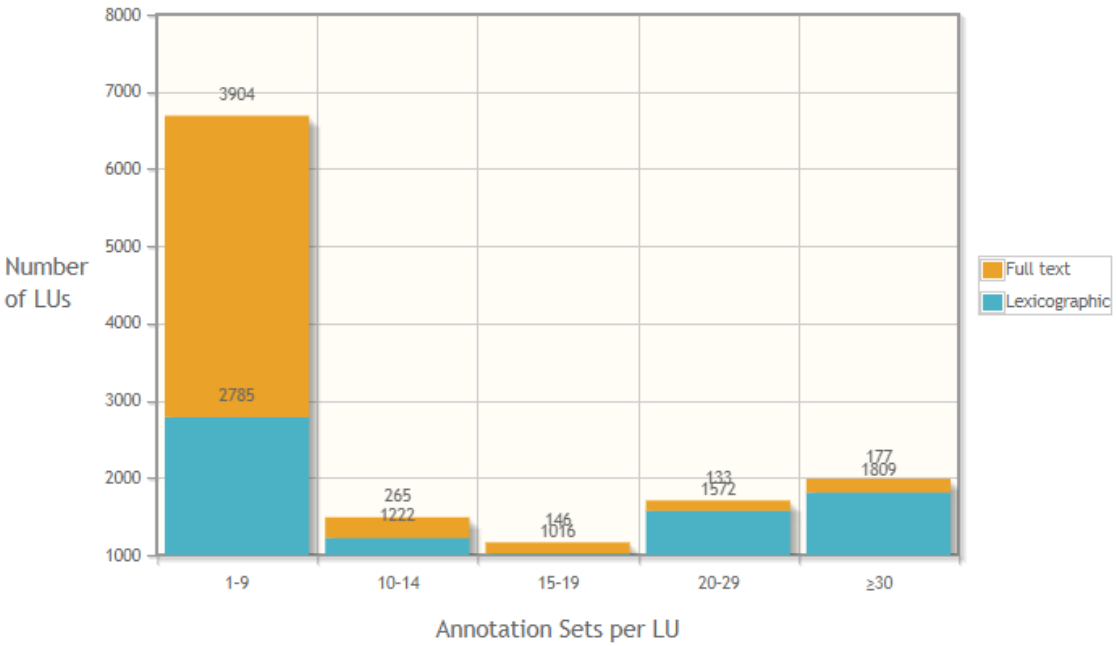


Figure 3.2: Status of Lexicographic and Full-text Annotations in FN, FrameNet website, retrieved Nov., 02, 2021, from https://framenet.icsi.berkeley.edu/fndrupal/current_status .

2. **Relations** - for example: `Personal_relationships, Kinship`;

3. **States** - for example: `Being_in_operation, Being_located`;

4. **Entities** - for example: `Gizmo, Body_parts, Architectural_part`.

The frame name is unique and mnemonic, and it is used in addition to the numeric ID of each frame in order to facilitate the access to data. There are some parts of frame names which are conventionalised, for instance the ending "_scenario" or "_image_schema" refer to more general frames that stand in higher nodes in FN hierarchy *(cfr. infra)*.

Each frame in FN appears alongside with:

- A frame definition which describes the situation or the object represented by the frame, often with example sentences (which are not part of the SSs group described below). It often illustrates also the major participants of the frame (fig. 3.3);

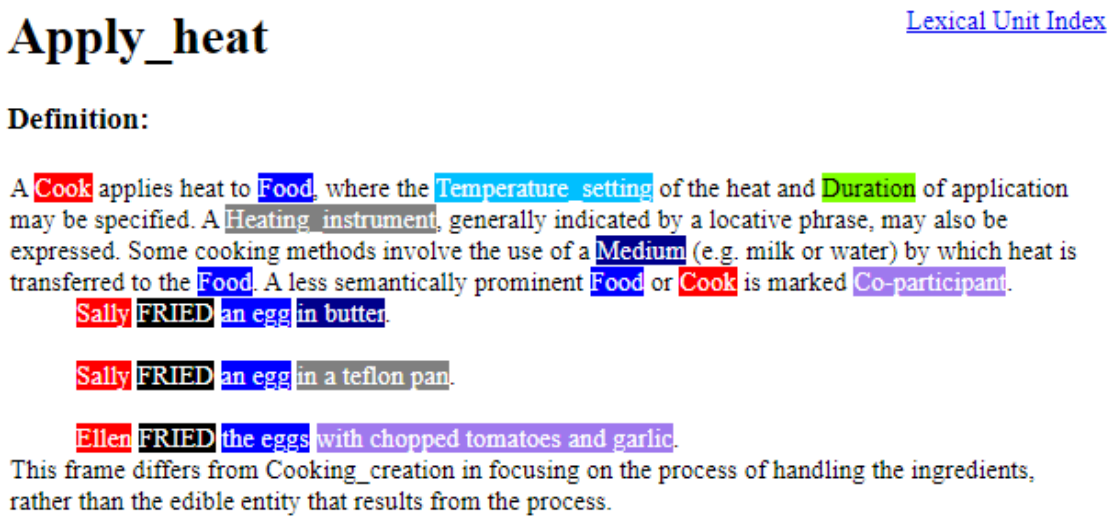


Figure 3.3: `Apply_heat` definition in FN.

- The list of its FEs, divided into Core and Non-core (*cfr. infra*), presented with the specification of their relationships and often presented with example sentences (fig. 3.4);

- The LUs that evoke the frame, first as a concise list and then in a table alongside with other information regarding the LU (*cfr. infra*) (fig. 3.5);

- The SSs that exemplify its linguistic realizations, accessible LU by LU in the Annotation Report section *(cfr.infra)*;

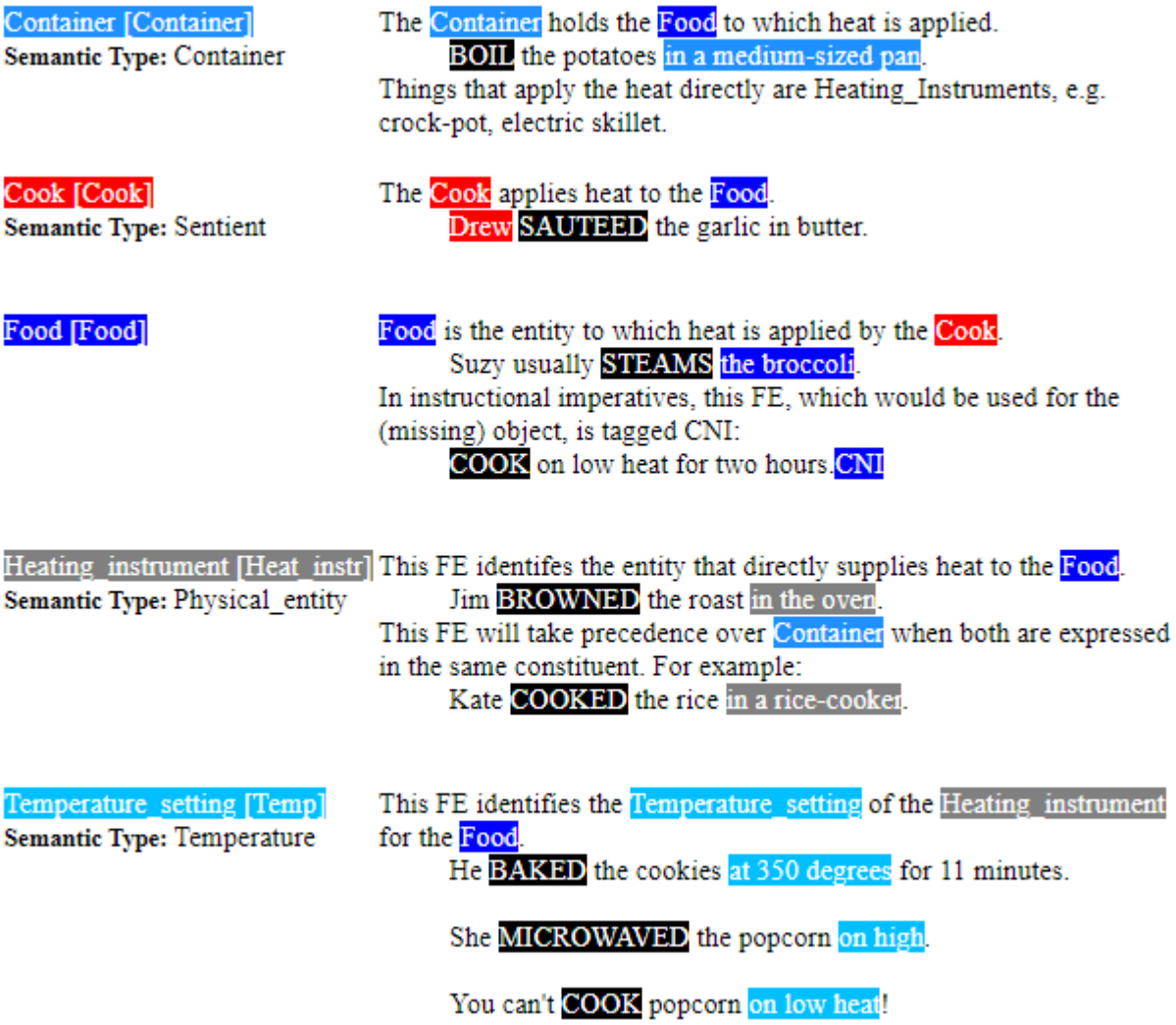


Figure 3.4: `Apply_heat` Core FEs in FN.

bake.v, baking.n, barbecue.v, blanch.v, boil.v, boiling.n, braise.v, broil.v, broiling.n, brown.v, char.v, coddle.v, cook.v, cooking.n, deep fry.v, fry.v, frying.n, grill.v, grilling.n, melt.v, melting.n, microwave.v, parboil.v, plank.v, poach.v, roast.v, roasting.n, saute.v, scald.v, scorch.v, sear.v, simmer.v, simmering.n, singe.v, steam.v, steaming.n, steep.v, stew.v, stewing.n, toast.v, toasting.n

Created by KCo on 10/03/2001 05:32:57 PDT Wed

Lexical Unit	LU Status	Lexical Entry Report	Annotation Report	Annotator ID	Created Date
bake.v	**Finished_Initial**	Lexical entry	Annotation	ACW	02/21/2002 10:46:36 PST Thu
baking.n	**In_Use**	Lexical entry	Annotation	HPh	04/13/2015 01:37:23 PDT Mon

Figure 3.5: List of `Apply_heat` LUs and description of the first two in FN.

Inherits from: Activity, Intentionally_affect
Is Inherited by:
Perspective on:
Is Perspectivized in:
Uses:
Is Used by: Cooking_creation
Subframe of:
Has Subframe(s):
Precedes:
Is Preceded by:
Is Inchoative of:
Is Causative of: Absorb_heat
See also: Cooking_creation

Figure 3.6: `Apply_heat` frame-frame relations in FN.

- The list of its relationships with other frames in the database (fig. 3.6).

Sometimes frames appear also with semantic type labels that further characterize them. The semantic type labels that a frame can have can be grouped into two categories: ontological semantic types (which may be also be omitted) and framal types (which are always specified) (Lönneker-Rodman and Baker, 2009, p.422). Ontological types are organized into a hierarchy (fig. 3.7) and when an ontological type is specified it implies that all the LUs that evoke the frame must have the same semantic type.

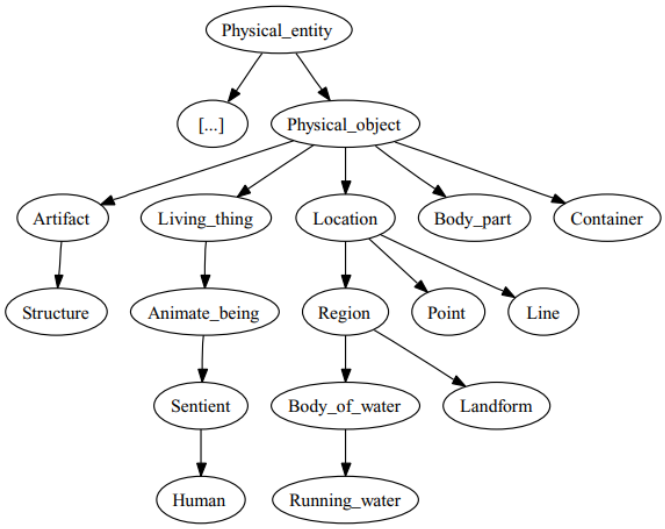


Figure 3.7: Hierarchy of a group of ontological semantic types in FN (Lönneker-Rodman and Baker, 2009, p.422)

Framal types do not regard the kind of LUs in a frame, but rather are metainformation about the frame itself. Because of the construction of FN as a net of frames interrelated by directional relationships, we can find two framal types of frames. Beside frames of the type presented so far, which are evoked by words and are linguistically encoded, called Lexical frames, we can find frames that stand at a higher node in the hierarchy and are functional to the architecture of relationships. These frames are called Non-Lexical frames.

Frame development FN frames are "models and groupings of ideas that are evoked by words, and" their descriptions "depend on decisions about the breath of vocabulary that we are modeling with a frame" (Ruppenhofer and Scheffczyk, 2016, p.11). In order to create a frame it is necessary to find groups of words that show some semantic overlap and decide the boundaries of these groupings. For this reason we start from the attestations in corpora

of semantically similar words and create groupings of attestations that present some regularities. The criteria on which these groupings are based are of two kinds: a) a checklist of features that words have to share to be put in the same frame, and b) the utility of the group in paraphrases.

Checklist of features Two lexical items are considered LUs of the same frame:

- If they have the same FE in number and type, both implicit and explicit. This criterion allows us, for example, to place Causatives (1) and Inchoatives (2) in different frames.

  (1) The Unionists in general **decreased** the number of their candidates. (`Cause_change_position_on_a_scale`)

  (2) The variation in day length **decreases** with distance from the poles. (`Change_position_on_a_scale`)

- If they are aspectually coherent, that is if they "all entail the same set of stages and transitions" (Ruppenhofer and Scheffczyk, 2016, p.13)
- If they reflect the same perspective on an event. For this reason two verbs like *buy.v* and *sell.v* cannot be placed in the same frame since the first takes the perspective of the buyer and the latter the perspective of the seller.
- If the both relationships between their FEs *cfr. infra* and the relationship with the background frame (i.e. the "presuppositions, expectations, and concomitants of the targets" (Ruppenhofer and Scheffczyk, 2016, p.14)) are the same.
- If their basic denotation is similar and the pre-specifications they impose on FEs are similar.

Paraphrasability In order to decide if two lexicals are to be considered LUs of the same frame "we ask whether one can more or less felicitously substitute one lexical unit for another and still evoke the same frame and express the same kind of semantic roles as syntactic dependents of the new lexical unit" (Ruppenhofer and Scheffczyk, 2016, p.15).

It is important to notice that the paraphrasability analysis is done at the level of LUs and not of sentences, for this reason LUs of sentences with similar meanings can still evoke different frames. For example, as in Ruppenhofer and Scheffczyk (2016, p.16), we can see that even though the meaning of the sentences in (3) and (4) is roughly the same, the word *harden.v* in the first sentence is inchoative and in the second is causative and therefore the frames evoked are `Change_of_phase` in the first sentence and `Cause_change_of_phase`.

(3) The paste **hardened** due to hydratation of the cement.

(4) The hydratation of the cement **hardened** the paste.

Frame to frame relations As we have said earlier FN is constructed as a net of frames. This allows the database to capture and express generalizations that transcend the boundaries of frames. For example it would be impossible to express the link between `Commerce_buy` and `Commerce_sell`, which focus on the same scene but from different perspectives.

Frame-to-frame relations are always directed, which means that they go from a specific frame to another specific frame and not the other way round. The frame from which the relation starts, which is more general and abstract, is called Super_frame (parent frame) and the frame towards which the relation is directed, is called Sub_frame (child frame). It is more specific and less abstract then the Super_frame.

The possible frame-frame relationships are:

- *Inheritance* - corresponds to the "IS-A" relation of many ontologies. It is the strongest frame-to-frame relation and is based on the idea that "each semantic fact about the father must correspond to an equally specific fact about the child" (Ruppenhofer and Scheffczyk, 2016, p.80). The child frame inherits all the frame-to-frame relations of the Super_frame (except for the *See_also* relation) and, given its higher degree of specificity, can present some differences with the parent. In particular the Sub_frame: can have completely different extra-thematic FEs from the parent (for a discussion of the types of FEs *cfr. infra*), can have FEs that are not listed in the Super_frame, often does not mention those FEs which are Core-Unexpressed in the parent, two FEs of the Super_frame may converge in only one FE in the child frame.

- *Perspective_on* - links frames which represent a specific point-of-view on a neutral frame to the neutral frame itself. For example, the `Commerce_sell` and `Commerce_buy` frames are linked through the perspective_on relationship to the `Commerce_goods-transfer` frame.

- *Using* - is similar to *Perspective_on*, but it is more general. It is used when a Sub_frame inherits only part of a Super_frame. For example the frame '`Judgment_communication` *uses* the frames `Statement` and the frame `Judgment` instead of inheriting them since only part of each Super_frame is inherited in the Sub_frame.

- *SubFrame* - Some frames refer to complex situations which can be seen as sequences of states and transitions and might be analysed in sub components. The frames which refer to these sub-components are related to the complex frames with the *SubFrame* relationship (subframes). For example, the act of bringing a criminal to justice,

expressed by the `Criminal_process` frame, can be seen as composed of several sub-events each corresponding to a specific subframe: `Arrest`, `Arraignment`, `Trial`, `Sentencing`, and `Appeal`.

- *Precedes* - Subframes of the same complex frame are linked through the Precedes relationship. Going back to the previous example we can say that: `Arrest` precedes `Arraignment`, `Arraignment` precedes `Trial` and so on.
- *Causative_of* and *Inchoative_of* - This relation links frames that refer to scenes that are causative or inchoative of a static scene with the frame that encodes the static scene.
- *Metaphor* - links a Source frame with a Target frame when "many of all the LUs in the Target frame are understood at least partially in terms of the Source frame" (Ruppenhofer and Scheffczyk, 2016, p.85).

See_also - is intended specifically for human users of FN as help when "groups of frames that are similar and should be carefully differentiated, compared, and contrasted"(Ruppenhofer and Scheffczyk, 2016, p.85).

FN frame-to-frame relations can be graphically visualised through two visualization tools: the FrameGrapher and FrameNet Lattice List. The FrameGrapher tool [2] allows users to view and browse the relations between frames and their FEs. The tool allows the user to systematically explore the connections between frames by selecting a starting frame. The user has the possibility to choose the relations and the number of links he wants to see displayed. Once the relation graph is displayed it is possible to click on nodes to expand the graph from that node. The FE-to-FE relations that accompany each frame-to-frame relation are not shown in the graph, but can be viewed by clicking on the arrow that connects the frames and that graphically corresponds to the frame-to-frame relation.

Moreover, FN has developed a visualization tool, complementary to the FrameGrapher, for visualising how ontological semantic types relate with frame-to-frame relationships, considering also these ontological types as a sort of abstract SuperFrames that stand at a top-level in the frame hierarchy. This tool is called Frame Lattice List [3].

3.2.3 Frame Elements

FEs are the participants or properties of the frames and roughly correspond to semantic roles or theta roles. The first difference we can notice is that

[2]accessible at: https://framenet.icsi.berkeley.edu/fndrupal/FrameGrapher
[3]Available at: https://framenet.icsi.berkeley.edu/fndrupal/FrameLatticeList

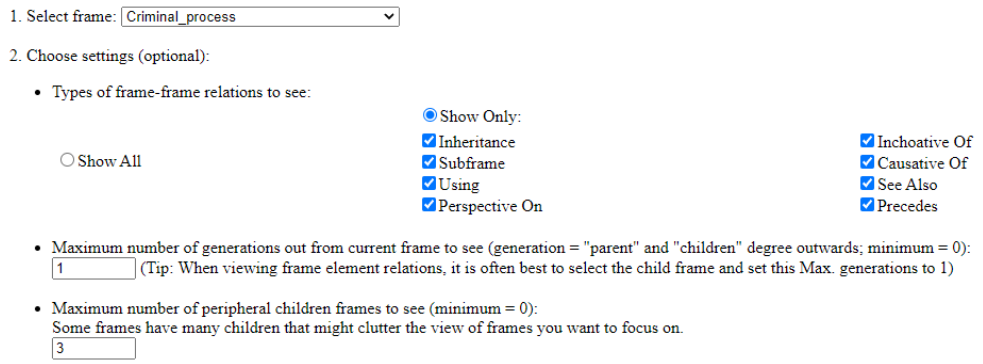


Figure 3.8: FrameGrapher search form

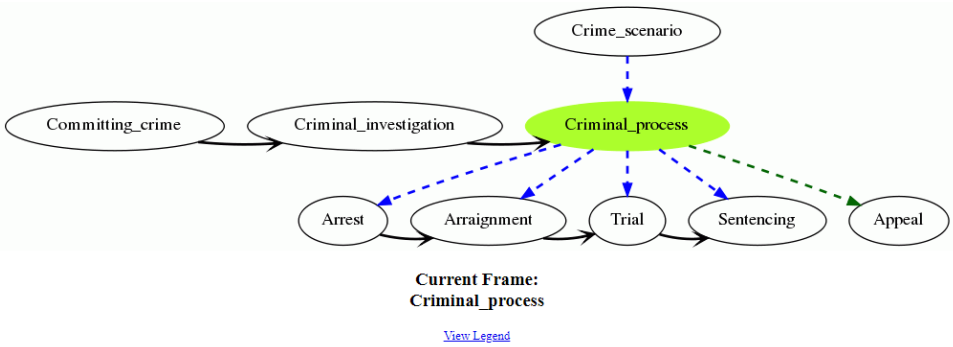


Figure 3.9: Graphic visualization of `Criminal_process` relations, as specified in the search form in fig.3.8

FEs, unlike semantic roles, are conceived as specific for the frame under analysis. This is reflected in the choice of FEs names. Even if they are not unique (unlike the frame names) they are not a small and closed class, but rather they adapt to the frame they appear in: for example the agent of a commercial transaction in which the focus is on the one that buys goods is not generically addressed as AGENT, but as BUYER. There are however FEs that are common to more than one frame and that maintain a high degree of generality *cfr. infra*.

Each FE in FN (3.4) is presented with a short description in free text that describes the meaning of the FE. It is often accompanied by an example sentence. Moreover, it is sometimes specified the semantic type of the FE which imposes semantic restrictions on the head words that can fill that role. For example if we consider frame `Communication` we find that the FE COMMUNICATOR needs to be filled by a word that identifies a sentient being.

FN FEs can be seen as the evolution of Fillmore's cases. In many situations FEs are linked to each other with edges that "go along with the frame-to-frame hierarchy to a high-level frame, such as `Event, Action, Intentionally_act, Motion`, etc. The FEs in these high-level frames are named AGENT, THEME, SOURCE, PATH, GOAL, MANNER, MEANS, INSTRUMENT, etc. thus covering roughly the basic case roles"[4] (Baker, 2008, p.13-14).

FEs can be divided into two main sub-classes, one of which can be further divided:

- **Core**
- **Non-core**, that can be:
  - Peripheral
  - Extra-thematic

Core FEs instantiate "conceptually necessary concept[s] of a frame, while making the frame unique and different from other frames" (Ruppenhofer and Scheffczyk, 2016, p.23). They need always to be overtly specified or implied and easily conceptually recovered. When omitted they receive a specific interpretation. Moreover, core FEs semantics do not depend on any formal marking but on the target itself, for this reason every FE that does not receive any formal marking or whose formal marking is idiosyncratic needs to be core.

Non-core FEs are participants or properties of the frame that can be omitted and are less central to the sense of the frame. There are two kinds of Non-core FEs, the Peripheral FEs and the Extra-thematic ones. Peripheral FEs do not uniquely characterize the frame and tend to be more generic.

[4]The font choice is ours.

They do not introduce new events, distinct from the ones the frame refers to. Extra-thematic FEs, instead, introduce a new event that specifies the background of the event to which the frame refers. They "situate an event against a backdrop of another state of affairs, either of an actual event or state of the same type" (Ruppenhofer and Scheffczyk, 2016, p.24).

The cases in which a Core FE is not overtly expressed are called Null Instantiantions (NULL) and can be of three kinds:

- Construction Null Instantiation (CNI) - in this case the omission of the FE is motivated and allowed by a specific grammatical construction;
- Definite Null Instantiation (DNI) - in this case the missing FE can be retrieved in the context;
- Indefinite Null Instantiation (INI) - in this case the missing FE can be imagined thanks to the shared knowledge of the world. In addition, we can assume that it has certain characteristics, but it cannot be recovered from the context.

  (5) They've been **eating** for hours!

  Here we can assume that what they ate is something edible, presumably a food, but we cannot specify it further since we cannot retrieve this information in the context.

It is sometimes possible that a single constituent instantiates more than one FE, in this case we speak of FE conflation. The different FEs that are instantiated by the same constituent are annotated in FN on different layers.

In the same sentence we can find the same FE label more than once for each target. This may happen either because in the sentence there are more than one instance of the same FE, or because the FE is only one, but it is realised in two discontinuous pieces rather than a continuous one. The situations in which a FE can be discontinuous are:

- With **raising predicates** like *may.v* or *might.v*: in this case the syntactic subject of the verb and its verb phrase complement together constitute the sole semantic argument of the raising predicate. For example in (6) the FE HYPOTHETICAL_EVENT is realized discontinuously by the syntactic subject of the target ("Parizeau") and its verb phrase complement ("have felt compelled to resign").

  (6) Parizeau **might** have felt compelled to resign.

- With **particular constructions** as for example, for English, the prepositional passive or the preposition stranding.

(7) The Peacock Throne has been **sat** on by the Iran monarchy since the days of Nadir Shah. (Ruppenhofer and Scheffczyk, 2016, p.38)

- With what is called **heavy modifier shift** that happens when finite relative clauses are separated from the head they modify.

(8) About this time a guy **appeared** who had only a pair of boxers on. (Ruppenhofer and Scheffczyk, 2016, p.39)

- In modifying structures when the modified head is preceded by the modifier and followed by a second argument.

(9) He **seems** a dumber man than you.

Frame Elements relations FEs are required by the frame and linked to it, but they are also linked together by interrelationships. These relations impact on annotation since they can license the omission of core FEs or impose the presence of FEs that otherwise can be omitted. There are three types of FE-to-FE relationships:

- **Coreness sets.** In some frames there are groups of core FEs that behave as a set, where the presence of only one of the members of the set is sufficient to complete the semantic valence of the target. For example in motion frames we have the Core FEs SOURCE, PATH, and GOAL, but but it is very rare that all three are expressed (the non expressed ones will then be annotated as Null Instantiations).

- **Requires.** The relationship Requires binds two frame Elements such that the presence of one necessarily requires that the other is also present. For example in the frame `Attaching` the presence of the FE ITEM requires the FE GOAL to be present (6) otherwise the sentence would be unacceptable (7):

(10) The robber **tied** Harry to the chair.

(11) *The robber **tied** Harry

- **Excludes.** The relationship Excludes binds a group of frames in which the presence of a member of the group means that no other group member can be present. For example in the frame `Attaching` the presence of the FE ITEM excludes the presence of the FE ITEMS. This is common when the same frame can be construed as symmetric/reciprocal (in this case the construction with the FE ITEMS) or

asymmetric (in this case the construction with the FE ITEM and GOAL).

Another common case in which we can find the Excludes relationship is in frames that refer to an event or situation which can be both be brought up by an unintentional cause or by an intentional agent (Ruppenhofer and Scheffczyk, 2016, p. 26).

3.2.4 Lexical Units

Until now we have used the term word in a generic way as an element that evokes frames, but it would be more correct to speak of LUs. A Lexical Unit according to the definition of Cruse et al. (1986) is a word taken in one of its senses, and it is defined as the pairing of a word, a lexical entry, with a meaning where to different meanings may correspond also different frames. It is different from the concept of lemma or from the concept of lexical entry because to each lemma (or to each lexical entry) may correspond more than one LU. Ruppenhofer and colleagues (2016, p.9-10) present as an example the lemma *bake.v*. It can be used to evoke three different frames according to the different meaning it assumes in the sentence:

- `Apply_heat`: Michelle **baked** potatoes for 45 minutes.
- `Cooking_creation`: Michelle **baked** her mother a cake for her birthday.
- `Absorb_heat`: The potatoes have to **bake** for more than 30 minutes.

Each one of these uses of the lemma *bake.v* corresponds to a different LU. Moreover, a LU does not always correspond to a lemma. It may correspond also to a multiword expression (MWE) or to an idiomatic phrase which is not further analysed in its internal structure.

LUs in FN are presented within the frame, alongside with:

- The LU status - It regards the level of completion of the entry writing in the database and it has Finished as a final state.
- The Lexical Entry Report - It presents the salient informations of the LUs: a dictionary definition, the report of the FEs that occur with that LU and their syntactic realizations.
- The Annotation Report - It presents the annotated sentences for that LU grouped by syntactic construction of the LU.
- The ID of the annotator.
- The date of creation of the LU entry.

LUs can potentially be of any PoS, but we can spot some differences between LUs refering to different PoS.

Verbs as LUs The simplest and most common case is that the LU is a verb. In this case we tend to find its FE (see above) realized as arguments of the verb. Consider for example the frame `Bringing` defined as follows:

> This frame concerns the movement of a THEME and an AGENT and/or CARRIER. The AGENT, a person or other sentient entity, controls the shared Path by moving the Theme during the motion. In other words, the AGENT has overall motion in directing the motion of the THEME. The CARRIER may be a separate entity, or it may be the AGENT's body. The CONSTANT_LOCATION may be a subregion of the AGENT's body or (a subregion of) a vehicle that the AGENT uses.

which has the following Core FE:

- AGENT: The Agent is a sentient being who physically controls the movement of the Theme via the carrier, accompanying the Theme.
- CARRIER:The Carrier provides support for the Theme. Movement of the Carrier results in movement of the Theme.
- AREA: Area is used for description of a general area in which the carrying action takes place when the motion is understood to be irregular or not to consist of a single, linear path.
- GOAL (Excludes: AREA): GOAL identifies the endpoint of the path.
- PATH (Excludes: AREA): Path along which carrying occurs.
- SOURCE (Excludes: AREA): SOURCE indicates the beginning of the path along which the Theme travels.
- THEME: The objects being carried.

and consider also the LU *carry.v* that evokes `Bringing` in the following sentence:

(12) Karl **carried** the books across campus to the library.

Here the FE core of `Bringing` are instantiated by the arguments of the verb: "Karl" instantiates the AGENT, "the books" represents the THEME, "across the campus" the PATH and "to the library" the GOAL.

Nouns as LUs Nominal LUs can denote three different things: events, relations, objects. The first two are more likely to be FEEs and the last one, which comprises natural kind nouns and artifact nouns, is more likely to be a slot filler.

Usually they "participate in lexicographycally relevant relationships with their governing predicates"(Ruppenhofer and Scheffczyk, 2016, p.41). The relationships between the frame evoking noun and their governing predicate may be of four different types. We can find: support expressions, copulas, existential sentences, and controllers.

Support expressions consist in a verb, called support verb, that combines with a state or event noun to form a verbal predicate. The verb usually does not contribute to the semantics of the noun but instead it denotes the same situation as the noun itself. Sometimes the support predicate may contribute to the semantic of the expression at different levels, for example it may change the temporal focus of the event, the point of view from which it is presented, the register of the conversation and finally it can add the idea of causation. We can distinguish 5 different kinds of semantic contributions (as summarized in Ruppenhofer and Scheffczyk (2016, p.44)):

- Plain Vanilla: in this case the support verb does not contribute to the semantics of the noun, i.e. it does not add anything (*be in a X mood)*;
- Aspectual: the support verb changes the temporal focus, the aspect of the predication (*fall into a X mood*);
- Point-of-view: the support verb may change the point of view over an event (*undergo a physical exam vs give a physical exam*);
- Registral: sometimes different support expression may be adequate to different register;
- Causative: the support may add the idea of causation to the event described by the noun. Usually there is also a non-causative support that corresponds to these support verbs as in *give a headache vs have a headache.*

When the LU is a noun combined with a support verb the FEs will be expressed as the arguments of the support verb.

(13) The Americans must have felt as if he was **taking** (support verb) **revenge** (nominal LU) on them for what had happened.

Copulas may be considered as a special kind of support verbs, the difference is that their semantic contribution appears bleached and they can combine not only with state or event nouns but also with relational nouns. Copular verbs can be used both to ascribe specific properties *(cf. ex.3)* or to predicate the identity between two referents *(cf. ex.4)*.

(14) Mark **is** (copula) nice.

(15) Jane **is** (copula) the head of the department.

Existential sentences correspond to *there-* constructions which may occur with a subgroup of nominal LUs to introduce the frame they evoke into the sentence.

(16) **There was** a fight last night.

As for today, existential sentences are annotated as sentences with support or copular verbs (e.g. in the previous sentence *was* would be annotated as copula).

Controllers are verbs that, unlike copular and support verbs, evoke a frame on their own but still have a shared participant with the frame evoked by the noun.

(17) Bill **offered** help in case of an emergency.

Here for example "offered" evokes the frame `Offering` and "help" evokes the frame `Assistance`, but "Bill" instantiates a FE of both frames.

Adjectives as LUs Adjectives are widely used in the fields of emotions (happy, sad, angry, frightened, etc.) and evaluations (nice, awful, pretty, etc.).

Adjectival LUs, such as nominal ones, often do appear with supports of various kinds such as copulas (*He **is** happy*) or support verbs (*He **feels** anxious*).

Adverbs as LUs Often constructions where adverbs evoke frames are used in alternations with adjectival constructions and even when adverbs evoke a frame it is usually not the predominant frame in the sentence.

As for today FN focused only on adverbs that describe the speakers attitudes *(cfr. ex.7)* and on epistemic and evidential adverbs *(cfr. ex.8 and 9)*.

(18) **Honestly**, I'm disappointed.

(19) He is **probably** in danger.

(20) She **reportedly** accepted bribes worth 45 million euros.

Prepositions as LUs Prepositions can be target and evoke frames within the fields of time, space and motion.

(21) She left the book **on** the table.

In most cases, anyway, prepositions are not FEEs but rather "inactive markers of FEs"(Ruppenhofer and Scheffczyk, 2016, p.50).

Conjunctions as LUs Conjunction LUs are very rare and in the few cases in which they evoke frames they describe "time, causality, conditionality or some other relationship between events"(Ruppenhofer and Scheffczyk, 2016, p.51).

(22) Just yell loudly **if** you need me.

Semantic types of LUs We can identify two different kinds of semantic types for LUs: Ontological types and Lexical types.

Ontological types are used, such as for frames and FEs, to classify the denotation of LUs. This classification by ontological types is independent of the division into frames and often does not coincide with it, crossing its borders. For example the ontological type "Body_of_water" is applied to some of the LUs of both `Natural_features` and `Biological_area`.

Lexical types correspond to labels applied to LUs in order to specify some characteristics that otherwise would not be expressed. The characteristics that can be specified are very varied and for this reason there is not a single or fixed way to interpret those labels and it is impossible to generalise across frames. Anyway, they can be grouped in three broad groups (Ruppenhofer and Scheffczyk, 2016, p.87):

- Types that specify semantic or syntactic constraints on the usage of LUs;
- Types indicating multi-frame relationships of LUs;
- Types that specify characteristics of the FEs that occur with the LU.

3.2.5 Sample Sentences

Sample Sentences (SSs) represent concrete linguistic realizations of frames and their FEs. These sentences are sampled from wide corpora with the aim of obtaining examples of all the valence patterns for each LU in a frame.

The idea of include real corpus examples in order to improve the quality and precision of the descriptions of lexical items traces back to the works of Fillmore and Atkins in the 1990s (1992, 1994, 1995).

3.2.6 FrameNet Annotation

There are two types of annotation: Lexicographic e Full-text (running-text). Lexicographic annotation aims to account for all the combinatory possibilities of the LUs, and record information on their syntactic and semantic valence. To achieve this purpose, in the lexicographic annotation, sentences are selected and extracted from the corpora based on the target LUs they contain.

The full-text annotation, on the other hand, aims to annotate all the FFEs in each portion of running text (potentially a LU on each token). Here sentences are not pre-selected on the basis of the LUs they contain.

The annotation is made on multiple layers and the most important are:

1. Target;
2. FE;
3. Grammatical Function of the FE (GF);
4. Phrase Type of the FE (PT).

The annotation on the first layer marks the target LU, while on the other three layers the annotation is done on the constituents that express the FEs of the target. Initially GF and PT were annotated only for Core and Peripheral FE, but now also Extra-thematic FEs are annotated.

PTs labels have been elaborated specifically for FN (for a complete account of FN PT labels see Ruppenhofer and Scheffczyk (2016, pp. 53 segg.), in order to describe the FEs and consequently to give a more precise description of the lexical targets they are linked to. GFs labels, instead are used to "describe the ways in which the constituents satisfy abstract grammatical requirements of the target word. FrameNet grammatical function labels do not describe surface-syntactic positions of the constituent to which we assign them" (Ruppenhofer and Scheffczyk, 2016, p.69).

3.3 FrameNet applications

FrameNet proved to be a useful resource for the accomplishment of many computational tasks. In this section we will not try to present the entire repertoire of the situations in which FN can be useful, instead we will present, as an example, an overview of some of the main or most recent applications of FN.

The usefulness of FN in Natural Language Processing depends largely on the success of systems for the automatic extraction and labelling of predicate-argument structures in texts, i.e. Automatic Semantic Role Labeling (ASRL) or semantic parsing, trained on the resource. This application of the resource has been studied since the early stages of the FN project. In fact, already

in 2002 Gildea and Jurafsky presented a shallow semantic interpreter based on FN frames and semantic roles and suggested several possible tasks for which this could be useful (e.g. Question Answering). During the years many systems of ASRL based on FN have been developed, we can recall for example SEMAFOR (Das et al., 2014, 2010), Framat (Roth and Lapata, 2015), and OPEN-Sesame (Swayamdipta et al., 2017).

Kaisser and Webber (2007) highlighted the importance of semantic roles in answering complex questions and showed that a frame-based method significantly outperforms a keyword-based system. In particular, the usefulness of FN for **Question Answering** was investigated by many researchers among which Sinha (2008) and Shen and Lapata (2007) that claim that "a FrameNet enhanced answer extraction module significantly outperforms a similar module that uses only syntactic information"(Shen and Lapata, 2007, p.19).

Another task that benefited from the exploitation of FN is **Information Extraction**. In fact, enriching Information Extraction paradigms with predicate-argument structure enhances the performances of the systems Surdeanu et al. (2003) and Fader et al. (2011).

FN has been used in **Text-to-Scene Generation** (Coyne et al., 2012) since it provides information on how actions and locations are conceptualised and linguistically expressed.

Ruppenhofer and Rehbein (2012) successfully applied FN model to **Sentiment Analysis**, noting that "tying sentiment analysis to frame semantics enables immediate access to a deeper lexical"(Ruppenhofer and Rehbein, 2012, p. 107)

FN has also proved useful in the context of dialogue systems. In particular, in 2013 Chen et al. showed that FN can be extremely useful in **Spoken Language Understanding**. In fact, an integration of the Spoken Language Understanding systems with FN would allow to automatically induce the semantic slots in which the Spoken Language would be mapped and therefore would limit the errors that can derive from a manual definition of the slots, such as the bias propagation.

Agarwal et al. (2014) applied FN to the automatic **extraction of social networks** from unstructured texts, taking advantage of the close relation between FN frames and social events and Søgaard et al. (2015) used FN frames to annotate Twitter data for **knowledge extraction**, arguing and finding that FS is particularly appropriate for the analysis of text from Twitter.

FN proved to be useful for analysing and structuring documents written in natural language. For example Alhoshan et al. (2018) used it to annotate software requirements written in natural language and therefore unstructured. Since, in order to be used, they need to be structured FN is useful because frame annotation adds structure and semantic metadata and allows to capture the meaning contained in the requirements.

Remijnse and Minnema (2020) showed the usefulness of FN in **linking**

events to conceptual knowledge in order to study how events are conceptualised in texts, how they are presented, what is the point of view, and which elements are highlighted. Moreover, in 2020 Lee et al. proposed to employ FN to **assess text difficulty**.

In 2018, building on previous researches (Torrent et al., 2014), da Costa and colleagues presented a project for building a personal travel assistant in the form of a chatbot. It would generate useful information for tourists, in particular by analysing and extracting relevant content from multilingual comments. This brings up another important issue, that will be addressed in the next section: the enlargement of FN to new languages.

FN can be useful also for non-computational purposes, as shown by Carrión (2006) in fact such a resource can be extremely valuable for **foreign language learners**. The possibility of accessing the lexicon structured in frames presented with the FEs conceptualised by native speakers would enrich the learning process and facilitate a "better understanding of the native speaker's conceptualization of a certain reality" (Carrión, 2006, p.75). This would help the learners since learning a language "implies much more than learning the system of communication and the aspects such as a reflection about the mode of conceptualization of the foreign language Community the culture and social construct created by that Community are key factors to be taken into account" (Carrión, 2006, p.75).

3.4 FrameNet for other languages

Given the many applications FN can have, its popularity increased over the years and as for 2018 "FrameNet's main publications have been cited over 2,500 times according to Google Scholar, and the database, in XML format, has been downloaded thousands of times by researchers and developers around the world" (Gilardi and Baker, 2018, p.13). During the years many research groups from all over the world started to develop FN-like resources for new languages (i.e. non-English).

The main projects for the development of FNs for new languages are:

- **Chinese FrameNet** - The Chinese FN project (You and Liu, 2005) begun in 2004 based at Shanxi University in Taiyuan. It is supported by corpus analysis and focuses both on common core of the language and on more specialistic domains such as law or tourism. In particular the Chinese FN team is focusing on the study of how FS relates to the Chinese language.

- **Danish FrameNet** - the Danish FrameNet project was launched in 2006 (Bick, 2011; Nimb, 2018). It is developed combining a Danish thesaurus and a Danish valence dictionary. The words in the valence dictionary were then translated into English and finally linked to a Berkeley FN frame. The choice of starting from "syntactic frames

considerably facilitated locating and checking corpus examples, since all syntactic complementation patterns were already available - and searchable" (Bick, 2011, p. 34) in parsed corpora.

- **Dutch FrameNet** - this project (Vossen et al., 2018) started from a Dutch corpus annotated with semantic roles (PropBank annotation). Dutch FN is now investigating also another way of developing FN, starting from events and linking them to texts using wikidata (Minnema and Remijnse, 2020). This event based approach allows to better capture the different framings on the same event.

- **Finnish FrameNet** - The Finnish FN (Lindén et al., 2017) was created frame by frame using Berkeley FN frames. For each frame a subset of its SSs was translated into Finnish and annotated, then Finnish sentences with similar meanings and valence patterns were extracted from newspaper articles and served as a base for the development of Finnish FN.

- **FrameNet Brazil** - The FN Brazil (Salomão et al., 2013) team is one of the most active teams in FS and FN research proposing a huge amount of possible developments and applications of the resource and also being the leader group of the Global FN challenge *(cfr. infra)*. The project for developing a FN for Brazilian Portuguese started in 2007 in the Computational Lexicography Lab at the Federal University of Juiz de Fora, Minas Gerais. The research group focused both on the development of a FN-link resource parallel to Berkeley FN and on the development of multilingual domain-specific resources, such as the mentioned field of tourism (Torrent et al., 2014).

- **French FrameNet** - This resource was built within the ASFALDA project (Candito et al., 2014). The ASFALDA project started in October 2012, and ended in June 2016. It was funded by the Agence Nationale de la Recherche (ANR). It aimed at annotating text in a French corpus with semantic information and at providing automatic tools for semantic analysis. It focused on four domains: verbal communication, commercial transactions, cognitive stance, and causality. For each domain the goal was to identify all possible relative frames, all LUs and to annotate SSs. The annotation is partially different from that of FN since non-core FEs are not annotated as FEs but rather the conjunctions that introduce them are considered FEEs.

- **German FrameNet** - During the years various research groups worked on the development of a FN for German. From 2002 to 2010 the SALSA project, based in Saarbrücken, worked on the TIGER corpus which was manually annotated with semantic roles. They used FN frames when possible and "proto-frames" (provisional frames) if FN was lacking of a suitable frame. The team worked also on FN

applications and in particular on textual entailment, releasing also an annotated training corpus for this purpose (Burchardt et al., 2009). Another team, set in Austin (Texsas), under the lead of Hans C. Boas, used the Saarbrücken data as a starting point and worked on a more detailed version of a German FN, employing FN software and methodology and basing the analyses on a larger corpus (Boas, Boas). Moreover, Boas is leading the annotation of a first-year textbook aiming at building a a frame semantic dictionary of German as a second language (Boas, 2013). In 2018 another team, headed by Oliver Czulo of the University of Leipzig, started a collaboration with FN Brazil for the full-text annotation of the TED talk "Do Schools Kill Creativity?" (Robinson, 2006).

- **Hebrew FrameNet** - This project is based at Ben-Gurion University. For the development of the resource, the team built a corpus of 23 million pairs of English-Hebrew sentences from the Open Subtitles database, word aligned them and parsed them. They then automatically annotated the English sentences using SEMAFOR and projected the annotation on Hebrew

- **Hindi/Urdu FrameNet** - Since Hindi and Urdu are closely related languages in 2018 started a project for developing at the same time a Hindi FN and a Urdu FN. They started from the full-text annotation of the TED talk mentioned *supra* ("Do Schools Kill Creativity?") (Robinson, 2006).

- **Japanese FrameNet** - The Japanese FN project started in 2002 at Keio University, after 2 years of preliminary studies. It built a Japanese resource starting from Berkeley FN structure and translating many of English LUs into Japanese. For this reason many of the LUs still lack annotation. The team is now enlarging the Japanese resource using crowdsourcing, within a joint project at the RIKEN Center for Advanced Intelligence Projects.

- **Korean FrameNet** - The Korean FN team started translating Berkeley English sentences into Korean. Moreover, they translated also LUs into Korean, but left many of them without annotation.

- **Latvian FrameNet** - The first project on the development of a FN-like resource for Latvian focused only on news domain and used a controlled language approach. The current project instead started from general corpus data, that were parsed and annotated. They are using FN 1.7 data and are doing only lexicographic annotation, not full-text.

- **Spanish FrameNet** - The Spanish FN project started in 2002 at the Autonomous University of Barcelona. They firstly built a corpus

representative of Spanish and New World Spanish. Then annotated with frame information the corpus data. Their practices remain close to Berkeley FN ones.

- **Swedish FrameNet** - The Swedish FrameNet project was developed at Gothenburg University. They started from ICSI frames and populated them with Swedish LUs. Such as with Japanese this approach led to a large dictionary, but few annotations. Moreover, the team added new frames for LUs that did not fit into Berkeley's frames. The Swedish team largely collaborated with other teams at the development of FNs for new languages (e.g. FN Brazil and Hindi/Urdu FN).

- **Bulgarian FrameNet** - The Bulgarian FN project (Koeva, 2010; Koeva and Dekova, 2008) started from the achievements of previous researches on valence in Bulgarian and on the result of these researches, i.e. a valence dictionary. The team worked on "lexical units identification and grouping, corpus annotation, valence frames development, and alignment with English semantic frames" (Koeva, 2010, p.325).

Studies have been carried out also for other languages such as Persian (Baghini et al., 2020; Nayeblui et al., 2015), Polish (Zawisławska et al., 2008), Arabic (Gargett and Leung, 2020), Thai (Leenoi et al., 2011), or Slovenian (Lönneker-Rodman et al., 2008).

As we can see the methodologies employed to develop FNs for new languages differ from project to project, for example they can start form corpus analysis (e.g. German, Hebrew), from FN frames and repopulate them with LUs in the new language (e.g. Japanese, Swedish), or from the translation of FN sentences in the new language (e.g. Korean).

These projects do not all adhere to FN to the same degree, some of them are more similar to FN while others are more distant. This is partly due to the different degree of similarity between English and other languages, partly because different research groups relied on different releases of Berkeley FN, and partly because of the different choices each research group made. For this reason in new FNs we can find both Berkeley frames and new frames written *ad hoc* for that language. Moreover, even when equivalent frames exist in two languages sometimes their structures differ. Finally, sometimes we can find, in the new FN-like resources, frames that are not present in Berkeley FN, but that are linked via various relationships to Berkeley frames (Baker and Ellsworth, 2017).

A question that arose since the early theorizations of FS, but more urgently after the beginning of projects for the extension of FN to new languages is whether semantic frames are universal and therefore applicable to all languages or if they are language specific. The universality of frames would imply the possibility of aligning between FNs in various languages,

while the language specificity would imply that the alignment of these resources is not possible and that therefore it is impossible to create a multilingual resource based on FS.

Even if there may be huge differences in how people conceptualize the reality across languages, FN frames have proven to be applicable to many languages with slight changes even when the considered languages are very different from English (such as Finnish or Chinese). In fact as stated by Gilardi and Baker 2018, p.14:

> While there are certainly many culturally specific phenomena and language specific preferences in patterns of expression, the conclusion from the ICSI FrameNet experience has been that many frames can be regarded as applying across different languages, especially those relating to basic human experiences, like eating, drinking, sleeping, and waking. Even some cultural practices are similar across languages, such as commercial transactions: in every culture, commercial transactions involve the roles buyer, seller, money, and goods (or services).

The fact that Berkeley frames are largely generalizable to other languages has suggested that it is possible to create a multilingual resource in which the various FNs for individual languages are aligned.

The main initiative for creating multilingual FNs is the Multilingual FrameNet project, headed by the ICSI at the University of Berkeley. The Multilingual FrameNet project (MLFN) represent an attempt to align all the different FNs developed for the various languages, despite the differences they hold (as pointed out earlier) in order to create a multilingual database.

Since the various FNs have been created adopting different approaches, also the alignment process needs to vary. The Berkeley team proposed an alignment scheme that "offers a unified view of the different FrameNet projects, which includes weighted relations between the frames in all the projects, a frame similarity metric both across projects and within the same project, a Frame Identification tool to suggest possible frame assignments for LUs that are present in some projects and absent in others, and utilities for importing projects in their native format" (Gilardi and Baker, 2018, p.19).

MLFN project embarked also in a shared annotation task, a project on the annotation of parallel corpora starting from the mentioned TED talk *Do schools kill creativity?* (Robinson, 2006). The choice of annotation a TED talk is due to the fact that TED talks offer the advantage of having freely available translations for many languages (61 as for 2018). Moreover, even if translations are done by volunteers and thus may not have a professional quality they "tend to be fairly "literal", so we would expect that the frames would be very similar across languages. However, frame differences occur even here" (Baker and Ellsworth, 2017, p.48). The aim of the shared annotation task is to assess the differences between FNs and thus help in

evaluating "the complexity of the work required to align the FrameNets developed for different languages" (Torrent et al., 2018), and to obtain a collection of annotated data.

Despite the fact that FN frames have proved to be widely generalizable across languages, the research carried out within the MFLN project has shown that in some cases the Berkeley frames (in release 1.7) are not the "best-fitting frames (BFF) for a word in another language [...] suggesting that different languages might require different adaptations to those frames"(Torrent et al., 2018). In particular Torrent and colleagues (2018, p.63) have compiled a list of possible cases in which FN frames (in the 1.7 release) are not the BFFs:

- Different perspective - when the LU evokes a frame with a different perspective from the ones in FN;
- Different causative alternation - the LU requires a causative interpretation we cannot find in the closer FN frames;
- Different inchoative alternation - the LU requires a inchoative interpretation we cannot find in the closer FN frames (which may be causative or stative);
- different stative alternation - the LU requires a stative interpretation we cannot find in the closer FN frames (which may be causative or inchoative);
- Too specific - FN frames are too specific for the LU under analysis, which is more generic;
- Too generic - FN frames are too generic for the LU under analysis, which is more specific;
- Different entailment - the LU has different entailments than the ones of FN frames;
- Different coreness status - the LU evokes a frame that is close to a FN one but with FEs with a different coreness status;
- Missing FE - the LU evokes a frame that is close to a FN one but with different FEs;
- Others.

The efforts for creating a multilingual FN, for creating frame-based resources for new languages and for developing new applications based on FNs are collected in GlobalFrameNet, a hub for collaboration created by FN Brazil [5].

[5]https://www.globalframenet.org/

Chapter 4

IFrameNet

4.1 Previous works on Italian FrameNet

The first efforts on the development of a FN-like resource for the Italian language date back to 2010 when many research groups in different research centers started to carry out researches on the possibilities of expanding FN to Italian. These research groups joined their efforts in the project IFrame to coordinate the research in the various centres. The members of IFrame were:

- University of Roma Tor Vergata (Rome) - Roberto Basili, Diego De Cao, Danilo Croce;
- Fondazione Bruno Kessler-IRST (Trento) - Emanuele Pianta, Sara Tonelli;
- University of Pisa (Pisa) - Alessandro Lenci, Martina Johnson;
- ILC-CNR (Pisa) - Simonetta Montemagni, Eva Maria Vecchi, Giulia Venturi;
- University of Trento-IRST (Trento) - Alessandro Moschitti;
- CELI (Turin) - Luca Dini, Giampaolo Mazzini, Marcella Testa.

At the University of Rome Tor Vergata the target research topics were: Automatic Lexical Unit induction and Automatic FrameNet labelling transfer to Italian. They proposed to exploit semantic spaces to automatically induce frames both for English and for new languages (Croce and Previtali, 2010; Pennacchiotti et al., 2008). The "hypothesis is that a frame semantic resource can be modeled and represented by a suitable semantic space model. The intuition is that semantic spaces are an effective model of the notion of "being characteristic of a frame" for both lexical elements and full sentences" (Pennacchiotti et al., 2008, p.790). They proposed and investigated three unsupervised models for LUs induction: the first relying

solely on distributional techniques, the second exploiting WordNet and the last one combining the two previous approaches. As a consequence of their research work they developed, for the English language, a Lexical Unit to WordNet Synset mapping, useful for the automatic induction of new LUs both for English and Italian (De Cao et al., 2008; Pennacchiotti et al., 2008). Subsequently, De Cao et al. (2008) investigated the methods proposed by Pennacchiotti et al. (2008) and exploited them to automatically induce LUs for Italian. They generated a set of 15,072 automatically induced LUs, but they did not validate all of them. Basili et al. (2009) proposed also a model to align semantic roles through parallel corpora.

In 2014 in Rome, Tor Vergata, Bastianelli and colleagues worked at the exploitation of FS annotation for enhancing the performances in Human Robot Interaction (HRI) considering frames as "the bridge between the linguistic knowledge contained in the utterances and the robotic actions" (Bastianelli et al., 2014, p.4522). The research group developed for this task a corpus, called HuRIC corpus (Human Robot Interaction corpus) of English robotic commands annotated with FN frames. The Universities of Rome, Tor Vergata and Rome, La Sapienza worked jointly at the HRI project *LU4R* that aimed at providing a context-aware system of Spoken Language Understanding for HRI, i.e. a system sensitive to the operational environment, and proposed to use FS annotation, in the form of FN frames, in order to achieve the objective (Vanzo et al., 2016). In 2016 HuRIC was extended to the Italian language by translating the English commands into Italian.

In Trento, at the Fondazione Bruno Kessler (FBK), Emanuele Pianta, Sara Tonelli and colleagues worked on the semi-automatic development of FN-like resources, in particular for the Italian language (Tonelli, 2010; Tonelli and Giuliano, 2009; Tonelli and Pianta, 2009a,b; Tonelli and Pighin, 2009; Tonelli et al., 2009). Their work focused on three approaches, exploiting:

- **Parallel Corpora** - They projected semantic information from English to new languages (here: Italian) relying on the idea that translation preserves semantic information;

- **WordNet/MultiWordNet** - They automatically induced new LUs using WordNet(Fellbaum, 2010), such as in Rome, Tor Vergata, and MultiWordNet (Pianta et al., 2002);

- **Wikipedia pages** - They proposed to exploit Wikipedia to automatically extract SSs, extract new LUs for English and use it as a bridge towards the development of FN-like resources for new languages.

With regard to parallel corpora, they tuned and tested two algorithms over two parallel corpora created for the task: "Europarl corpus" and "MultiBelrkeley corpus". The first one is a English-Italian bitext which is a

subpart of the multilanguage parallel corpus *Europarl* (Koehn et al., 2005) that contains the proceedings of the European Parliament in 11 European languages (French, Italian, Spanish, Portuguese, English, Dutch, German, Danish, Swedish, Greek, and Finnish). The second one was developed specifically for this task and consists of a subset of FrameNet SSs that were manually translated into Italian. The second proposal of the researchers at FBK was to link FN frames and WordNet synsets and acquire LUs for new languages using MultiWordNet as a bridge. Finally they proposed to use Wikipedia as a frame repository linking FN and Wikipedia using a word sense disambiguation system that for a LU l finds the Wikipage that best expresses the meaning of l and use the data acquired as a starting point to develop FNs for new languages (Tonelli and Giuliano, 2009, p.276).

Another line of research investigated at the University of Trento together with the FBK is the computational processing of spoken texts and the elaboration of dialogue systems. In 2008 Coppola and colleagues tried to exploit FN frames in order to create a shallow semantic parser to improve the management of complex dialogues. They run some experiments on an Italian spoken dialogue corpus, the LUNA corpus, they annotated with semantic frames (Raymond et al., 2007; Tonelli and Riccardi, 2010), and obtained good performances, showing that FN would be helpful for the management of dialogue systems.

In Pisa, Lenci et al. (2010) worked on the development of a FN-like resource for Italian starting from verbs and on the treatment of some Italian-specific issues that need to be addressed when creating a FN for Italian, such as the omission of syntactic subject, frequently occurring in Italian (pro-drop language), but not in English (non pro-drop) (Lenci et al., 2012). They manually annotated LUs, but proposed to rely on distributional information extracted from *La Repubblica* corpus, a large newspaper text corpus (Baroni et al., 2004), that was previously lemmatised, PoS tagged, and parsed. In particular, Johnson and Lenci (2011) worked on 6 verbs expressing visual perception, i.e.*avvistare, intravedere, notare, osservare, sbirciare, scorgere* (sight, glimpse, notice, observe, peek, see), identifying 3 frames evoked by those verbs (Perception_experience, Perception_active, Becoming_aware).

In 2012 a research group of the University of Pisa, jointly with the ILC-CNR enriched the dependency annotated corpus ISST-TANL (Montemagni and Simi, 2007) with frame semantic annotation (Lenci et al., 2012).

Moreover, a group of researchers both of the University of Pisa and ILC-CNR worked on the enrichment of legislative texts with FS annotation and on the creation of an extension of FN specialised in legislative texts both for English and Italian (Venturi, 2011; Venturi et al., 2009).

In Turin, at CELI, scholars investigated "the effects of the evolution of an Italian dependency grammar on a task of multilingual FrameNet acquisition" (Dini and Mazzini, 2010, p.8), i.e. the impact that different adopted grammars used for parsing texts can have on the development of

FN-like resources when the semantic induction relies heavily on parsing results.

In 2011 was proposed a task of Semantic Role Labeling, and in particular frame labeling, over Italian texts within the EVALITA campaign, a periodic evaluation campaign for NLP and speech tools. This task, the "Frame Labeling over Italian Texts" (FLaIt) Basili et al. (2012), aimed at obtaining "representation models, inductive algorithms and inference methods which address the Semantic Role Labeling (SRL) problem" (Basili et al., 2012, p.195), and in particular the subtasks of Frame Identification and Argument Classification. The research centers members of IFrame took part in the campaign with promising results.

Unfortunately, for few years, until 2017, the research on the development of an Italian FN stopped without coming up to a resource even remotely equivalent to the American resource.

4.2 IFrameNet

In 2017 the Universities of Bologna and Rome Tor Vergata jointly started a new project for the development of a FN-like resource for Italian. The project, named IFrameNet (IFN) (Basili et al., 2017), aimed at creating a large scale FN for Italian starting from the achievements of previous researches (when materials were made available) and integrating them with robust and scalable methods that rely both on automatic corpus processing and manual analysis and validation.

As well as the many other resources we talked about in the previous chapter, IFN is also based on the idea that frames are valid interlinguistically and that therefore it is possible to apply FN frames to Italian once the language-specific information has been eliminated, i.e. LUs, SSs and syntactic valence patterns. In particular, to date IFN is based on the frames, FEs, frame-to-frame and FE-to-FE relationships of FN 1.7 (i.e. the latest release).

The project went through two main phases, the first from 2016 to 2017 and the second from 2019 until today.

As of today IFN project focused only on nouns, verbs and adjectives, given the fact that these PoS are more likely to evoke frames, as we can also see from the current status of FN dictionary, which shows that only 490 of the 13,685 LUs correspond to other PoS (Figure 4.1).

The resource currently contains:

- **10,717 LUs** of which 1,379 adjectives, 5,359 nouns, 3,970 verbs, 4 adverbs, and 5 prepositions (the presence of adverbs and prepositions in the dictionary is due to the fact that we integrated datasets that annotated also adverbs and prepositions). The LUs in the dictionary cover 1,010 of the 1,048 lexical frames in FN;

Lexical Units	In FN	Finished	>10 Annotation Sets
Nouns	5575	2698	2225
Verbs	5213	2852	2300
Adjectives	2407	1368	1063
Other POS	490	67	134
Total	13685	6985	5722

Figure 4.1: LUs in FN dictionary by PoS and status (University of Berkeley, 2022).

- **10,778 SSs** annotated and validated (9,216 from the corpus CORIS, 204 from HuRIC, 968 from ItaEuroparl, and 390 from MultiBerkeley corpus);
- At least **5 SSs** for each frame with LUs in IFN.

4.2.1 First phase

In the first phase of the project, 2016-2017, we worked on both a preliminary dictionary of the resource and on the population with SSs of the frames to which LUs were assigned in the initial dictionary.

The work carried out in this period can be divided into the following steps (described partially in Basili et al. (2017) and more exhaustively in Brambilla (2017)):

1. LUs validation;
2. Corpus processing and lexical modeling;
3. SSs extraction;
4. SSs validation;
5. Integration of previous resources.

LUs validation As mentioned above, the research held in Rome Tor Vergata automatically induced a list of potential ⟨LU, Frame⟩ pairs which, however, had not yet been validated. The couples that needed to be validated were 15,134 for 554 frames (not corresponding to all the lexical frames in FN, that are 1,075) and were obtained relying on FN 1.3.

In this phase the ⟨LU, Frame⟩ pairs have been manually analysed in order to eliminate the cases in which a lexical entry was wrongly assigned to frames and in order to align the induced couples to FN 1.7. All the Italian LU candidates have been compared frame by frame to FN LUs in order to verify their belonging to the frame both with regard to their meaning and with regard to their semantic valence (i.e. we compared the FEs they required in Italian with the FEs of the frame they were automatically assigned). Of the 15,134 initial potential LUs (of which 6,670 nouns and 8,464 verbs and adjectives) 7,377 LUs (4,871 nouns and 2,506 adjectives) were considered correctly assigned to a frame and therefore accepted.

For each frame of this initial non-validated dictionary, the missing lexicals were then manually extracted, i.e. the LUs that were absent in Italian but whose English counterpart was present in Berkeley's FN. For this step we relied on:

- On the knowledge of Italian as a native speaker of the annotator;
- On WordNet (Fellbaum, 2010), MultiWordNet (Pianta et al., 2002) and ItalWordNet (Roventini et al., 1998);
- On monolingual and bilingual online dictionaries (e.g. Wordreference (Kellogg, 1999), Cambridge Dictionary (Colin McIntosh, 2014) and Vocabolario Treccani (V.V., 2014)).

In this way we extracted additional 4,922 new LUs of which 2,084 nouns and 2,838 verbs and adjectives.

In this first phase we inserted only the most central LUs for the frames under analysis, relying on their corpus frequency, on a preliminary analysis of their corpus distribution and on my knowledge of Italian as a native speaker. In this way the LUs in IFN dictionary increased from 7,377 to 7,902 (of which 5,128 nouns and 2,774 verbs and adjectives). For example "considering the frame `Killing` the extracted nominal LUs are: *annichilimento.n, delitto.n, bagno_di_sangue.n, spargimento_di_sangue.n, olocausto.n, martirio.n, matricidio.n, patricidio.n, parricidio.n, parricida.n, patricida.n, sparatoria.n*, but only *delitto.n* has been inserted. LUs not included at this stage will be taken into account at a later stage"(Brambilla, 2017).

Corpus processing and lexical modeling After we cleared the errors and refined the dictionary we used the 7,902 LUs to obtain a representation in a distributional space of the single frames from the corpus CORIS (Rossini Favretti et al., 2002) according to the metodologies presented in Mikolov et al. (2013). We mapped the validated LUs into distributional vectors $\vec{l}$ and used them to acquire a representation of frames. We then acquired a representation also of sentences by linearly combining the vectors of their words according to what presented in Mitchell and Lapata (2010).

SSs extraction We then exploited the information collected to automatically extract candidate SSs from the corpus CORIS. For the frames associated with at least 5 LUs (326 frames) we trained a statistical classifier in order to allow automatic classification of sentences, as explained in Basili et al. (2017). We extracted over 2 million sentences that were automatically labelled by the classifier.

SSs validation Finally, in order to assess the performances of the classifier, three annotators validated a subset of those sentences choosing between:

- Correct - if the frame label proposed by the classifier for a target LU in the sentence is correct;
- Incorrect - if the frame label proposed by the classifier for a target LU in the sentence is not correct.
- Missing Frame - if the frame evoked in the sentence by the identified LU was not one of the frames for which we obtained the geometrical representation;
- Not Applicable - if the LU identified in the sentence was not used in its proper senses (e.g. metaphors etc.);

They validated 667 sentences for 113 frames and 212 different LUs and the precision (computed only over Correct and Incorrect sentences) resulted to be 75,2%.

Integration of previous resources a further step of this first phase was the integration of some resources developed in previous researches. In particular, we integrated the training set developed by FBK for FLaIT *(cfr.supra)* and the Italian part of the corpus HuRIC *(cfr. supra)*. These datasets needed to be aligned with the 1.7 release of FN since both of them were developed according to FN 1.3. FBK set consisted of two subsets, Europarl corpus and Multiberkeley corpus, which contained respectively 987 and 391 sentences and HuRIC set contained 214 sentences. At the end of this step were added to IFN 1336 sentences form FBK set and 214 from HuRIC set.

4.2.2 Second phase

In the second phase of the project, roughly corresponding to the years of my doctoral research, from 2019 to the present time, we focused on:

1. Development of a platform manage the data;
2. A further refinement of the dictionary;

3. The enlargement of the resource coverage;
4. The population of frames with SSs;
5. The automatic induction of LUs;
6. Insertion of the words of the NVdB (De Mauro et al., 2016) in the dictionary;
7. The study of the portability of FN to Italian.

IFrameNet Platform creation In this phase the IFN research group has also developed a tool that allows the data storage and manipulation, the IFrameNet Platform. It will be presented and explained in detail later in this Chapter.

Refinement of the dictionary Starting from the achievements of the first phase we analysed all the Italian LUs, both the 7,902 LUs in the dictionary and the LUs manually extracted but not inserted *cf.supra*. We revised the whole dictionary and expunged, when the frame had other possible LUs, the LUs whose lemma had low frequency in CORIS, i.e. the LUs whose lemma had less than 20 occurrences in the corpus. The reason of this choice is that CORIS is a large-scale and general-purpose Italian corpus (without biases to any domain) and therefore it is representative of the Italian written language. For this reason we speculate that LUs that have such low frequency can hardly characterize a frame in Italian (Brambilla et al., 2020).

Coverage enlargement As mentioned in the previous section, as for the first phase we focused only on part of FN lexical frames. In the second phase we wanted to enlarge the coverage of IFN and create a seed set of at least one LU for each lexical frame in FN.

In order to reach this objective we manually analysed frame by frame all lexical frames in FN and for each frame we tried to find at least two seed LUs, by: a) analysing the frame English LUs, b) translating them into Italian with bilingual dictionaries, c) checking their semantic valence navigating its occurrences in the corpus CORIS, d) checking that their occurrences within the corpus are more than 20.

As an example we can mention the frame `Complaining` which is defined in FN as:

> A Complainer communicates their negative emotional reaction to some state of affairs in a Complaint to an Addressee. As an alternative to the specific Complaint, the Topic of the speaker's Complaint may be specified. Likewise, instead of (or in addition to) the Complainer, a Medium may be stated.

and has the following LUs:

> belly-ache.v, bitch.v, complain.v, complaint.n, grievance.n, gripe.n, gripe.v, grouse.v, grousing.n, grumble.v, lament.v, moan.v, piss and moan.v, whine.v, whinge.v

For this frame, using (as described above) bilingual and monolingual dictionaries and WordNet, MultiWordNet, and ItalWordNet, we identified the following Italian LUs:

> *brontolare.v* (558 occurrences in CORIS), *frignare.v* (151 occurrences in CORIS), *lagnanza.n* (94 occurrences in CORIS), *lagnarsi.v* (212 occurrences in CORIS), *lamentarsi.v* (5188 occurrences in CORIS), *lamentazione.n* (84 occurrences in CORIS), *lamentela.n* (583 occurrences in CORIS), *lamento.n* (1326 occurrences in CORIS), *protesta.n* (7926 occurrences in CORIS), *reclamo.n* (973 occurrences in CORIS), *recriminare.v* (150 occurrences in CORIS), *recriminazione.n* (184 occurrences in CORIS), *rimostranza.n* (205 occurrences in CORIS).

At the end of this process the LUs in the database amounted to a total of 10,379 LUs (7,776 lexical entries).

For some of the 1,048 lexical frames in FN we could not find any appropriate LU. This is due to different reasons:

- 12 frames marked as lexical are not associated with any LU in the English FN, namely the frames: `Cause_to_burn, Disaster_scenario, Distributed_abundance, Fire_emergency_scenario, Fire_end_scenario, Fire_stopping_scenario,Government_institution, Identity_scenario,Preferred_alternative_scenario, Sexual_reproduction_scenario, Undergoing_scenario, Visit_host`;

- The possible LUs of 18 frames are not nouns, nor verbs, nor adjectives, namely the frames: Accompaniment, Concessive, Conditional_occurrence, Conditional_scenario, Continued_state_of_affairs, Contrary_circumstances, Domain, Expected_location_of_person, First_experience, Goal, Interior_profile_relation, Medium, Negation, Negative_conditional, Partitive, Presentation_of_mitigation, Spatial_co-location, Within_distance;

- For 8 frames we did not find dedicated expressions in Italian, e.g. for the frames `Distant_operated_IED, Planned_trajectory, See_through, Serving_in_capacity, Setting_back_burn, Short_selling, Victim_operated_IED, Hedging`.

Population of frames with SSs In this phase we aimed at obtaining at least 5 SSs for each lexical frame in FN. We started from the sentences that were automatically labelled in the first phase and for each frame we tried to find 5 sentences that represent good examples of linguistic realization of the frame both by searching them within the platform (automatically extracted sentences, partially validated) and by manually extracting them from CORIS.

Automatic LUs induction We investigated the applicability of automatic methods for frame induction to enlarge the coverage of IFN. In fact, whereas coverage is a compelling problem for lexical resources the manual enlarging requires a huge effort from the annotators and is highly time consuming.

For this reason we tried to develop a method that exploits distributional techniques to automatically propose frames for given lemmas and thus automatically induce new LUs.

The research we conducted over this topic will be explained with deeper details in the next subsection.

Integration of NVdB lemmas In order to bring the resource to a broader coverage of Italian, we choose to focus on the lemmas of the NVdB (De Mauro et al., 2016), in order to integrate them into the LUs dictionary (*cf.infra*). In fact, the NVdB by collecting the fundamental vocabulary, the vocabulary with higher frequency and with higher availability, guarantees a wide range coverage that covers the core of the language. Since we are focusing, as for today, on nouns, verbs, and adjectives the only lemmas we intend to integrate are the ones that correspond to these PoS.

Integration process In order to link each lemma of the NVdB to all the frames it can evoke we proposed to exploit the automatic methods explained in 4.2.3 and manually evaluate the automatic pairings. For each nominal, verbal, and adjectival lemma in the NVdB we represented it in the distributional space and automatically retrieved the 20 closest frames (in the semantic space). The manual annotator will then have to evaluate the system's proposals and, if necessary, integrate them with new proposals of ⟨LU, Frame⟩ pairings. As for today the work has been completed only on adjectives.

The adjectives listed in the NVdB are 1,544. During the evaluation process 46 entries have been considered wrongly assigned to adjectives. In particular 38 were nouns (and 6 of them could also have been past participles of verbs), 3 were past participles of verbs, 13 of them were adverbs (1 of which could have also been a pronoun) and 2 were pronouns.

Of the 1,498 adjectives: 487 were already associated with at least 1 frame in IFN and for 298 them we discovered at least another frame; for

466 adjectives not in the dictionary we have found at least one frame.

In general the system proposed 1,780 correct frames of which: 1,019 correspond to frames already associated in IFN dictionary with the given lexical entry and 761 to new ⟨LU, Frame⟩ pairs.

Portability of FN to Italian As we also mentioned in the previous chapter, a question that has interested many researchers in relation to FN is that of portability, i.e. the applicability of the English structure to new languages, i.e. to languages other than English. As Gilardi and Baker (2018) pointed out in their article, the FN structure turns out to be applicable to new languages, but nevertheless, in some cases it is necessary to make some changes in order to adapt FN structure to the new language.

The changes are particularly necessary especially when working on languages with greater differences from English or that diverge from it in some aspects (for example when working with languages that, unlike English, are pro-drop). In the development of IFN we therefore investigated whether the structure of FN was applicable to Italian or whether it was necessary to make some changes.

4.2.3 Annotation workflow

Once the LU dictionary, the validated SSs as well as the candidate sentences have been uploaded on the platform, we decided to proceed frame by frame covering all the frames with at least 5 SSs (*cf.supra*).

We decided to fully annotate the constituents of the FEs, while as regards the LUs it depends on the cases:

- If the LU is made up of a single word, obviously the problem does not arise and the label is placed only on that word;
- If the LU is a noun or an adjective construed with a light verb or a support verb we will annotate as LU only the noun and the adjective. As for today, however we don't have specific labels for support and light verbs.
- If the LU is a **multiword verb** we decided to annotate only the word that includes the root of the verb, without annotating auxiliaries;
- If the LU is a **pronominal verb** we can have three different possibilities: (i) the pronoun is intrinsically linked to the lemma and there is no non-pronoun form of the verb; (ii) the pronoun is not intrinsically linked to the lemma but is found in alternation with non-pronoun forms and these two forms evoke, in a stable way, two distinct frames; (iii) the pronoun is not intrinsically linked to the lemma and the pronominal form and the non-pronominal evoke the same frame. In the first case we annotate also the pronoun, and the LU basic form

appears as pronominal. In the second case we will have two separate LUs (a pronominal one and a non-pronominal one) in the dictionary and we will annotate also pronouns within the sentences. In the third case we will have only a non-pronominal LU in the dictionary and we will not annotate the pronoun within the LU boundaries but instead we will annotate it as FE.

For each frame we revised the sentences proposed by the classifier as linguistic realization of that frame. We checked whether these sentences actually constituted an instance of the frame being analyzed, with the aim of selecting 5 correct sentences for each frame. In case the classifier did not propose at least 5 correct sentences, we searched the platform through keywords to see if potential good examples of the frame could be found within the set of phrases uploaded into the platform. If neither this procedure provided us with enough SSs we searched the CORIS corpus via its web interface[1] and we manually extracted example sentences. We searched the corpus by lemma and PoS and scanned the first entries proposed by the corpus interface trying to find good examples of the frame. In this second case we also tried to choose the sentences, among those proposed by the CORIS interface, which had the greatest number of FEs realized and, when possible we also preferred to choose sentences with different syntax rather than phrases with identical syntactic realizations.

For each of the sentences we annotated we controlled and verified also all the annotations automatically inserted by the classifier and pruned them from errors (i.e. we deleted wrong frame assignations).

The next step will be the completion of the sentences annotation or the identification and subsequent annotation of all the possible frames evoked by the LUs of the sentence.

Treatment of new LUs In the event that during the cleaning phase of the automatically annotated sentences, or during the annotation of new sentences there is the need to label as LUs elements that (yet) do not appear in the IFN dictionary, we decided to proceed as follows:

- First case: the element we want to label is not present in the LUs dictionary, but the frame that this evokes is. In this case it will firstly be necessary to add the new LU to the dictionary, then it will be possible to proceed with the annotation.

- Second case: the element we want to label evokes a frame that has not yet been considered in the IFN project. In this second case it will not be possible to insert the LU.

[1] http://corpora.dslo.unibo.it/TCORIS/

Choice of the frame To decide whether a sentence is actually an instance of the frame being analyzed, it is necessary to:

1. Carefully read the description of the frame and check its relevance for the considered sentence;

2. Check which FE are indicated as Core and which as Non Core in FrameNet and evaluate if they are consistent with those that the LU projects in the sentence under analysis. This type of FE analysis can be very useful to discriminate in the case of very similar frames. For example, the frames `Statement` and `Telling` appear to be very close, but differ with respect with their FEs. In fact, while both have the core FEs Medium,Message, Speaker, and Topic only Telling has the FE Addressee as core.

4.2.4 Automatic induction of new LUs

The problem of the automatic induction of frames is not a new problem and already in 2008 Pennacchiotti et al. dealt with this task. The reason and the importance of a task like this are related to the need to expand the resource dictionary while minimizing the time and effort of the annotator. In fact, while it is fundamental, for large-scale lexical resources (as recalled by Pennacchiotti et al. (2008) and Pavlick et al. (2015)), to have a large coverage resource the manual enlargement of the dictionary is extremely time consuming. The automatic induction of frames would allow to increase the number of LUs per frame very quickly and therefore would make it possible to develop a better and more useful resource. For these reasons, many researches have been conducted over the years on the automatic or semi-automatic association between predicates and lexical items (in this case frames and LUs) as summarised in Zadeh et al. (2019).

In particular, in 2008 Pennacchiotti and colleagues, as mentioned before, proposed a methodology to automatically acquire new LUs for English exploiting distributional methods and then representing frames and word meanings in a geometrical space. Since then distributional models have largely improved both in terms of scalability (since they are built over much bigger corpora then in 2008) and in methodology. We started from the work of Pennacchiotti et al. (2008) and investigated the possibility of exploiting word embeddings to automatically enlarge the dictionary also for the Italian language. The step of our method can be subdivided in:

1. Acquisition of Word Embeddings (WE);

2. Building of the clusters;

3. Automatic association of new lexical items to frames;

4. Evaluation of the system.

Acquisition of Word Embeddings As a first step, thanks to the work held in Rome, Tor Vergata[2], we obtained a distributional representation of the CORIS corpus. We acquired the WE and represented each LU as a vector $\vec{l}$ investigating three slightly different approaches: the Continuous Bag-of-Words model (`CBOW`), the Skip-gram model (`skip-gram`) (Mikolov et al., 2013) and the Structured Skip-gram (`sskip-gram`) model (Ling et al., 2015).

Since this last method better captures syntactic properties, we expected it to be the most suitable to represent the frame properties of each LU, given that "syntax is, in general, in agreement with semantic arguments (i.e., Frame Elements, FEs) and their order" (Brambilla et al., 2020).

Building of the clusters As a second step, we represent in the distributional space the meaning of frames exploiting the distributional representation of their LUs. "We assume that a frame f can be described by the set of its LUs $l \in F$ and that LUs vectors $\vec{l}$ can be thus used to acquire a distributional representation for each frame" (Brambilla et al., 2020).

In order to represent each frame we:

- Select its LUs with at least 20 occurrences in CORIS;
- Apply a clustering algorithm to LUs vectors $\vec{l}$.

The frames are then represented through the clusters of their LUs and correspond to a set of clusters, where each cluster will represent a sort of "sub-frame" capturing a particular sense of the frame and the centroid of each cluster will represent the prototype for a subset of the senses of a frame. As explained in Brambilla et al. (2020, p.3):

> [...]given that each frame can have various nuances and that it can be representative of non overlapping senses, sparse in the semantic space, we represent it through its "clusters of senses". This captures, in the semantic space, the possible "framehood" distributions, as dense regions of LUs.

Each frame is therefore represented in the distributional space not as the centroid of the vectors of its LUs, but as the centroid of the centroids of the various clusters formed by its LUs.

For our work we decided to apply standard K-means (Hartigan and Wong, 1979), and therefore to represent each frame f as a set of k clusters depending on the number of each frame's LUs. Here k corresponds, for each frame, to the square root of the number of LUs l in that frame: $k = \sqrt{|l|}$ (where $|l|$ denotes the count of l per frame). "In this way, each f will have

[2]Within this project the group of Rome Tor Vergata dealt with the informatic part of the process, e.g. the practical creation of the algorithms, while I dealt with the linguistic part.

k clusters depending on the number of its LUs and the centroid of each cluster will represent the prototype for a subset of the senses of a frame" (Brambilla et al., 2020, p.3).

Automatic association of new lexical items to frames Once we obtained distributional representations of lexical items and frames, we tried to automatically induce frames given a candidate lexical item. In order to do that, for each candidate LU we computed the distance between the word and the frames in the distributional space, i.e. between the word's vector and the centroid of the set of clusters representing the frame.

The frames that will be identified as closest in the semantic space will be the frames whose LUs are more similar to the candidate lexical item. These will be suggested by the system as the frames evoked by the lexical item under analysis.

Evaluation of the proposed method In order to evaluate the proposed method we tested its performances over existing LUs, testing its ability in retrieve the frames originally associated with them.

We applied a leave-one-out schema: for each lexical entry in the dictionary we eliminated it from the dictionary and rebuilt the frame clusters. Then we queried the model to suggest up to 10 frames as evoked by the lexical entry under analysis by computing the distance between the lexical item's vector and the new distributional representation of frames i.e. the rebuilt set of clusters representing all frames. Then, we compare the 10 suggested frames with the frames that were originally linked to the lexical item.

As in Pennacchiotti et al. (2008) Accuracy is computed as the fraction of the LUs that are correctly re-assigned to their original frames. "Accuracy is computed at different levels b: a lexical item is correctly assigned if one of its gold standard frames appears among the best-b frames ranked by the model"(Brambilla et al., 2020, p.3). Each lexical item can in fact be LU of more than just one frame. We label as correctly assigned each lexical item for which the system retrieves at least one of the frames for which it is LU within the b closest frames, the best-b.

The test bed over which the system is evaluated is sampled according to the two dimensions in tab.4.1: the PoS of LUs, and the minimum number of LUs a frame should be connected to in order to be considered.

The first dimension we considered is the PoS of the lexical entries and of the LUs of the frames (the rows in tab.4.1). Since lexical items with different PoS are generally projected in different sub-spaces within word spaces we decided to evaluate the model taking into account this dimension:

> We thus evaluate the model considering separately LUs and frames containing adjectives (a), nouns (n) or verbs (v). For the sake of completeness, we also evaluated the model without any

POS	1	2	5
a	295	207	65
n	631	463	250
v	675	514	245
a-n-v	1,041	916	511

- Automatic association of existing LUs to frames;
- Evaluation of the system.

Table 4.1: Frames considered according to different filtering policies. In row: the frames filtered by PoS, in column the threshold applied to the number of required LUs for each frame (Brambilla et al., 2020)

> selection by POS (row *a-n-v*). When a frame does not contain any LU represented in the wordspace with a required POS, it is discarded during the evaluation: as an example, the actual dictionary contains 631 frames containing at least one noun (Brambilla et al., 2020, p. 3-4).

The second dimension we considered is the number of frames a LU should be connected to in order to be taken into account (the columns in tab.4.1). We evaluated the system:

- Without applying any threshold over the number of frames per LU - In this case each lexical item that appears at least 20 times in CORIS is considered (column 1);
- Applying a threshold of 2 - In this case a lexical item needs to be LU of at least 2 frames to be taken into account (column 2);
- Applying a threshold of 5 - In this case a lexical item needs to be LU of at least 5 frames to be taken into account (column 5).

The threshold of at least two frames for lexical item helps to overcome the limitations of adopting a leave-one-out schema. In fact, if a frame is represented uniquely by a single LU it will be impossible for the system to retrieve it in the test data once that the clusters have been rebuilt without its representing LU, in fact it will not be represented by any LU.

Of course the stricter the filtering policies are the lower the number of considered frames. For this reason the Accuracy baseline depends on the number of selected frames: "when no filter is applied (row $a - n - v$ and column 1) a random assignment would achieve $0.09\% = \frac{1}{1{,}041}$ of Accuracy, or $0.4\% = \frac{1}{250}$ when only frames containing at least 5 nouns are selected"(Brambilla et al., 2020).

The word embedding that proved to be more suitable for this task are the ones acquired using `sskip-gram`. The experimental results of the model

POS	th	$b-1$	$b-2$	$b-3$	$b-4$	$b-5$	$b-6$	$b-7$	$b-8$	$b-9$	$b-10$
a	1	32%	41%	47%	50%	52%	53%	55%	56%	57%	58%
	2	41%	54%	62%	65%	68%	70%	72%	74%	75%	76%
	5	60%	75%	83%	87%	89%	90%	91%	93%	94%	95%
n	1	42%	53%	59%	62%	65%	66%	68%	69%	70%	71%
	2	48%	61%	67%	71%	73%	75%	76%	78%	79%	80%
	5	59%	72%	79%	82%	85%	87%	88%	89%	90%	91%
v	1	25%	35%	41%	44%	47%	49%	50%	52%	53%	54%
	2	32%	43%	50%	53%	57%	59%	61%	62%	64%	65%
	5	42%	55%	63%	69%	72%	74%	76%	78%	79%	81%
a-n-v	1	36%	47%	53%	56%	59%	61%	62%	64%	65%	66%
	2	41%	52%	58%	63%	65%	67%	68%	70%	71%	72%
	5	49%	61%	68%	73%	75%	78%	79%	81%	82%	83%

Table 4.2: Accuracy on LU induction according to the best-b ranking and split according to number and POS tag of LUs (Brambilla et al., 2020, p.4)

derived using a `sskip-gram` model are reported in table 4.2. The results are reported according to the filtering dimensions and the best-b frames considered.

For example we can see that the Accuracy of the system considering only n without applying any threshold and considering only the $b-1$ frame is 32%, but raises to 41% once a reasonable threshold ($th = 2$) is set. We can notice that the performances of the system over n are better than the performances when considering $n-v-a$ jointly. This may be due to the higher polysemy that characterizes verbs and adjectives with respect to nouns (Casadei, 2014). This is confirmed by the fact that the performances over a and v when considered separately are slightly lower than the performances over only n.

Of course the lower the number of considered frames, the highest the Accuracy, since, as explained, its baseline depends on the number of considered frames.

Discussion of the experimental results When looking at the results of the experimental evaluation it is important to consider that the dictionary of the resource is a work-in-progress and thus is incomplete. For this reason some of the frames that have been automatically labelled as "incorrect assignments" are, in fact, evoked by the lexical item under analysis, which should be added to the LUs of the automatically retrieved frame.

Moreover, often the non-correct frames that appear within the $b-10$ are semantically related with the lexical item and/or with the other frames for which it is a LU.

For example if we consider the lexical item "*impiccare.v*" ("hang.v") we see that the model did not retrieve among the $b-10$ the frame "Execution" which is the only frame to which it was linked in the dictionary and thus the only "correct" frame. Anyway, the model suggests within the $b-1$ frame the frame "Killing" which is linked with "Execution" with an Inheritance

relation and also appears to be evoked by "*impiccare.v*". Also if we consider the lexical entries "*innalzarsi.v*" ("raise.v and rise.v"), "*innocenza.n*" ("innocence.n") and "*radiazione.n*" ("radiation.n" or "expulsion.n") we notice that the system does not retrieve their original frames within the $b - 10$. However, it suggests new frames evoked by the lexical items:

- "Change_position_on_a_scale", fourth closest frame to "*innalzarsi.v*", is actually evoked by it in sentences such as "*La marea si innalzava*" ("The tide was rising");
- "Candidness", closest frame to "*innocenza.n*", is evoked by it in "*Lei rispose con innocenza*" ("She answered genuinely").
- "Nuclear_process" is suggested as the closest frame to "*radiazione.n*". This assignation allow us to retrieve one of the correct meanings of the word "*radiazione.n*", i.e. the meaning "radiation.n", which did not appear in the dictionary. In fact, in the dictionary "*radiazione.n*" was only linked to the frame "Exclude_member" highlighting the meaning of "exclusion.n".

In other cases the system retrieves the original frames (or at least one of the original frames) but proposes also other correct frames. For example if considering the lexical entries "*alleato.a*" ("ally.n") and "*agnello.n*" ("lamb.n") we see that the system proposes, beside the original frame also another frame that can be plausibly evoked: for "*alleato.a*" it proposes "Member_of_military" and for "*agnello.n*" it proposes "Animals". Moreover the LU "*agnello.n*" (*lamb.n*) evokes in the dictionary only the frame FOOD; anyway, as correctly suggested by the system, it is also LU of the frame ANIMALS. Moreover, for "*agnello.n*" the system proposes also, in sixth position, PEOPLE_BY_MORALITY that "recalls the idea of innocence and righteousness that represents (at least for the Italian language) a metaphorical extension of the meaning of "*lamb.n*", strongly influenced by the religious image of the lamb." (Brambilla et al., 2020, p.4).

In some cases the system suggests the existence of possible relationships between frames. For example, if we consider the lexical entry "*identico.a*" ("identical.a"), which is a LU of the "Identicality" frame, we can see that the system proposes within the $b - 10$ the frames "Similarity" and "Diversity". These frames in FN are not "Identicality" via any relationship, anyway they seem to be strictly related with it.

Usefulness of the system This system, in addition to being useful for automatically enlarging the dictionary, can also be useful for helping to automatically identify frame assignment errors. In fact, existing frames that are not retrieved by the system should be less likely associated with a given LU. For example, this investigation helped us to spot the wrong assignment of the LU *abbandonare.v* to the frame "Abounding_with", error

that was not amended in the previous dictionary refinement. It is of course not always the case, since the system has a margin of error and since, such as also FN, the IFN resource is a work in progress and thus the training data are not fully complete.

4.2.5 Cyberbullying and IFrameNet: BullyFrame

Brambilla et al. (2019) carried out a research, jointly at the Universities of Trento and Bologna, over the feasibility of applying frame annotation to social network texts in order to help the automatic detection of potential cyberbullying. In our study we analysed the application of FN paradigm to the labeling of social media texts and in particular of cyberbullying related texts in order to assess the coverage of FN and its suitability for the analysis of online chats that, "in addition to their non-standard nature, contain offensive language and informal expressions"(Brambilla et al., 2019, p.1). Finally, we analyzed the potential interrelationships between frames and expressions of cyberbullying.

The result of our work is the creation of BullyFrame, a dataset of WhatsApp conversations annotated with FN frames and FEs.

Dataset The chats are taken from an Italian corpus of data on cyberbullying interactions written by 12-13 years old lower secondary school students simulating instances of cyberbullying (Sprugnoli et al., 2018). It has been built through an experimentation with lower secondary school students and "consists of 10 chats for a total of 2192 messages (14,600 tokens) and includes 1,203 cyberbullying expressions, corresponding to 6,000 tokens" (Brambilla et al., 2019).

All the sentences in the dataset have been previously annotated with information regarding cyberbullying, in particular (Sprugnoli et al., 2018) annotated:

- The role of the writer (i.e. Victim, Bully, or supporter of one of the two sides);
- The type of offense in the message, if any (i.e. Threat or blackmail, General Insult, Body Shame, Sexism, Racism, Curse or Exclusion, Insult Attacking Relatives, Harmless Sexual Talk, Defamation, Sexual Harassment, Defense, Encouragement to the Harassment, and Other).

Frame annotation of messages We annotated the sentences in the dataset according to FN 1.7, trying to annotate, for each sentence, all the possible evoked frames alongside with their FEs. Of the 2,192 total messages we were able to annotate with FN frames 1558 sentences for a total of 2458 frames and 2769 FEs. It was impossible to annotate the remaining 1211 sentences because:

- For 1180 sentences there were no suitable frames in FN;
- 19 messages consisted of a media file;
- 12 messages had actually been deleted by the sender.

We annotated a total of 268 unique frames and 696 unique FEs. Some statistics are shown in the tables 4.3, in particular they show: (a) the most frequent frames in the dataset along with their individual frequencies, (b) statistics on the number of FEs annotated for each frame.

Frequency	Frame
167	Silencing
138	Desirability
109	Statement
108	Correctness
107	Cause_emotion
97	Desiring
87	Awareness
83	Opinion
73	Capability
69	Intentionally_act

Frame elements	Frames
4	7
3	118
2	633
1	1121
0	332

Table 4.3: Table (a) shows the nomber of occurrences of the most frequent frames in the dataset and table (b) shows statistics on the number of FEs annotated for each frame. (Brambilla et al., 2019, p.4)

Annotation problems During the annotation process we found some problems on three different layers: Frames layer, Frame Elements layer and Frame Evoking Elements layer.

Frames layer For some of the FEEs in the messages we could not find suitable frames in FN. This "missing frames" were:

1. Concepts that were new to FN and that were linked to the nature of online conversations. - "This is the case for instance of frames that occur often in conversations or in oral communication. These concepts are often not present in FrameNet, but frequent in our dataset since it includes interactions between participants and is close to oral communication. For example we found that FrameNet does not have a frame that covers "greetings"" (Brambilla et al., 2019). For example:

(1) **Ciao** ci sentiamo domani.
***Bye**, we'll talk tomorrow.*

(2) Hahahah esatto **ciao** e buon allenamento.
*Hahahah, exactly **bye** and have a good training.*

(3) **Buongiorno** a tutti!
***Have a good day**, everybody!*

2. Concepts that were new to FN and that were linked to the nature of offenses and cyberbullying interactions. - For example we found that 12-13 years olds often refer to sexual orientation in their insults, but a frame that covers this concept is still missing. For example:

(4) Crede di essere figo facendo il **gay** a danza
*He thinks he looks cool acting like a **gay** when he dances*

(5) Manco fossi **gay**
*What am I, **gay**?*

(6) Sei così **effemminato** che intorno a te ci sono più finocchi che in un orto
*You are so **effeminate** that around you there are more pansies than in a garden*

3. Concepts that were new to FN but not linked nor to the nature of the text nor to cyberbullying. - This is the case for example of the field of sports and hobbies, which is almost completely missing in FN. For example:

(7) Anche tu fai **calcio**
*You play **football** as well*

(8) Lui non fa **danza** classica
*He does not do **ballet**?*

4. Concepts that are not new to FN, but for which the frames in FN cover only a particular stative alternation, inchoative alternation or causative alternation. For example in FN exist the frames "Silencing" and "Becoming_silent" but not a frame for "Being_silent". Or again in FN there are the frames "Evoking", nor "Reminder" or "Remembering_*", but not a frame such as "Cause_to_remember". It is thus impossible to annotate sentences such as:

(9) Ti **ricordo** che io ho ballato con Kledi
*I **remind** you that I danced with Kledi*

Frame Elements layer Sometimes even when there was a FN frame suitable for annotating the message it was impossible to annotate some of its FEs, since FN lacked of labels for them.

For example in sentences such as:

(10) Lo **diciamo** per il tuo bene
*We **say** that for your own sake*

It is impossible to annotate "per il tuo bene". It appears to be missing a FE "Reason" for the frame "Statement" evoked by "diciamo". The reason for this can be found both in the work-in-progress nature of FN and on the structural differences between English and Italian.

Frame Evoking Elements layer Finally, we found that in some cases the frames in the sentence were not evoked by a lexical item or a multiword expression, but for example from a construction or an image (an emoji).

1. Constructions - For example in the following sentences the frame "Surpassing" is evoked by the construction *"essere più X di Y"*("to be Xer than Y") rather than by a specific LU:

   (11) Di sicuro un cane è più bravo di lui
   A dog is better than him for sure

   (12) Noi siamo più forti di te
   We are stronger than you

2. Emoji - For example in the following sentence the frame "Desirability" is evoked by an emoji, the "pile of poo" emoji that stands for the word:

   (13) Ma tu sei già una 💩
   But you are already a 💩

Relations between frames and cyberbullying interactions In order to highlight possible interrelations between frames and offenses or cyberbullying interactions we computed the correlation between the cyberbullying information annotate on the texts by Sprugnoli et al. (2018) *(cf. supra)*, and the frames annotated in the various sentences. We computed their correlation using the weighted mutual information.

In this way we aimed to highlight correlations that would make it possible to facilitate the automatic extraction of potential conversations containing episodes of cyberbullying thanks to the frame annotation of the texts.

As shown in tab.4.4 the results are for the most part in line with what was expected. For example, we see that the type of offense *"Treat_or_Blackmail"* is correlated with the frame "Cause_harm" and the type *"Insult-BodyShame"* with the frame "Aesthetics", perfectly matching our expectations. Or again the type *"General_insult"* is related with frames such as "Mental_property" or "Desirability",

> this well matches with the intuitions that those frames capture respectively expressions which denigrates the interlocutor by referring to his/her lower intelligence, e.g. *"Idiota"* or *"Stupida"* (*"Idiot"*, *"Stupid"*), or to his/her scarce desirability, e.g. *"Sfigato"* (*"Loser/Lame"*)

(Brambilla et al., 2019).

Bullying annotation	Frame	wMI
Curse_or_Exclusion	Silencing	0.0672
General_Insult	Desirability	0.0304
General_Insult	Mental_property	0.0227
Encourage_Harasser	Correctness	0.0177
Curse_or_Exclusion	Desiring	0.0135
Threat_or_Blackmail	Cause_harm	0.0127
Discrimination-Sexism	Suitability	0.0083
Curse_or_Exclusion	Required_event	0.0080
General_Insult	Silencing	0.0065
Insult-BodyShame	Aesthetics	0.0046

Table 4.4: Correlations between frames and the type of offense contained in the message (Brambilla et al., 2019, p.5).

4.2.6 Studies on specific domains or on specific aspects

As said before, some researches have been carries out within the IFN project in order to assess the suitability of FN structure for Italian and analyse how certain situations and scenarios belonging to specific domains were represented at the level of semantic frames in Italian.

These researches have been carried out as of MA thesis researches and PhD researches both at the Universities of Bologna and Rome Tor Vergata. In particular have been analysed (or are under analysis):

- **Motion Domain** - MA thesis of Gilda Pepe;
- **Medical Domain** - MA thesis of Giorgia Armenti;
- **Change of State** - MA thesis of Irene Pagliai;
- **Communication Domain** - PhD research of Idea Basile;
- **Treatment of Meronymy** - MA thesis work of Francesca Nannetti.

Motion Domain The analysis of the Motion Domain in Italian (Pepe, 2019) was conducted by analysing and annotating Italian sentences that contained potential motion-frames evoking LUs. This research highlighted that the use of dative in some Italian constructions would require the introduction of a new FE for some frames. The information conveyed by this element, which could plausibly be labeled as Beneficiary, in English is not in fact represented through an autonomous FE but is contained within phrases that primarily express other FEs (such as Goal, Theme, Source).

Moreover, since the coding strategy, between Italian and English, for the FEs "Path" and "Manner" makes it impossible to annotate some of the Italian sentences using existing FN frames (e.g. "Self_motion"), Pepe (2019) proposes to introduce a new frame, i.e. not yet in Berkeley's FN: the "Motion_manner" frame.

This frame would have only the FE "Theme" within its core set, while FEs such as "Path", "Goal", "Area", and "Source" are considered not fundamental and yet non-core.

Medical Domain The analysis of the frames pertaining to the medical domain (Armenti, 2020), showed that FN structure (i.e. its frames, FEs and the relations between them) is applicable to the Italian language without changes either at the frame layer or at the FE layer.

Frames of the medical domain have been enriched with new LUs exploiting:

1. the comparison with the LUs in Berkeley's FN;
2. online resources such as:
    - the *Dizionario della salute* ("Healthcare dictionary") (Corriere);
    - the *Enciclopedia Medica* ("Medical Enciclopedia") (IRCCS Humanitas);
    - the *Specialità Mediche* ("Medical Specialities") category of Wikipedia (Wikipedia).

Change of State In this research (Pagliai, 2020) the verbs of change of state were analyzed and in particular the pronominal polysemic verbs ending in -si starting from the annotation of the Italian LUs. From their constant comparison with FN, problems have emerged relating to frame to frame Inchoative and Causative relationships which do not appear to be attributed in an organic and consistent way within the database.

Communication Domain This research focuses on the Communication Domain aiming at better describing how the field is conceptualised in Italian and therefore how it is represented from a FS point of view (Basile, Basile).

Treatment of Meronymy This research started from a subset of frames showing some interesting part-whole relations and aims at investigating FN strategies to treat meronymy, for example through frame-to-frame relations, and at verifying the suitability of FN frames and structures when applied to Italian (Nannetti, 2022).

Fear and Anxiety Domain Finally, in my PhD research we investigated the domain of emotions and in particular the domain of Fear, Worry and Anxiety, a field that seemed particularly interesting given its prominence in today's world. Another aspect that makes this domain particularly interesting is the fact that it can be considered at the same time as part of those "shared basic experiences" which therefore tend to be represented in a constant way, as well as a domain strictly dependent on social and cultural aspects. In fact, although the emotions of fear, anxiety and worry are considered fundamental emotions and therefore common to all human beings, they are also strongly linked and influenced by social and cultural aspects.

4.3 IFrameNet tools

The tools that have been developed within the IFN project are two. The IFN platform we have mentioned before and the IFN navigator which allows the graphical representation of frames and LUs in the semantic space.

4.3.1 IFrameNet platform

The data collected and elaborated within the IFN project are storaged in the IFN platform a tool developed *ad hoc* for the project in the University of Rome, Tor Vergata.

It allows, beside the data storage, the manipulation of data and provides preliminary statistics. It can be accessed via the browser using the login credentials. It has four main sections, namely:

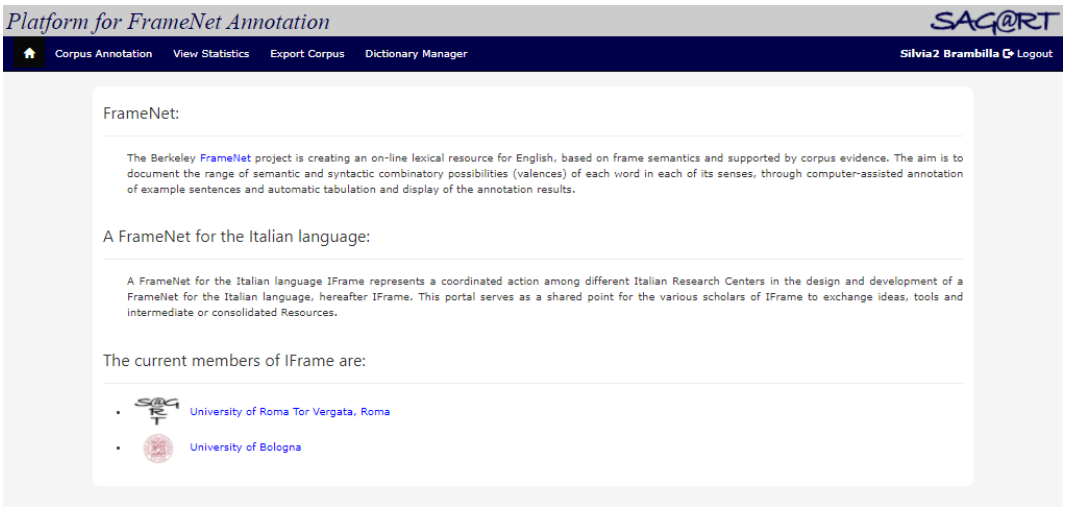


Figure 4.2: Platform's main page

- **Corpus Annotation** - which contains all the annotated sentences, divided by corpus or corpus subpart;
- **View Statistics** - which allows the visualization of the status of the resource;
- **Export Corpus** - which allows to export the data in XML format selecting them by corpus and annotator;
- **Dictionary Manager** - which contains the dictionary of the resource that can be browsed either by lexical entry and by frame.

Corpus Annotation

This section (fig.4.3) collects all the annotated sentences of the IFN project, except the sentences collected for the BullyFrame project. In fact, the nature of the corpus, which is closer to spoken dialogues rather then to written texts, annotated in the BullyFrame project and the not-refined quality of the data (i.e. misspelled words, broken sentences, etc.) made it unsuitable as training data.

In this section the user can select the dataset he wants to work on. This will make it possible to see and navigate between the sentences of that corpus. As for today in the platform can be selected 8 datasets from the CORIS corpus (4 of which need to be merged two by two), a dataset from the ItaEuroparl Corpus, and a dataset from the MultiBerkeley corpus. The datasets will be further explained and presented later on in the chapter. Once the dataset of interest has been selected, it is possible to filter the sentences by selecting further search parameters (fig.4.5), in particular:

- The **Frame** - It allows the selection of only the sentences that have a specific frame annotated;

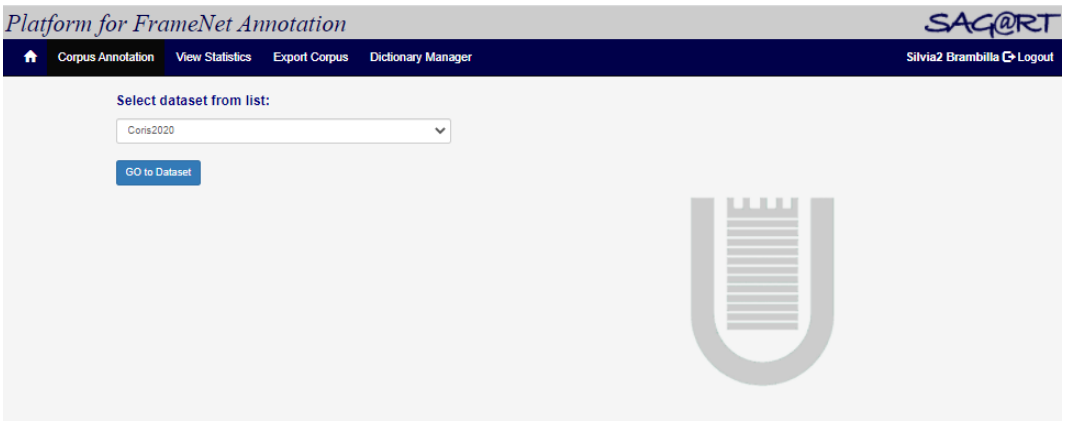


Figure 4.3: Corpus annotation section - Dataset selection.

- The **LU** - It allows the selection of only the sentences that have a specific LU annotated;
- The **PoS of the LUs** - It allows the selection of only the sentences which LUs have a specific PoS;
- The **Other filter** - It allows to select sentences based on their annotation status, the labels are:
  1. Not validated sentences;
  2. Validated sentences - regardless the annotator;
  3. Without annotations sentences;
  4. Other users annotations sentences - sentences non annotated by the current user;
  5. Yours annotations sentences - sentences annotated by the current user;
  6. Machine annotation - sentences automatically annotated and not yet validated.

Once the filters have been set the platform displays a list of sentences (4.5, reporting for each sentence: the annotator, the annotated frame,and the cosene similarity (from -1 to $+1$) of the sentence to be an instantiation of that frame. Each sentences can appear as many times as the number of frames that have been annotated on it.

It is possible to select any sentence which will then be displayed, as shown in fig.4.6, as a table in which for each token it is specified its lemma, its PoS and the annotations on it, if any. Finally, on each sentence annotations can be added, modified and validated (fig.4.7).

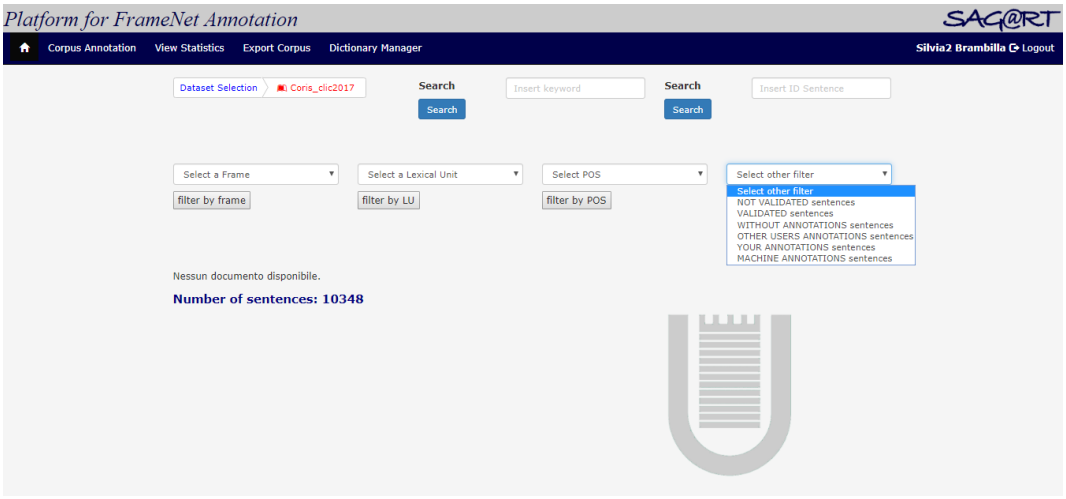


Figure 4.4: Corpus annotation section - Searching parameters.

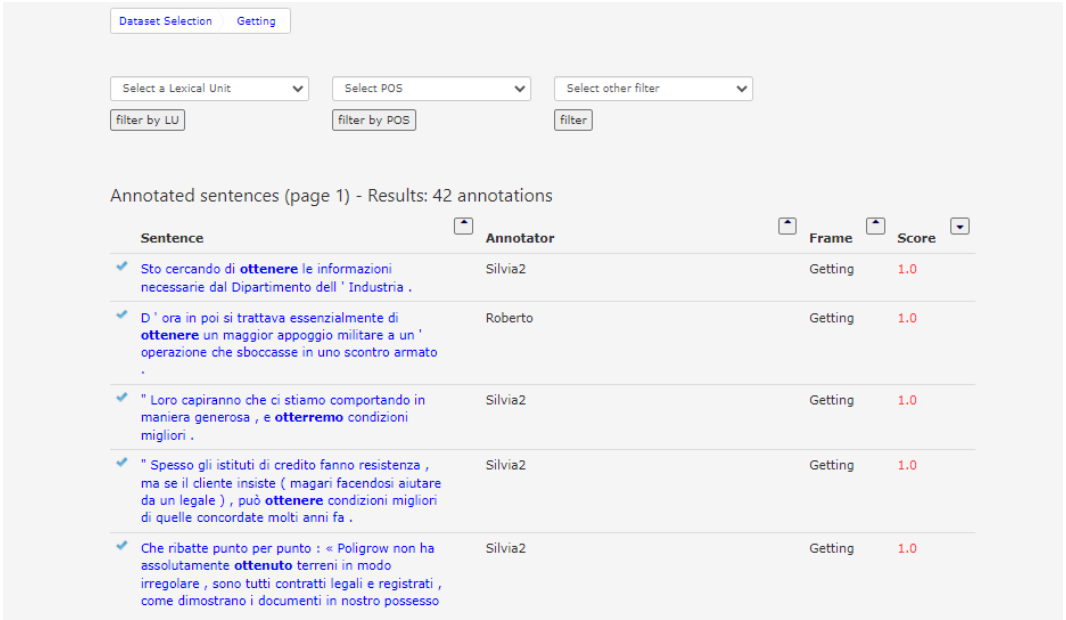


Figure 4.5: Corpus annotation section - Visualization of the annotated sentences for a selected frame, here the “Getting” frame.

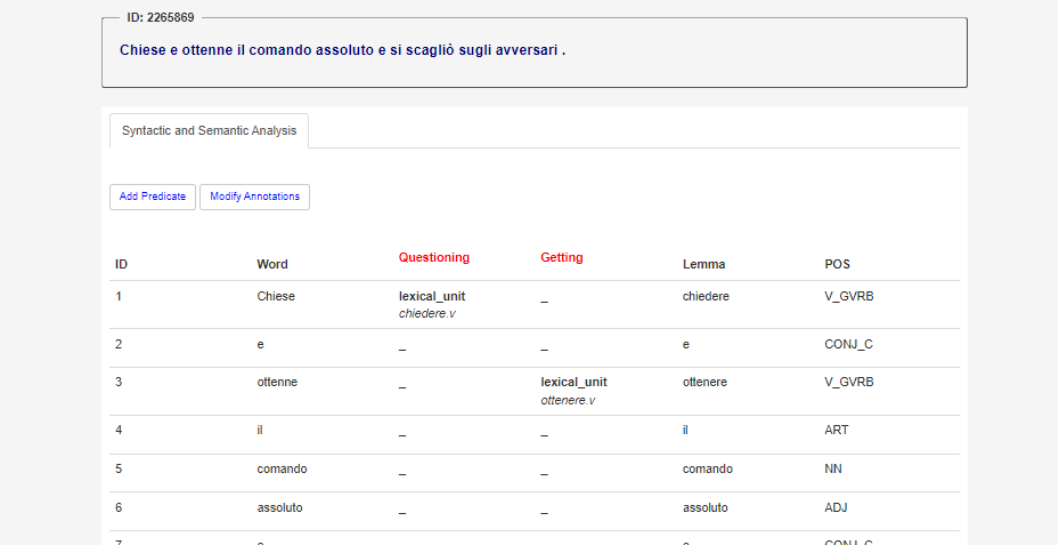


Figure 4.6: Corpus annotation section - Visualization of the annotations (frames and FEs) on the non-validated sentence *"Chiese e ottenne il comando assoluto e si scagliò sugli avversari ."*("He asked for and obtained absolute command and threw himself on his opponents.")

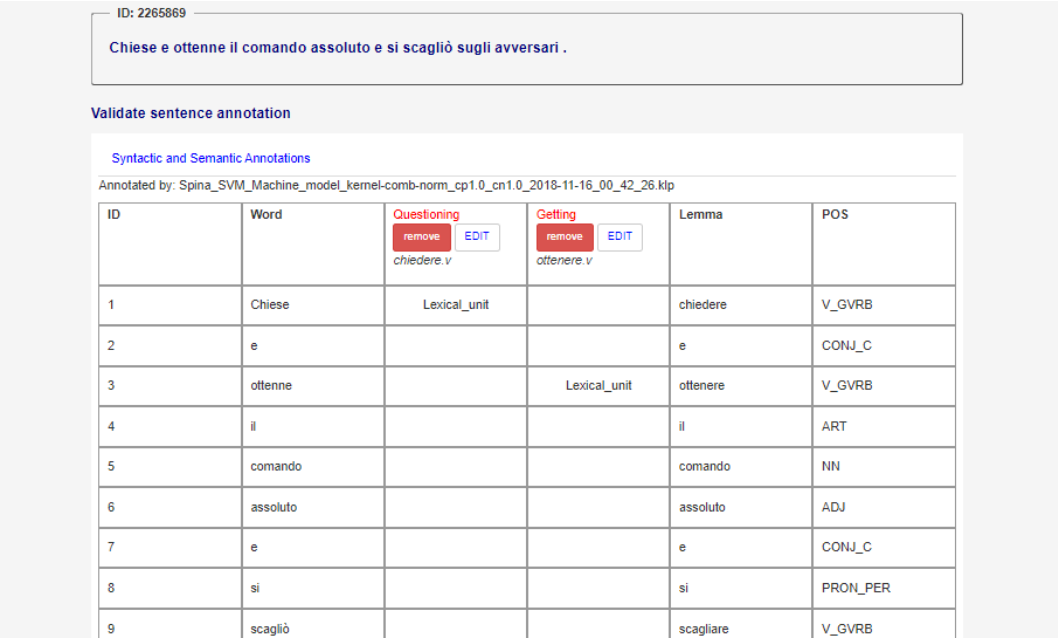
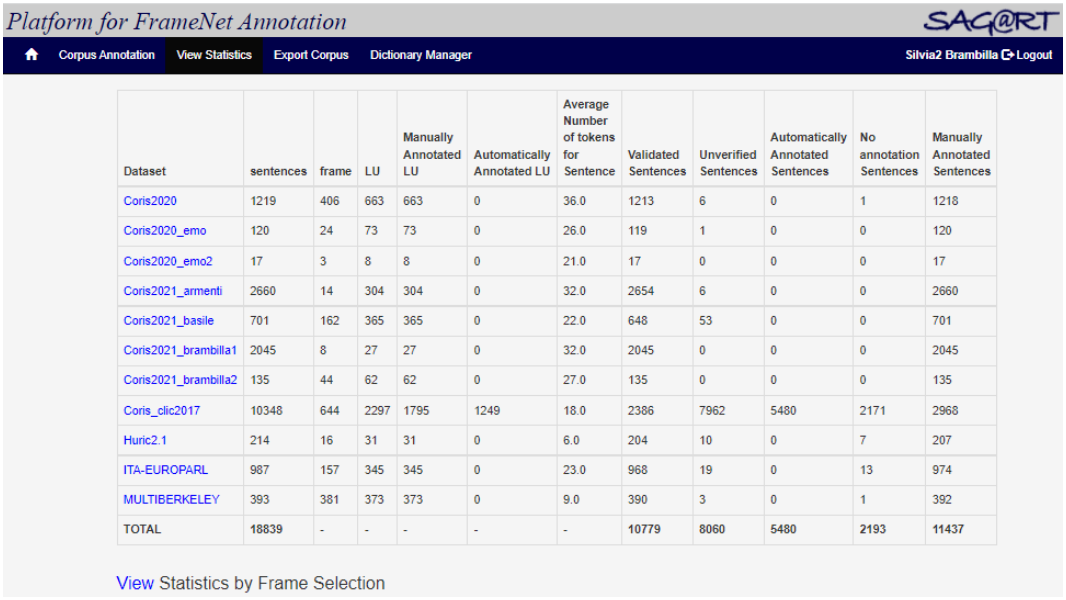


Figure 4.7: Corpus annotation section - Interactive window for the annotation of sentences, here: *"Chiese e ottenne il comando assoluto e si scagliò sugli avversari ."*("He asked for and obtained absolute command and threw himself on his opponents.")

View Statistics

This section allows the visualization of some of the statistics of the platform, as shown in fig.4.8:

- The number of sentences for each dataset;
- The number of different frames for each dataset;
- The number of different LUs for each dataset;
- The number of manually annotated LUs for each dataset;
- The number of automatically annotated LUs for each dataset;
- The average number of tokens for sentence in each dataset;
- The number of validated sentences for each dataset;
- The number of unverified sentences for each dataset;
- The number of automatically annotated Sentences for each dataset;
- The number of sentences without annotations for each dataset;
- The number of manually annotated Sentences for each dataset.



Dataset	sentences	frame	LU	Manually Annotated LU	Automatically Annotated LU	Average Number of tokens for Sentence	Validated Sentences	Unverified Sentences	Automatically Annotated Sentences	No annotation Sentences	Manually Annotated Sentences
Coris2020	1219	406	663	663	0	36.0	1213	6	0	1	1218
Coris2020_emo	120	24	73	73	0	26.0	119	1	0	0	120
Coris2020_emo2	17	3	8	8	0	21.0	17	0	0	0	17
Coris2021_armenti	2660	14	304	304	0	32.0	2654	6	0	0	2660
Coris2021_basile	701	162	365	365	0	22.0	648	53	0	0	701
Coris2021_brambilla1	2045	8	27	27	0	32.0	2045	0	0	0	2045
Coris2021_brambilla2	135	44	62	62	0	27.0	135	0	0	0	135
Coris_clic2017	10348	644	2297	1795	1249	18.0	2386	7962	5480	2171	2968
Huric2.1	214	16	31	31	0	6.0	204	10	0	7	207
ITA-EUROPARL	987	157	345	345	0	23.0	968	19	0	13	974
MULTIBERKELEY	393	381	373	373	0	9.0	390	3	0	1	392
TOTAL	18839	-	-	-	-	-	10779	8060	5480	2193	11437

Figure 4.8: View statistics main page

It is also possible to view the statistics by frame selection, in order to verify the number of annotated sentences for each frame and to visualize all the sentences in the database for a given frame, without restrictions of dataset.

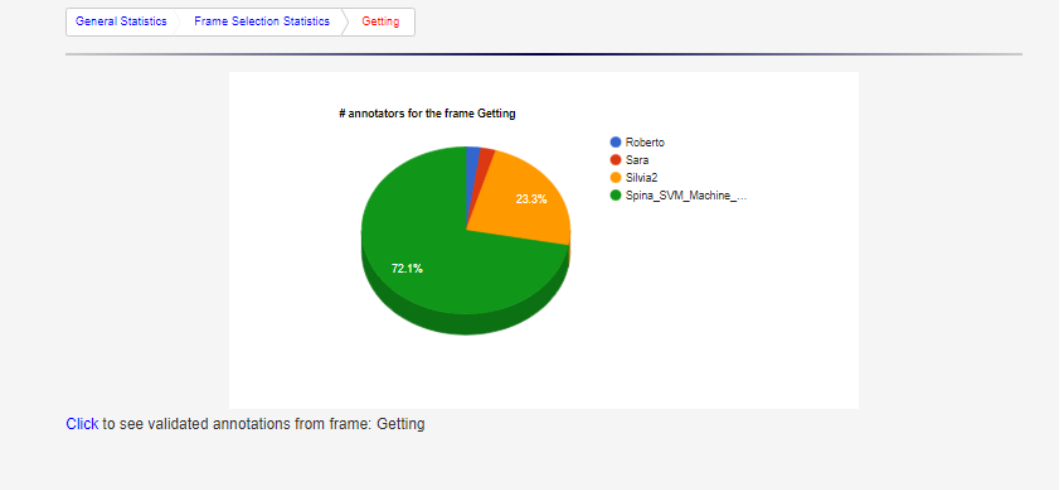


Figure 4.9: Statistics for the frame "Getting"

Export Corpus

The data in the platform can be selected by dataset and annotator and exported (fig.4.10.

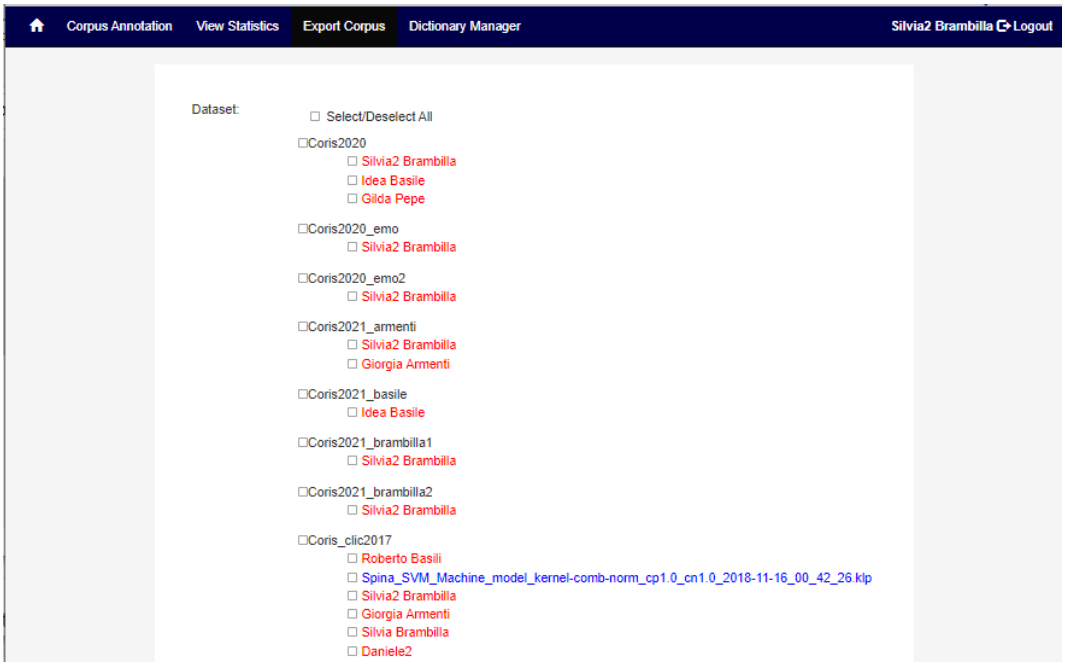


Figure 4.10: Export corpus section.

Dictionary Manager

Furthermore, it is possible to browse the dictionary of the resource both by frames and by lexical entry.

Browsing by frame When the frame is selected the platform displays all the LUs that evoke it and lists the datasets that contain annotated sentences for each LU.

Browsing by lexical entry If, instead of a frame, it is selected a lexical entry the platform opens a page that shows all the frames to that lexical entry, i.e. the frames for which it is LU. Also in this case in the page are listed all the datasets that contained annotated sentences for each ⟨LU, Frame⟩ pair.

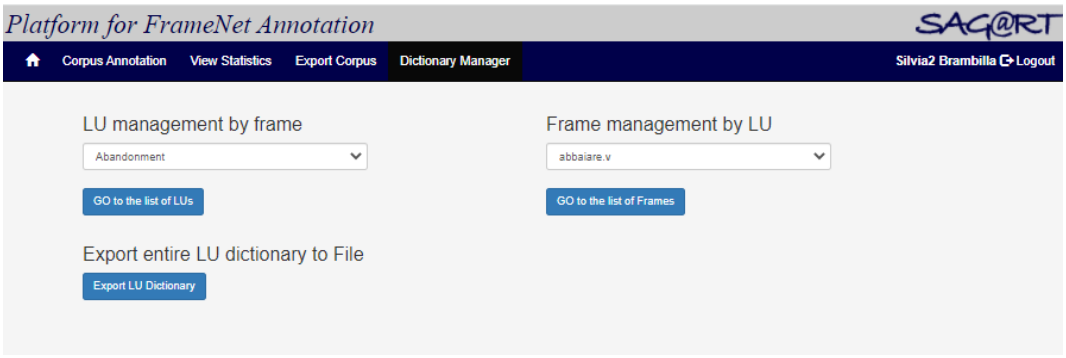


Figure 4.11: Dictionary manager main page.

Datasets description

The datasets that can be selected in the platform belong to 4 different corpora: CORIS, the Italian part of Huric, ItaEuroparl, and Multiberkeley.

In particular they are:

- **CORIS corpus**:
  - **CORIS – General.** This dataset covers the frames transversely, but the occurrences of each frame are very unbalanced. This is due to the fact that initially the sentences in this dataset were not collected in order to obtain balanced representations for the various frames but rather it represents the result of the first experimentations on the automatic extraction of Italian SSs . The fact that some frames have a much higher number of occurrences reflects the fact that not all frames occur with the same frequency (most frequent frames will be more represented, e.g. `Statement`). This dataset has been integrated during the years and the first highly unbalanced nucleus of this dataset has been integrated in order to reach at least 5 sentences for each frame in the Italian dictionary (i.e. all the lexical ones with the exceptions illustrated above). The majority of the sentences in this dataset it is not fully annotated, i.e. often not all possible

evoked frames are annotated. Moreover, FEs have been added only for few frame annotations.

- **CORIS - Emotion Domain.** This dataset contains sentences annotated with frames that pertain to the domain of emotions. In this case sentences have been annotated in order to obtain for each frame of the domain at least 10 sentences.
- **CORIS - Medical Domain.** This dataset represents the result of the research of Armenti (2020) on the Medical Domain. For each LU of the domain there are 10 annotated sentences. Each sentence has been annotated only with respect to one LU and do not present any annotated FE.
- **CORIS - Communication Domain.** This dataset focuses on the *verba dicendi* and the emission of sound verbs. The data collection was born in 2019 from a linguistic analysis restricted to this field. The dataset includes 61 Lexical Units divided into 44 frames, for a total of 701 sentences. At the moment, FEs have not been annotated.
- **CORIS - Fear Domain.** The 2,045 sentences present in this dataset are all related to the domain of fear, anxiety and worry and have been annotated during the analysis presented in Chapter 6. They are all related to a subset of lexical entries (23, of which 11 nouns, 6 verbs and 6 adjectives) considered fundamental for the domain under analysis.

- **Huric2.1** This dataset corresponds to the Italian part of the HuRIC corpus, annotated with frames within the research held by Bastianelli et al. (2014). It contains 214 sentences annotated with respect to 14 frames. Since the frame annotations referred to FN 1.3 they have been manually corrected and aligned with the release 1.7.

- **ItaEuroparl** This dataset corresponds to one of the two subsets of the FBK training corpus for the FLaIT evaluation exercise of the EVALITA 2011 campaign (Basili et al., 2012). It contains 987 Italian sentences taken from the English-Italian bitext of Europarl, the corpus that collects the European Parliament Proceedings. Such as the Huric2.1 dataset, also the annotations of this dataset were made according to release 1.3 and have been aligned to 1.7.

- **Multiberkeley** This dataset corresponds to the other subset of the FBK training corpus. It contains 391 sentences corresponding to Berkeley's FN sentences translated into Italian. Also the annotations of this dataset needed to be aligned with FN 1.7.

4.3.2 IFrameNet Navigator

In order to make the model explained in 4.2.3 valuable for annotators, it has been created a Graphical User Interface, in order to allow the graphical visualization of the distances between frames and lexical entries: the IFrameNet Navigator. "It allows querying and navigating the geometrical representation of semantic phenomena as it displays, for each lexical entry in the dictionary, the best-10 frames" (Brambilla et al., 2020, p.5). In turn, frames can be selected to display the LUs that are closest to them in the semantic space as shown in fig. 4.12 Finally, it is possible to select LUs in order to browse the list of corresponding annotated sentences.

Figure 4.12: Graphical visualization of the LU *alleato.a* in the IFrameNet Navigator

This tool can be particularly useful in the development of the resource. In fact, it could support the analysis of the dictionary, the development of new entries or new connection for the already existing entries (i.e. it would support the creation of new LUs), and validation of SSs. Moreover, it could be extremely useful in potential future crowdsourcing operation aimed at the enlargement of the resource.

Chapter 5

Fear, anxiety, worry and FrameNet

Defining what fear, anxiety and worry are is a very difficult and delicate operation, just as the context of emotions in general is complex and variously interpreted. Over time, many scholars have tried to answer the questions "what is an emotion?" and "what are fear, anxiety, worry?" "what are the boundaries of these and what differentiates them?" and the answers they have come up with are varied and often contradictory. The purpose of my research work is not to propose a theory as better or more valid, nor to answer these age-old questions. However, I am convinced that it is important, in order to then proceed with the analysis of the frames related to this area, to see some of the answers that scholars have given themselves over time and also to define the theoretical area in which we will move.

For this reason, in this chapter I will scan through some of the most important theories of emotions and fear. In particular I will focus on the theory of Ortony, Clore and Collins (Ortony et al., 1990) that seems to be particularly relevant with regard to the construction of emotional frames in FrameNet and that I will adopt for the interpretation and analysis of fear, worry and anxiety. I will also analyse more in detail the concepts of Stimulus and Experiencer, central also to the development of Emotion Frames.

The presentation of the different psychological theories of emotions does not claim to be complete and exhaustive, it only aims to provide an overview of the debate related to emotions in order to allow a better understanding of the complexity of the field.

5.1 Psychological theories of Emotions

Ortony et al. (1990, p.3) stated that "Emotion is one of the most central and pervasive aspects of human experience", yet the notion of emotion itself has been long debated and there is not a single definition of what an

emotion is, nor a single theory about how emotions are structured and how they arise and fade away.

Firstly, we can draw a distinction between theories that claim emotions to be innate and universal to the human beings and theories that claim emotions to be a socio-cultural product, that is not possible to generalise across different cultures. This point is of primary importance for our study since, as mentioned before, the degree of universality of an experience has a strong impact on the degree to which frames that schematise it can be generalised cross-linguistically.

Within the innatist theories we can recall for example the evolutionist theory of Darwin, the neurophisiological theories of James-Lange (James, 1884; Lange, 1885) and of Cannon-Bard (Cannon, 1927) as well as the neoevolutionist theories for example of Plutchik or (Ekman, 1992, 1999; Ekman and Friesen, 1971; Plutchik, 1970, 2001). The innate nature of emotions is not shared by the cognitivist theories (e.g. Frijda et al. (1986); Lazarus (1991); Schachter and Singer (1962)) as well as the constructivist theories which instead emphasize the psychological component of emotions and the primacy of cognitive evaluation of stimuli over the emotive response.

Darwin's evolutionist theory Darwin gives an interpretation of the emotions as adaptive mechanisms, fundamental for the survival of the specie. In the book "The expression of the emotions in man and animals" (1872) he claimed the stucture of emotions to be innate and adaptive (i.e. over time, the emotions that best adapted to the environment and that proved to be most useful for survival were selected) and attributes to culture only the responsibility for the regulation of emotions.

Neurophysiological theories Starting from Darwin's work, many of the modern theories were developed, in particular the neurophysiological theories, among which we can find James-Lange and Cannon-Bard's opposing stance. In 1884 the psychologist William James in his article "What is an emotion?" (1884), going in the opposite direction to traditional theories, theorized that the emotions arise as a consequence of physical modifications and that the emotion itself consists in the conscious perception, in the conscious experience, of these modifications. According to James's theory, shared with slight differences also by the psychologist Lange (1885), when someone is presented with a potential Stimulus they experience physiological reactions and visceral physiological changes that are consequently elaborated within the brain. This leads to a conscious sentiment that corresponds to the emotion. His theory has been addressed as "peripheral theory" or "feedback theory", since it postulates that the emotive reaction to the Stimulus goes from the peripheral nervous system to the central. According to his theory for example we do not tremble *because* we are afraid but we are afraid *because* we tremble.

In contrast with this theory the psychologists Walter Cannon and Philip Bard, proposed the priority of the central nervous system (CNS) (Cannon, 1927). They conducted experimental studies and proved that animals kept showing emotional behaviour (e.g. behaviour typically associated with anger or fear) even when the connections between the CNS and the viscera were eliminated. For this reason they claimed that the physical expression of emotions was not necessary in order to feel them. According to their theory, called "central theory", the emotion starts within the brain and both the physical reaction to the Stimulus and the emotional conscious experiences arise at the same time as a consequence of the stimulation of the talamic area.

Cognitivist theories These theories underline an important aspect of emotional experience that had been overlooked by both the Evolutionist Theories and the Neurophysiological theories: the psychological component. The most important cognitive theories are:

- Schachter–Singer two-factor theory of emotion;
- Lazarus appraisal theory;
- Frjida cognitive emotion theory.

Schachter–Singer two-factor theory of emotion According to Schachter and Singer (Schachter and Singer, 1962) emotions arise as a consequence of the interaction between two elements: a) a physiological component, called arousal and b) a psychological component. These two are connected via a causal interaction during which the Experiencer attributes a specific label to a particular physiological activation.

Lazarus appraisal theory In his article "Progress on a cognitive-motivational-relational theory of emotion" (Lazarus (1991)) states that the emotions are determined by the cognitive evaluation of the events and the effects that they cause in different people. The central concept of his theory is the concept of *appraisal* that indicates the cognitive processing of the event and comprises both the evaluation of the event (primary appraisal) and the analysis of the possible coping strategies (secondary appraisal).

Frjida cognitive emotion theory According to Frijda et al. (1986) emotions are tendencies towards specific behaviours in relation to what is believed to be beneficial to the Experiencer, they arise from the analysis of events and the effects they can have on the individual. The emotional process goes from the cognitive processing of the Stimulus to the execution of a consequent action.

Neoevolutionist theories: Plutchik and Ekman The neoevolutionist theories are based on the darwinian idea that emotions are adaptive programs, adaptive responses to the environment. Two of the most important scholars which are part of this current of thought are Paul Ekman and Robert Pluchik.

Plutchik theory of emotions Plutchik theory (1970; 2001) identifies the emotion as an evolutionary adaptive product, common both to animals and humans, which varies according to the adaptive necessities, but presents some prototype patterns that are shared across species. He claims that exists a small number of primary emotions that serve as a basis for the characterization of all other emotional states. These basic emotions can be seen as couples of polar opposites and can be organized by intensity as is shown in Figure 5.1. He identifies a set of eight basic emotions: Joy, Trust, Fear, Surprise, Sadness, Disgust, Anger and Anticipation. These eight emotions can be combined in dyads and triads of more complex emotions as explained in figures 5.2 and

Figure 5.1: Plutchik's wheel of emotions (Garcia and Hammond, 2016, p.779).

Plutchik's wheel of emotion, given its clarity and completeness, has been widely exploited in NLP, for example for the development of the

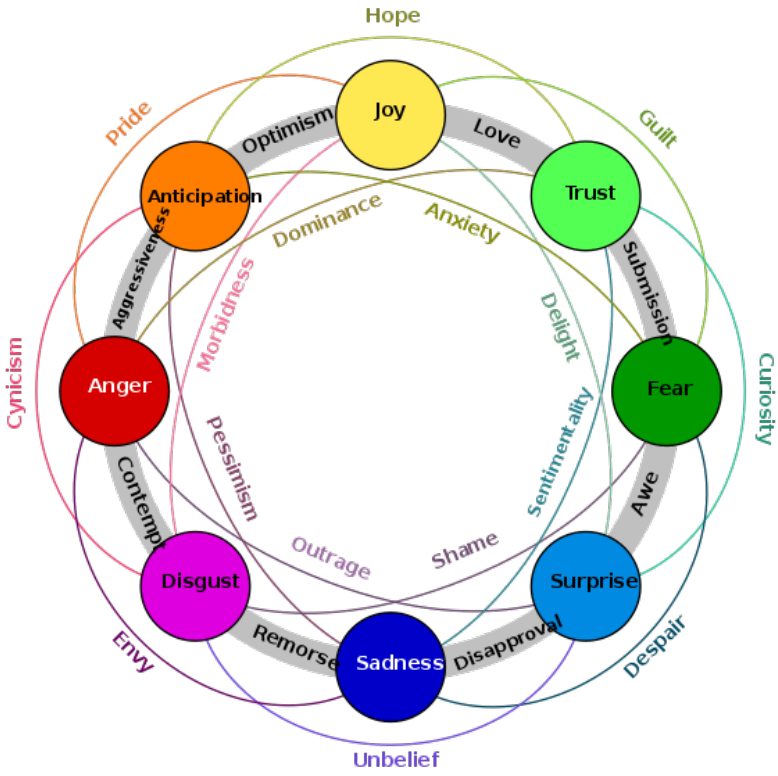


Figure 5.2: Graph of primary, secondary, and tertiary dyads on Plutchik's wheel of emotions (Wikimedia Commons, 2019).

Figure 5.3: List of primary, secondary, tertiary dyads, and opposites on Plutchik's wheel of emotions (Marini, 2019, p.144)

Word-Emotion Association Lexicon (EmoLex) (Mohammad and Turney, 2013), and for tasks of emotion detection (for example: Abdul-Mageed and Ungar (2017); Krommyda et al. (2021); Tromp and Pechenizkiy (2014).

Ekman theory of emotions Since 1965 Ekman conducted studies and experiments on the cross-cultural expression of emotion. His experiments consisted in showing pictures of faces expressing different emotions to subjects of various and distant cultures. He noticed that the facial expressions represented in the pictures were interpreted consistently even by people of very different cultures. This led to claim that emotion expressions were universal and therefore that at least a set of basic emotion needed to be universal. According to his theory (Ekman, 1999; Ekman and Friesen, 1971, 2003) in order to be considered primary an emotion needs to be, as said, universal (and thus universally codified by facial expressions), to activate the same physiological activation and to trigger the same response (that corresponds to the best adaptive response to the situation). In his first work in particular there was a set of six primary and basic emotions: Anger, Disgust, Sadness, Joy, Fear and Surprise.

Constructivist theories The claim of constructivist theories is that emotions need to be interpreted as social constructions. Averill 1980 claimed that, more precisely, emotions are "socially constituted syndromes or transitory social roles" (Averill, 1980, p.1). With his claim he does not want to imply that the biological system does not contribute to the emotional experience, but that it is primarily a sociocultural experience.

5.1.1 Ortony, Clore and Collins theory of emotion

The theory of Ortony, Clore and Collins (Ortony et al., 1990) will be presented in more detail because it is at the basis of the construction of emotional frames in FN. Their position has to be found within the spectrum of cognitive theories. Their theory focuses primarily on the connections between cognition and emotions and on the extent to which cognition contributes to emotions. They claim that the emotions "issue from cognitive interpretations imposed on external reality, rather than directly from the reality itself"(Ortony et al., 1990, p.4) and that, then, what causes the emotions to arise is the subjective construal of events. They question the usefulness of focusing on basic emotions and instead propose to represent emotions as a set of groups of emotion types, which are organized on the basis of their cognitive origins (Ortony et al., 1990, p.13). In particular, their view focuses on the different cognitive elicitors of emotions and specifically on 3 different groups: agents, objects and events. According to their theory, emotions are "valenced reactions to events, agents or objects, with their particular mature being determined by the way in which the eliciting situation is construed"(Ortony et al., 1990, p.13).

Their work aims to develop a theoretical approach that could be implemented in a computer and over time has been applied to different NLP tasks (e.g. emotion extraction from online reviews (Huangfu et al., 2013), affect sensing from texts (Shaikh et al., 2009). Moreover, it represents the underlying structure to FrameNet emotion domain (Ruppenhofer, 2018).

The structure they propose is the one illustrated in Figure 5.4.

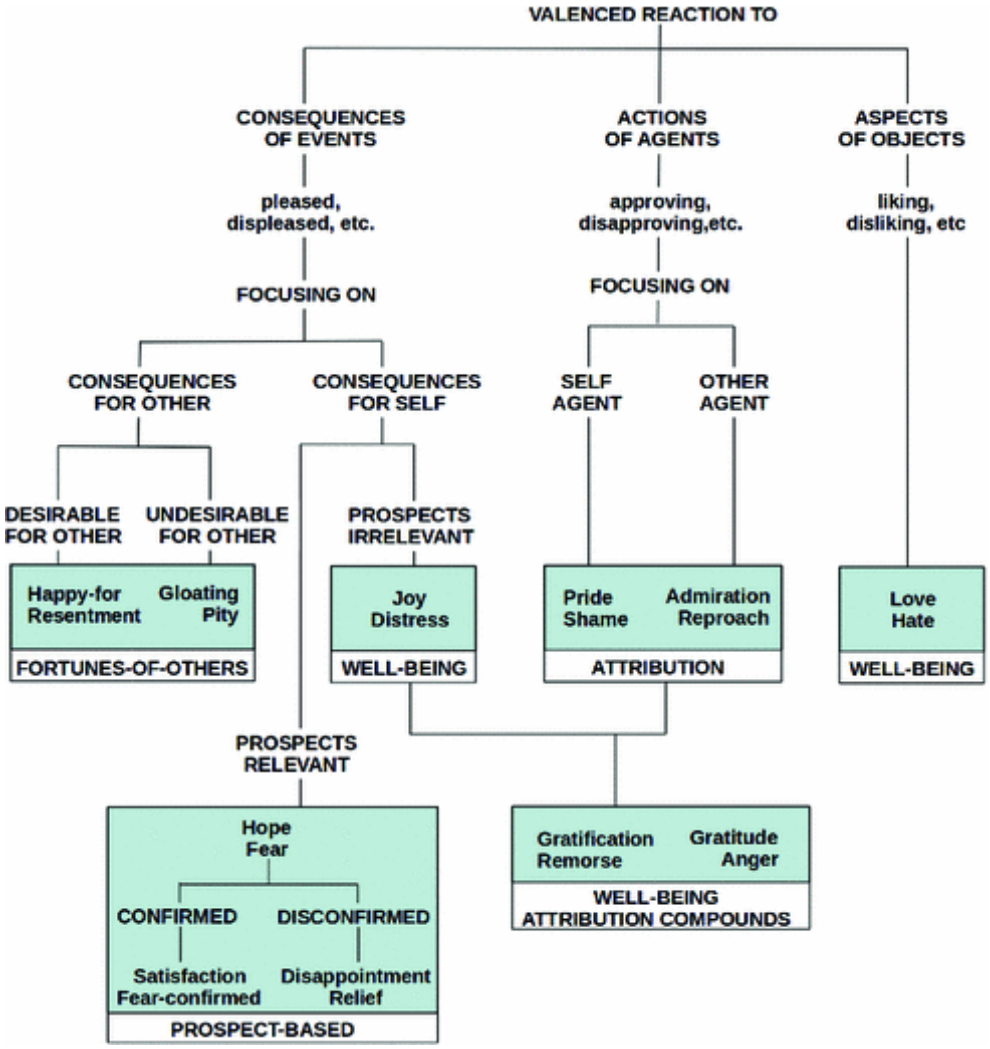


Figure 5.4: Global structure of emotion types according to Ortony et al. (1990, p.19)

As mentioned before the primary distinction is made on the basis of the type of eliciting situation, the type of the Stimulus, which can be an event, an object or an agent. This first distinction corresponds to three distinct basic classes of emotions:

- Being pleased or displeased as a reaction to EVENTS;
- Approve or disapprove as a reaction to AGENTS;

- Like or dislike as a reaction to OBJECTS.

The event-based emotions can be further divided into three groups: a) the Fortune-of-others focuses "on the consequences for oneself of events that affect other people"(Ortony et al., 1990, p.33), b) the Prospect-based and c) the Well-being which focuses on events that have a direct effect on the Experiencer. Moreover, it is possible to identify another group that straddles event-based and agent-based emotions: the Well-being/Attribution compound.

The experience of emotions depends on the individual's appraisal of the situation which in turn is based on some variables which can be divided into two groups: global variables, which apply to all classes of emotions, and local variables, which apply to particular groups of emotion. All the emotions, in fact, depend on how real and close the Stimulus is perceived (*sense of reality* and *proximity*), on how unexpected it is (*unexpectedness*) and on the level of arousal of the individual when presented with the Stimulus. The local variables instead only impact particular groups of emotion: the event-based emotions are affected by *desirability*, agent-based emotions by *praiseworthiness* and object-based emotions by *appealingness*, where:

> Desirability is evaluated in terms of complex goal structure, where there is a focal goal that governs the interpretation of any event. The desirability of the event is appraised in terms of how it facilitates or interferes with this focal goal and the subgoals that support it. Similarly, the praiseworthiness of an agent's actions is evaluated with respect to a hierarchy of standards, and the appealingness of an object is evaluated with respect to a person's attitudes.(Ortony et al., 1990, p.58)

Moreover, within the event-based emotions, the Prospect-based depend on the degree to which something is believed to be likely to happen (*likelihood*), on how much energy and effort one puts into trying to get to a desired event or to avoid an unwanted one (*effort*) and on the degree to which what is desired happens (*realization*). The Fortune-of-others emotions depend on how much the Experiencer thinks that the event is desired by the other person (*desirability-for-other*), on how much he likes/dislikes the other person (*liking*) and on how much the event is considered to be in line with what the other person would have deserved . The agent-based emotions are affected not only by the central *praiseworthiness*, but depend also on the degree to which the Experiencer identifies with the agent (*strenght of cognitive unit*) and on how much the actions of the agent deviate from what would be expected. Finally, the object-emotions are influenced also by the *familiarity* of the object and by its *appealingness*.

5.2 Fear, Worry and Anxiety

Fear is usually interpreted as an adaptive response of animals to dangerous situations. In this sense, therefore, fear would be functional and part of problem-solving mechanisms. As recalled by Rosen and Schulkin (1998), this vision of the problem can be traced back to Aristotle, Darwin (1872), Dewey (1999), Arnold (1960), and Frijda et al. (1986). However, other scholars highlighted that this view of fear contrasts with the reality of the facts, since frequently in situations of fear the response to the threat becomes less effective and the ability to respond to the situation can be compromised (Freud et al., 1977; Goldstein et al., 1996; Sabatini et al., 2011).

As we presented above, the problem of what an emotion is, how emotions are structured and how they arise and end is a complicated one and has been addressed by many different scholars who have often reached conflicting conclusions. Also when it comes to the definition of fear, worry and anxiety, many definitions can be found and if the scope of investigation is extended to disciplines other than psychology, the definitions multiply visibly. Anyway, it is important to point up that sometimes the differences that we may notice between the various theories do not always correspond to real oppositions, but rather to different uses of terminology. Moreover, what is identified as anxiety or fear, for instance in the specific neurobiological lexicon, may not be the same as what is meant by using non-specific lexicon or by moving from the specific lexicon of one area to that of another.

Fear and fear related emotions have been studied since ancient times, already Aristotle wondered about the nature of fear. Over the years several researchers have proposed different theories showing how difficult it is to define precisely the nature of this emotion (as in line with what was presented above). If we look at the theories of emotions we presented above we can see that also in this case the definitions and interpretations of the concept of fear are not unanimous and consistent. However we can see that in many of these works fear is given a role of great prominence and importance.

Darwin in his book (1872) interprets fear as a universal emotion, result of adaptive evolutionary mechanisms, that helps to better react to fearful and threatening situations. According to the James-Lange theory of emotion (James, 1884; Lange, 1885), as mentioned above, emotion emerges as a consequence of physiological arousal. Fear therefore, like other emotions, would arise following the recognition of a certain arousal pattern, for example the increase in heartbeat. The Cannon-Bard theory (Cannon, 1927), on the other hand, argues that the experience of the emotion of fear and physiological arousal occur concurrently. Also according to the Schachter-Singer theory (Schachter and Singer, 1962) fear is directly linked to physiological arousal, and as in the James-Lange theory fear derives from this. However, it does not emerge directly from the physical arousal patterns

but from the cognitive appraisal of these physical sensations. According to Lazarus (Lazarus, 1991) instead fear emerges from the immediate conscious or unconscious appraisal of fearful situations and events (stimuli). Plutchik and Ekman (Ekman, 1992; Ekman and Friesen, 1971) present fear as fundamental and universal. Plutchik (Plutchik, 1970, 2001), for example, argues, as seen above, that fear is one of the basic emotions and in particular recognizes three different degrees of fear ranging from apprehension to terror, where apprehension represents the mildest form and terror the most intense.

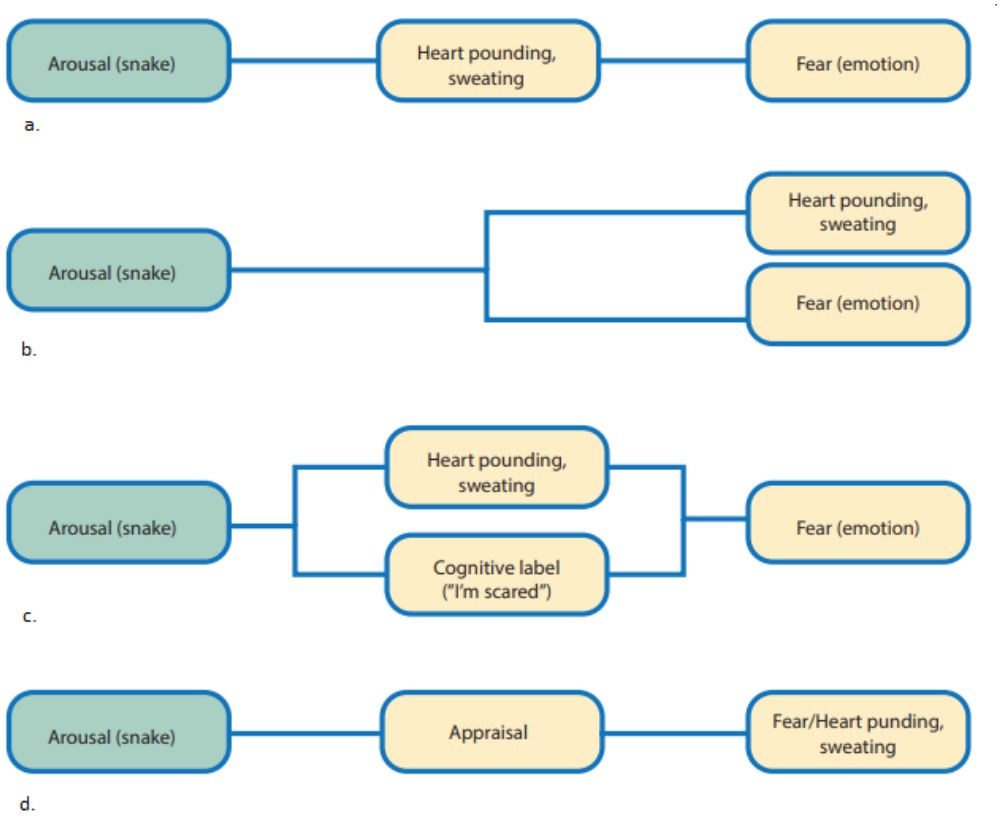


Figure 5.5: Fear patterns according to: a. James-Lange theory, b. Cannon-Bard theory, c. Schachter-Singer Two Factor theory, d. Lazaru's Cognitive-Mediational theory

Zampa (2013) proposes a scenario of fear that combines Kövecses description of the prototypical scenario of fear (Kövecses, 1990) and the study of Kailuweit (2012). This scenario includes as participants: an Experiencer, a situation that is perceived as dangerous and a concrete threat (the source of danger). As shown in figure 5.6, it is possible to identify 5 stages:

- Stage 1 - something, someone or a particular situation or event is perceived as dangerous;
- Stage 1b - in this stage we find those cases when the subject does

not experience this dangerous situation directly, but the danger is reported to him by someone else;

- Stage 2 - the subject experiences the physiological sensations linked to fearful situations and consequently experiences fear;
- Stage 3 - the subject assesses the risks;
- Stage 4 - the reaction of the subject to the fearful situation occurs.

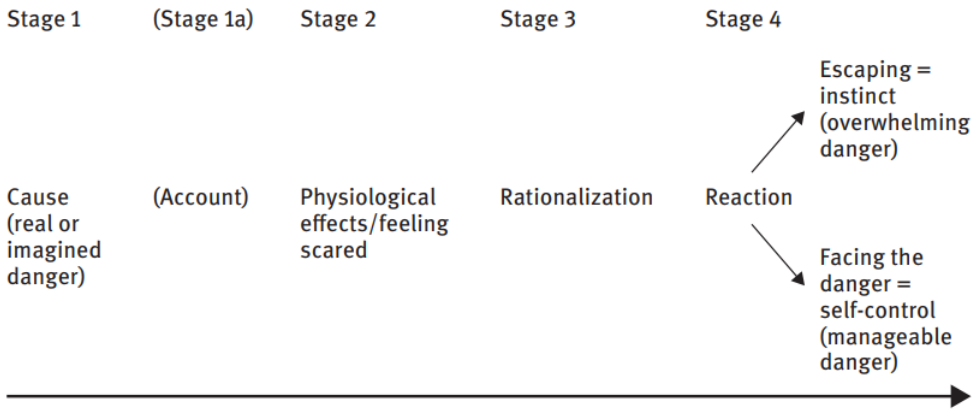


Figure 5.6: Fear scenario as proposed by Zampa (2013, p.52)

Fear and anxiety are both usually, and quite unanimously, considered emotional responses to danger or threat (Epstein, 1972; Ohman, 1993; Rosen and Schulkin, 1998) usually evaluated as negative by the Experiencer which tends to get out of the negative emotional state through different behavioural responses. They are seen as evolutionary responses to the need to adequately react to threats. It is already from a very early age that human beings are able to understand potentially risky or dangerous situations by making use of emotions, in particular: "as early as 6-12 months of age infants start to display an attentional bias toward the fearful facial expressions" (Raber et al., 2019, p.158).

According to Raber et al. (2019, p.138): "the experience of human fear as an emotion [...] occurs as a result of the complex interaction between the activation of basic threat detection systems, memory storage and retrieval, and our own conscious awareness" and can be defined as the state that "occurs when the sentient brain is aware that its personal well-being (physical, mental, social, cultural, existential) is challenged or may be at some point" (LeDoux, 2014, p.2876).

A fundamental problem we have to face is whether fear, anxiety and worry are different aspects of the same thing or completely different things and, if so, what are the differences between them. As we can see they are usually indicated as different, but there is no single position in this

regard and indeed we often find ourselves faced with definitions that are also conflicting with each other.

According to the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association et al., 1980), both fear and anxiety correspond to anticipations of a future that is perceived as potentially dangerous or negative. The difference is that anxiety corresponds to an apprehensive anticipation of a non-defined future, while fear necessarily originates from a concrete and identifiable threat. In this sense, anxiety would also precede the presence of a concrete threat (pre-Stimulus), while fear would arise in response to a threat (post-Stimulus).

Beck et al. (2005) claim that: "fear is a cognitive response to threat whereas anxiety is an emotional response to fear. In other words anxiety is the emotional byproduct of fearful cognitions" (Sylvers et al., 2011, p.124).

According to Epstein (1972) the differences between the two are related to the possibility of the Experiencer of dealing with the threat. Fear would occur when specific situations are interpreted as threatening and would manifest itself through avoidance and flight behaviors. Anxiety, on the other hand, could originate in the event that: (i) it is impossible to avoid a feared Stimulus; (ii) the threat is not specific and there is no clear possibility of avoiding it; (iii) the expectations of the individual do not coincide with the environment in which he is immersed. In his view "fear is an avoidance motive. If there were no restraints, internal or external, fear would support the action of flight. Anxiety can be defined as unresolved fear, or, alternatively, as a state of undirected arousal following the perception of threat" (Epstein, 1972, p.311).

Öhman (2008) claims that: "fear and anxiety are closely related emotional phenomena originating in evolved mammalian defense systems. Nonetheless, in spite of their overlap, research during the last decade has started to unravel important differences between them. [...] They both involve intense negative feelings and strong bodily manifestations. Subjectively, however, they take somewhat different forms. Fear denotes dread of impending disaster and an intense urge to defend oneself, primarily by getting out of the situation. Clinical anxiety, on the other hand, has been described as an ineffable and unpleasant feeling of foreboding"(Öhman, 2008, pp.709-710). Therefore, for Ohman there is a difference between anxiety and fear and it lies in the possibility or not of being able to manage the threat. Fear would in fact originate when the Experiencer is forced to face the threat while anxiety would be the result of a perception of a dangerous situation but without means of coping.

Adolphs (2013) assumes a continuum of fear related emotional states where the variable is the proximity or distance from the threat. The farthest part from the threat is occupied by anxiety while the closest part is occupied by panic. In the midst of this continuum he places fear.

Another possible difference between anxiety and fear is brought to light by Raber et al. (2019) which highlight that while fear only presents

a potential negative outcome to be avoided, in the case of anxiety the outcomes can potentially be both positive and negative.

Also LeDoux and Pine (2016) claim that there is a difference between fear and anxiety and that this difference is based on the imminence of the Stimulus. In his view

> The mental state term fear be used to describe feelings that occur when the source of harm, the threat, is either immediate or imminent, and anxiety be used to describe feelings that occur when the source of harm is uncertain or is distal in space or time (LeDoux and Pine, 2016, p.1084).

However, LeDoux and Pine (2016) also notice that in non-specialist language the two terms are often interchangeable and have no clear boundaries and that, moreover, even specialists do not always denote the same exact thing with the terms fear and anxiety. This is also due to the fact that the interrelationships between fear and anxiety are so close that the very concepts of fear and anxiety become fluid. In fact, when we are in a situation of fear such as when we are faced with an imminent threat, this fear can quickly turn into anxiety, as we start thinking of all the possible outcomes of the dangerous situation we are in. LeDoux (2018) gives as an example the situation of an encounter with a snake. In this case he argues that the perception of the threat would provoke a sense of fear that could quickly turn into anxiety. We would start to think about what could happen in that situation: the snake could be poisonous, the snake could bite us, we could have trouble finding a doctor, we could have trouble finding a hospital, we could not be able to escape, in case it bites us we may not be able to control our heartbeat and this beating too quickly would circulate the toxin too quickly. LeDoux argues that all these are anxieties and worries while the one at the beginning was simply fear.

One last thing we can highlight is that anxiety and fear can be both personality traits, that characterize individuals and are more or less stable in time, and emotional states linked to a particular circumstance or a particular context and limited in time (Öhman, 2008, p.710).

We could further distinguish between worry and anxiety. Crowe et al. (2007) present anxiety as "a complex set of reactions including cognitive, behavioural, emotional and somatic components"(Crowe et al., 2007, p.170) and state that it can be subdivided into two components:

- the perception of the affective physiological effects of anxiety, "emotionality" or "somatic anxiety";
- the cognitive elements of anxiety, "worry" or "cognitive anxiety". It includes "preoccupation over one's performance, negative self-evaluations and expectations, and comparison to others" (Crowe et al., 2007, p.170).

Worry is quite unanimously interpreted as a type of cognitive event and in particular the cognitive component of anxiety (Borkovec and Inz, 1990; Castaneda and Segerstrom, 2004; Crowe et al., 2007; Ortony et al., 1990; Roemer and Borkovec, 1993) but Gana et al. (2001) claim that it can also be interpreted independently from anxiety. Moreover, O'Neill (1985) holds that there is no substantial difference between worry and anxiety. Nevertheless, a few years later Davey et al. (1992) provided evidences of the separateness of the concepts of worry and anxiety, investigating how some of the characteristics of worrying are independent of anxiety and other related concepts. They found that "worrying was associated with adaptive problem-focused coping strategies and an information seeking cognitive style" whereas anxiety was instead independently associated with psychological processes that are normally considered to result in poor psychological outcomes (Davey et al., 1992, p.133).

5.2.1 Fear, Worry and Anxiety in Ortony's theory

Ortony et al. (1990) in their theory of emotion interpret fear as a valenced reaction to events and in particular they place it among the Prospect-based emotions, that are "reactions to (i.e. being pleased or displeased about) the prospect of an event, or to the confirmation or disconfirmation of the prospect of an event" (Ortony et al., 1990, p.109).

In particular they identify six groups within the Prospect-based emotions according to two criteria. The first criterion is the Experiencer's belief upon the status of the event:

- He may not know yet if the event took or will take place (unconfirmed status - *Prospect emotions*);
- He may know that the event did take place (confirmed status - *Confirmation emotions*);
- He may know that the event did not take place (disconfirmed status - *Disconfirmation emotions*).

The second criterion is the desirability of the event which may be desirable or undesirable. These two variables may be summarized as in 5.1

Each group represents a family of emotional states which vary with regard to some dimensions such as intensity, proximity of the event or how specific or vague the trigger event is.

Fear, anxiety and worry represent, in this paradigm, different family members of the "Fear emotions" group. Fear emotions are reactions to unconfirmed unpleasing events occurring when someone is "(displeased about) the prospect of an undesirable event"(Ortony et al., 1990, p. 112). Of course there may be displeasing events which do not give rise to emotions, for example situations which are perceived as only slightly undesirable, such

	APPRAISAL OF PROSPECTIVE EVENT	
STATUS OF EVENT	DESIRABLE	UNDESIRABLE
UNCONFIRMED	Pleased about the prospect of a desirable event (e.g. hope)	Displeased about the prospect of an undesirable event (e.g. fear)
CONFIRMED	Pleased about the confirmation of the prospect of desirable event (e.g. satisfaction)	Displeased about confirmation of the prospect of an undesirable event (e.g. fears-confirmed)
DISCONFIRMED	Displeased about the disconfirmation of the prospect a desirable event (e.g. disappointment)	Pleased about the disconfirmation of the prospect of an undesirable event (e.g. relief)

Table 5.1: Prospect-based emotions in Ortony et al. (1990, p.110)

as the possibility of losing 10 cents, do not normally give rise to emotions but lead either to indifference or to cognitive states of (mild) concern which is of too low intensity to be considered an emotion.

The members of the group vary with regard to some dimensions such as intensity, proximity of the event or how specific or vague the trigger event is. According to Ortony et al. (1990) then when talking about "fear", "anxiety" and "worry" we refer to the same type of valenced reaction, but with differences regarding the intensity of the reaction ("fear" is more intense than "anxiety"), the specificity of the threat ("anxiety" relates to less specific and more diffuse causes) or the proximity of the event ("fear" refers to closer events than "worry"). Moreover, when using the term "worry" the focus is on the cognitive aspects of fear.

We saw in this section that Ortony et al. interpret fear as an event-based emotion. This may surprise given the fact that for example we can think of fears such as "the fear of spiders" and one can say to be "afraid of thieves". This is only an apparent counter-evidence of the theory and it is easy to overcome it by thinking at spiders or thieves as evoking, in the mind of the Experiencer, a certain event that is linked to them or caused by them. By fearing a thief one can fear the possibility of being robbed and by fearing a spider one can fear the possibility of being bitten.

5.2.2 Fear, Anxiety and Worry lexicon

As we have seen, there are numerous interpretations of nature and the role of fear. However, many scholars agree on its importance and many come to define it as one of the fundamental emotions, one of the basic emotions. In this subsection I will present some of the main works on fear lexicon.

Studies related to the lexicon of fear have a long history and as early as 1899 Chamberlain dealt with it. In his article he makes an excursus of the lexicon of fear for various languages creating subdivisions based on concepts or characteristics shared in each group. In particular, he creates groupings according to the physiological effect of fear highlighted by the various expressions, namely: the idea of tremble, the idea of agitation and movement, the idea of sudden movement, the sinking of the heart, the bristling of the hair, the freezing of the blood, the idea of loss of power, the idea of being thrown to the ground, the idea of being rooted to the ground, and the idea of being transfixed with fear.

Wierzbicka (1990) believes that all the emotion-related words can be defined in terms of cognitive structures typically associated with the emotion being described, i.e. the prototypical scenario related to that emotion. In order to analyse the domain of emotion words (and more precisely of fear words) she proposes to exploit the Natural Semantic Metalanguage (1972; 2015), which is a way to formalize the lexicon that proposes an analysis of the language in componential terms and uses the English language as lingua franca. She claims that "emotions are often overtly described in terms of a prototypical situation (' I felt as one does when...', or 'I felt as one would if...'). I hypothesise that ready-made emotion terms such as *sadness* or *joy* provide handy abbreviations for scenarios which members of a given culture see as particularly common and salient" (Wierzbicka, 1990, p.361). Wierzbicka describes fear words as words that refer to "possible misfortunes" that are perceived as something undesirable and preferably avoided. Moreover, they are often accompanied by a sense of helplessness and the perception that something should be done, but the lack of awareness of what should be done. The three basic cognitive dimensions, shared by all fear terms are (Wierzbicka, 1990, p.363):

- The perception that something bad will happen to the subject;
- The subject's perception of not wanting this to happen;
- The perception of the impossibility of preventing it, or the perception of the lack of knowledge of how to prevent or deal with it.

For example she describes fear and anxiety as:

Fear
X feels something (when X thinks of Y)
sometimes a person thinks something like this:
I don't know what will happen

something very bad can happen
I don't want this
because of this, I would want to do something
I don't know if I can do anything
because of this, this person feels something bad
X feels like this

Anxiety
X feels something
sometimes a person thinks something like this:
something bad can happen to me
I don't know what
I don't want this
because of this, I would want to do something
I can't do anything
because of this, this person feels something bad
X feels like this

The analysis that Wierzbicka (1990) proposes that linguistic concepts are not fuzzy but clearly defined.

Many studies have been conducted also on languages different from English, for example Spanish (Alba-Salas, 2007), French (Cislaru, 2009; Ströbel, 2015), Italian (Giacomini, 2011; Zampa, 2013), Portuguese (Maia and Santos, 2012).

Alba-Salas (2007) examines the constructions of the state noun "*miedo*" with the causative light verbs "*dar*" (lit. "to give") and "*hacer*" (lit. "to make") used to express the concept of "frightening". In particular he examines their diachronic evolution and presents the transition from "*hacer miedo*" (lit. "to make fear") to the currently used "*dar miedo*" (lit. "to give fear").

Cislaru (2009) analysed the expression and description of fear (without distinguishing it from anxiety) in 2 types of texts: the evaluation reports of social services in the context of reports of children in danger, and press articles in order to examine how the strategies of representation of fear can prefigure the interpretation in the perspective of the pragmatic-communicational aim of these discourses.

An interesting aspect she points out is the distinction between "*structures réflexives*" ("reflexive structures") and "*structures allocentrées*" ("allocentric structures").

In the first case the anger targets the speaker and corresponds to structures such as X fears for Y, in the second case the danger's target is someone else with whom the speaker empathises. According to Cislaru "les structures allocentrées rendent compte d'une prise en charge énonciative de l'émotion qui semble tenir du domaine de l'empathie: en effet ces structures sont dues à la substitution de sujet énonciatif au sujet psychologique cible

de danger" [1] (Cislaru, 2009, p.51)

Giacomini (2011) worked on the collocations of "*paura*" ("fear") in order to build an online dictionary of onomasiological representations of Italian collocation for translators.

Maia and Santos (2012) pointed out the complexity of the interrelationships between emotion, cognition and the language of fear and analysed fear lexicon in English and Portuguese, through corpus analysis, in order to highlight the similarities and differences between the two languages. They do not differentiate between worry and anxiety and propose that the difference between them and fear is only relating to the strength of the expression.

Ströbel (2015) presents fear as a universal and primary emotion and analyses the lexicon of this domain in French, presenting the individual entities of the lexicon of fear as different stages of the emotional process. Unlike most studies on the lexicon of fear, Ströbel also focuses on the distinction between state and trait fear and notices that terms that present trait fear are associated, unlike those that describe state fear, with the property of being permanent, lasting over time. Finally, she highlights the French tendency to avoid the direct expressions of fear which is instead often expressed through metonymic and metaphorical means.

Many studies have been conducted on the usage of metaphors in the language of emotions and in particular within the domain of fear (5.2. They highlighted that the metaphors used to describe fear are in part constant cross-linguistically and cross-culturally, in part, instead, specific within various cultures (Bordin, 2011; Lakoff and Kövecses, 1987; Maalej, 2007; Pamies Bertrán and Iñesta Mena, 2000; Ströbel, 2015; Szulmajster-Celnikier, 2007; Zibin and Hamdan, 2019).

The metaphors that tend to remain more stable across cultures are those related to the physical sensations and physical changes that fear causes, such as the increased heart rate, the feeling of trembling, the feeling of being anchored to the ground, while the metaphors that tend to be more variable are those related to cultural aspects. Maalej (2007) and Zibin and Hamdan (2019) propose that the conceptualization of fear is both linked to universal physical experiences and socioculturally structured and explain its different linguistic realizations in terms of different kinds of embodiment. They claim that "the reason emotions can be interpreted on both universal and culture-specific basis is that emotions are not only experienced as psychological states triggered by psychological events, but also by social events" (Zibin and Hamdan, 2019, p.240) and argue "that embodiment does not proceed just from the body, but also from the socio-cultural offloading itself onto the body and the linguistic" (Maalej, 2007, p.90).

An important contribution to the understanding of the liguistic con-

[1]The allocentric structures account for an enunciative handling of the emotion which seems to belong to the domain of empathy: indeed these structures are due to the substitution of the enunciative subject for the psychological subject target of danger.

SOURCE DOMAIN	METAPHOR
BODY AND MOVEMENT	Fear as: a downward movement, an upward movement, a vibratory movement, an inward movement, an outward movement, the inability to move.
BODY AND TEMPERATURE	Fear as: cold, heat, a combination of cold and heat.
BODY AND COLOUR	Fear as a change of colour.
ANIMALS	Fearful individual as an animal.
POSSESSION	Fear as possession or as possessor.
CONFLICT - AGGRESSION	Fear as something that attacks and kills.
DEATH	Fear as something close to death.
MENTAL ILLNESS	Fear as something that drives crazy.

Table 5.2: Common fear metaphors across languages as presented by (Pamies Bertrán and Iñesta Mena, 2000)

ceptualization of emotion experiences is the work of Fedriani (2014) that in particular investigated the experiential construction in Latin. She described the experiential situation and its two main participants namely the Experiencer and the Stimulus *(cfr. infra)* and analysed the complexity of their status. Moreover, she highlighted that the relation they establish is usually expressed through a verb or a support verb and in particular verbs denoting movements, possession, and activities.

Lastly, another aspect that many scholars pointed out for different languages is that fear lexicon is not always used to express fear. For example it can be used to express politeness or regret (Maia and Santos, 2012), or as an intensifier (Benigni et al., 2017; Marcato, 1997; Ströbel, 2015).

The importance of studying fear lexicon In this period, the concepts of fear, anxiety and worry are particularly relevant for numerous reasons ranging from economic crises, to climate change to the current pandemic situation. For this reason, the study of the lexicon of these domains could be important to help us better understand how they are conceptualized within the various cultures.

Moreover, many psychological disorders are related with fear and anxiety (fig.5.7) and as of today fear and anxiety in humans can be analysed and assessed primarily relying on the self-reports of individuals (LeDoux and Hofmann, 2018; Raber et al., 2019).

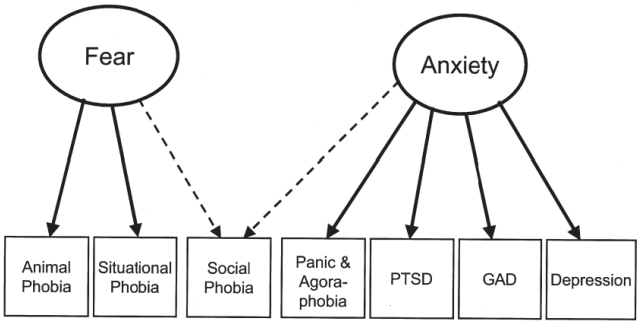


Figure 5.7: Fear and Anxiety related disorders, in Öhman (2008, p.723). Fear is linked to specific phobias (animal and situational phobias) and anxiety is linked to panic disorders and agoraphobia, posttraumatic stress disorder (PTSD), generalized anxiety disorder (GAD), and depression. The schema shows also that social phobia has relationships that link it to both clusters.

5.3 Stimulus and Experiencer

Until now I have often used the terms Stimulus and Experiencer without defining them. Before going on to illustrate the ways in which FrameNet represents emotional frames, however, I would like to spend a few words to better clarify these two key concepts of every emotional experience. In fact, there can be no emotional experience without someone experiencing it, nor can we speak of emotion as a valenced reaction in the absence of something that stimulates this reaction. By its nature, the Experiencer is always animate while the Stimulus can be animate but can also be inanimate. For this reason Experiencers are "good candidates for attaining syntactic and pragmatic primacy over Stimuli. Stimuli, in turn, can be interpreted as a Source- or Cause-like and are therefore entitled to be expressed as a subject as well, due to their status as instantiators of events"(Fedriani, 2014, p.15).

Their syntactic realizations in Indoeuropean languages fall under 4 types, according to Fedriani (2014):

- Generalized or Experiencer centered - the Experiencer is construed as the syntactic subject. This construction is the most frequent within the Indoeuropean languages;
- Inverted or Stimulus centered - the Stimulus is construed as the syntactic subject;
- Metonimically generalized or Experiencer's body part centered type - the Experiencer's body is construed as the syntactic subject;
- Impersonal or non centered type - neither the Experiencer nor the Stimulus are construed as the syntactic subject.

Experiencer The Experiencer, that is the one who experiences the emotion, on a linguistic level is of a very complex nature. From the point of view of semantics it shares properties both with the Agent and the Patient. With regard to its inherent properties it shares with the Agent the animacy, but unlike the Agent it is non-volitional. With regard to its relational properties it is close to the Patient in that it lacks control over the situation and is subject to external forces. Smith (2011) calls this hybrid nature of the Experiencer "bilateral involvement", Lehmann (2011) "ambivalent status" and Fedriani (2014) "constitutive vagueness". As a consequence of its conceptual complexity, at a morpho-syntactic level, there are no cases or constructions that are consistently dedicated cross-linguistically to the coding of the Experiencer. Experiencers can, in fact, "structurally accomodate different possibilities of coding, exploiting cases and constructions that primarily express other functions" (Fedriani, 2014, p.21). This peculiarity of the Experiencer has been noticed by many scholars, Pustet (2015) calls the Experiencer a "syntactic chameleon", Bick (2011) calls its behaviour "morphological downgrading of the Experiencer", and Haig (2008) claims that its syntax is parasitic.

For this reason over the years some scholars have argued that the Experiencer could not be seen as a semantic role in its own right (Dik, 1981). As presented by Fedriani

> Experiential constructions typically stray far from more basic morphosyntactic patterns, accommodating naturally multiple structural possibilities and often getting encoded by co-opting a number of different cases and constructions. In many languages, for instance, this role takes a non-subject case often the indirect object case, that is the dative, or the direct object case, especially with impersonal patterns or it instantiates constructions that deviate from the transitive prototype. (Fedriani, 2014, p.2)

With regard to its realization, the Experiencer tends to be more topical, given its inherent animacy and therefore its semantic and pragmatic

relational primacy over the Stimulus (Plank, 1979). For this reason the Experiencer tends to "correlate with syntactically dominant relations like that of subject" and to "gravitate toward clausal topic positions" (Fedriani, 2014, p.36)

Stimulus The Stimulus, i.e. the participant that triggers the emotion, in case of a fear emotional state corresponds to an element in the environment that can pose a threat to the status, the health, or even the existence of an individual (e.g. a dangerous animal, a poisonous insect, but also a political or social opponent).

It is characterised by ontological vagueness in that its position in the animacy hierarchy is not fixed. It can be either animate (e.g. "a spider", "a snake", etc.) or inanimate and when inanimate can be both concrete (e.g. "a cliff") and abstract (e.g. "the truth", "loneliness", etc.). It can even be an event (e.g. "the mysterious disappearance of Mr. Smith"). Also in terms of relational properties the Stimulus "is not straightforwardly delineated in terms of relational properties and is formally compatible with a number of related roles" (Fedriani, 2014, p.30), it is in fact indeterminate with regard to properties such as volitionality and affectedness. In fact, if it is true that Stimuli are typically not in control of the situation they cause, it is also true that some emotional reactions can be caused on purpose in this case the Stimulus would partially coincide with the role of the Agent. Furthermore, as noted by Croft, the stimulus can be represented both as the Cause that triggers the beginning of a certain situation and as the target of the attention of the Experiencer.

As we have seen the Experiencer tends to be syntactically realized as the subject of the clause, anyway it is possible to find also the Stimulus as the syntactic subject and this relies on the property of the Stimulus of being what triggers the process, the source from which the process emanates.

5.4 Emotions in FrameNet

Given the importance of the emotional lexicon, noted for example by Marco, the domain of emotions was one of the first 13 general domains initially included in FN.

The criteria initially used to group words into frames were (Ruppenhofer and Rehbein, 2012, p.101):

- Valence patterns - for example two frames were created according to the syntactic function of the Experiencer: `Experiencer_subj` and `Experiencer_obj`;
- Salient metaphorical conceptualization - for example we can see that the frame `Emotion_heat` is motivated by the metaphor that equals emotion with heat;

- Particular emotion concept - in this case all the LU of the frame relate to a particular emotion (e.g. `Desiring`).

Clearly, the LUs of the frames created according to the first 2 criteria (and above all the first) can be related to different emotions, even within the same frame, and therefore presuppose different backgrounds. For this reason FN emotion frames can't fit in specific emotion theories, since within a single frame there are LUs that refer to different emotions. Nevertheless, some emotion frames (in particular those based on specific emotion concepts) present similarities with the structure presented in Ortony et al..

After the introduction of more criteria for the creation of frames (*cf. Chapter 2*) the original emotion frames were further subdivided into finer frames. The frames that arose as a consequence of these divisions can be mapped onto Ortony et al. (1990) categories: for example the frame `Other_situation_as_stimulus` corresponds to Ortony's category "Consequences for others" and the frame `Emotions_success_or_failure` corresponds to "Prospects relevant (Confirmed)" (Ruppenhofer and Rehbein, 2012, p.113).

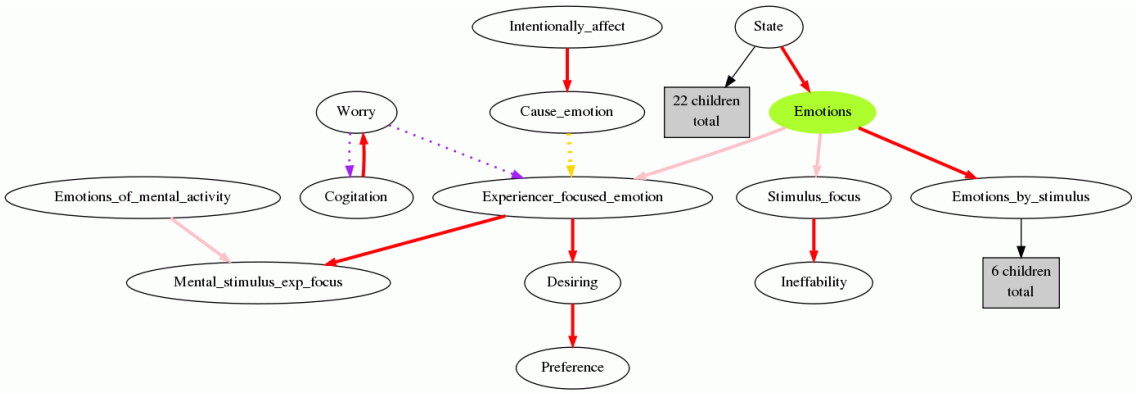


Figure 5.8: Some relations of the frame `Emotion` in FN. Pink arrow = *Perspective_on*, red arrow = *Inheritance*, purple arrow = *See_also*, yellow arrow = *Causative_of*.

Given the nature of FN, emotion frames have been created in different phases of the development of the resource and reflect the criteria used in the different phases. This may lead to some apparent inconsistencies or ambiguities between the frames or with regard to their frame-to-frame relationships. Ruppenhofer and Rehbein (2012), speaking of 1.5 FN release, point out the need of a reanalysis of the emotion area which, however, has not been accomplished.

5.4.1 Fear, Worry and Anxiety in FrameNet

In FrameNet we can find LUs belonging to the domain of fear scattered in seven different frames (as shown in the table 5.3). Some of them

Cause_to_experience	*terrorize.v*
Emotion_active	*worry.v*
Emotion_directed	*agitated.a, agitation.n, alarmed.a, anxious.a, concern.n, concerned.n, petrified.a, terror-stricken.a, worried.a*
Experiencer_focus	*afraid.a, dread.n, dread.v, fear.v, scared.a, terrified.a, worried.a*
Experiencer_obj	*alarm.v, frighten.v, petrify.v, scare.v, terrify.v, worry.v*
Fear	*afraid.a, apprehension.n, dread.n, fear.n, freaked.a, frightened.a, live in fear.v, nervous.a, scared.a, terrified.a, terror.n*
Stimulus_focus	*alarming.v, dreadful.a, frightening.a, scary.a, terrifying.a,worrying.a, worrisome.a*

Table 5.3: Fear-related frames in FN alongisde with their fear-related LUs.

are of a more general nature (such as for example `Experincer_focus` or `Experincer_object`) and others more specifically related to anxiety and fear (such as `Fear` and `Emotion_active`).

In the following subsections I will present individually the frames I focused on for my research. I will illustrate their FN description, their core and non-core FEs and their relations with other frames in FN.

Cause_to_experience

This frame describes the situation in which a volitional Agent intentionally causes a specific emotion.

It is defined in FN as: "An *Agent* intentionally seeks to bring about an internal mental or emotional state in the *Experiencer*."

(1) [The local railway administrators EXPERIENCER] were **terrorized** [into collaborating RESULTING_ACTION]. [CNI AGENT]

(2) In short , [young hooligans AGENT] are **terrorising** and destroying [the neighbourhoods in which they live EXPERIENCER].

This frame in FN have only one fear-related LU, which is: "terrorize.v". Its core FEs are: AGENT and EXPERIENCER. It *Inherits* from the frame `Intentionally_affect`.

It is close both to the frame `Experiencer_obj` and `Cause_emotion`. The fundamental characteristic that differentiates it from `Experiencer_obj` is the fact that what causes the emotion in this second frame is not intentional and can be both animate and inanimate, it is therefore addressed as STIMULUS and not AGENT. The frame `Cause_emotion` is described in FN as "An AGENT acts to cause an EXPERIENCER to feel a certain

emotion" and present as LUs "affront.n", "affront.v", "call name.v", "concern.v", "insult.n", "insult.v", "offend.v, "offense.n", "offensive.a". The difference between this frame and `Cause_to_experience` is that in this frame the emphasis is on the kind of act the AGENT performs, whereas in `Cause_to_experience` the emphasis is on the causation of the particular emotion. In fact, within the core set of `Cause_emotion` we can find, beside the AGENT and the EXPERIENCER also the EVENT.

Emotion_active

This frame is defined in FN 1.7 release as similar to `Experiencer_focus`, but with a "more active" meaning.

(3) His son has gone off to London , and [he $_{\text{EXPERIENCER}}$] **worries** [that he may lose touch with him $_{\text{TOPIC}}$.

Currently it changed its name into `Worry`, which better mirrors its nature. Furthermore also the description has now been changed and it now characterizes the frame more clearly and completely highlighting the characteristic of the frame to represent situations in which an individual constantly or continuously thinks about a certain topic whose outcome is not yet known (fig. 5.9).

Worry

Lexical Unit Index

Definition:

An Experiencer continually thinks about some Topic whose consequences are important to the Experiencer and considered not yet known or resolved. The Experiencer has difficulty in NOT thinking about the Topic and continually feels the urge to act in some way, but the available actions are not sufficiently productive to be satisfying or to ensure a good outcome related to the Topic. As a result, worry may drive the Experiencer to negative consequences like unsettled digestion, disturbed sleep, and frantic, pointless, and repetitive action.

Pat is still WORRYING about the exam.

This frame can be thought of as a blend of a basic emotion frame with Cogitation, but differs from Cogitation in emphasizing the emotional consequence of thinking about something. This frame has similarities to Experiencer_focus, but here the verbs are more 'active' in meaning. (For example, they often occur in negative imperatives, e.g. "Don't worry!"). They also differ from Experiencer_focus verbs in that they occur with Topic expressions and can be used in the present progressive:

*Pat is fearing the exam.

All of these characteristics are a result of Worry being an activity that has a duration and is partially under the control of the Experiencer.

Figure 5.9: Current name and definition of `Worry` in FN online database (last accessed: 10/01/2022), previously called `Emotion_active`.

Also this frame shows only one fear-related LU, i.e "worry.v". Its core

FEs are: EXPERIENCER and TOPIC. It *Inherits* from `Cogitation` and *Uses* `Emotion`.

It is close (as recalled also in FN description) to `Experiencer_focus`, but in this case the focus is on the cognitive experience . The other LUs in its dictionary are "agonize.v", "fret.v", "fuss.v", "lose sleep.v", "obsess.v", "obsession.n" which do all entail an emotion (and for this reason is distinct from `Cogitation`), but focus on describing a type of mental cognitive experience. In terms of core FE we can notice that here we do not find a STIMULUS, but rather a TOPIC.

Emotion_directed

This frame is transversal, it collects terms that refer to a large number of emotional experiences.

It is defined in FN as follows: "The adjectives and nouns in this frame describe an EXPERIENCER who is feeling or experiencing a particular emotional response to a STIMULUS or about a TOPIC. There can also be a CIRCUMSTANCES under which the response occurs or a REASON that the STIMULUS evokes the particular response in the EXPERIENCER."

(4) [They $_{\text{EXPERIENCER}}$] seemed **anxious** and hesitant [about leaving $_{\text{TOPIC}}$].

(5) [Franco $_{\text{EXPERIENCER}}$] *became* very **alarmed** [at this $_{\text{STIMULUS}}$].

The fear-related LUs of this frame in FN are: "agitated.a", "agitation.n", "alarmed.a", "anxious.a", "concern.n", "concerned.n", "petrified.a", "terrorstricken.a", "worried.a". Its core FEs are: EVENT, EXPERIENCER, EXPRESSOR, STATE, STIMUSUL, TOPIC as explained in 5.10. Currently also the FE REASON has been added to its core FEs. It is only linked with the frame `Emotion` by the *Using* relationship. The reason that seems to motivate the presence of the *Using* relationship rather than the *Inheritance* relationship is the fact that the core FE EVENT does not appear in `Emotion_directed` core sets. However, if we look at the list of its core FEs this is present, with the same definition it has in the general frame `Emotion`.

It is closely related with the frame `Experiencer_focus` and in some cases with `Emotion_active`. For example the following sentence appears in `Emotion_directed`, but we could have expected it also in `Emotion_active`.

(6) [Alan Hickman from Derbyshire $_{\text{EXPERIENCER}}$] *became*[2] **worried** [about the advice he was receiving over his pension transfer $_{\text{TOPIC}}$].

In this case anyway it is more appropriate the frame `Emotion_directed`, because the presented TOPIC is not something that constitutes an obsession or a recurrent thought, but rather something toward which the EXPERIENCER turns his emotion.

[2]Here the italic is used to indicate the support verb.

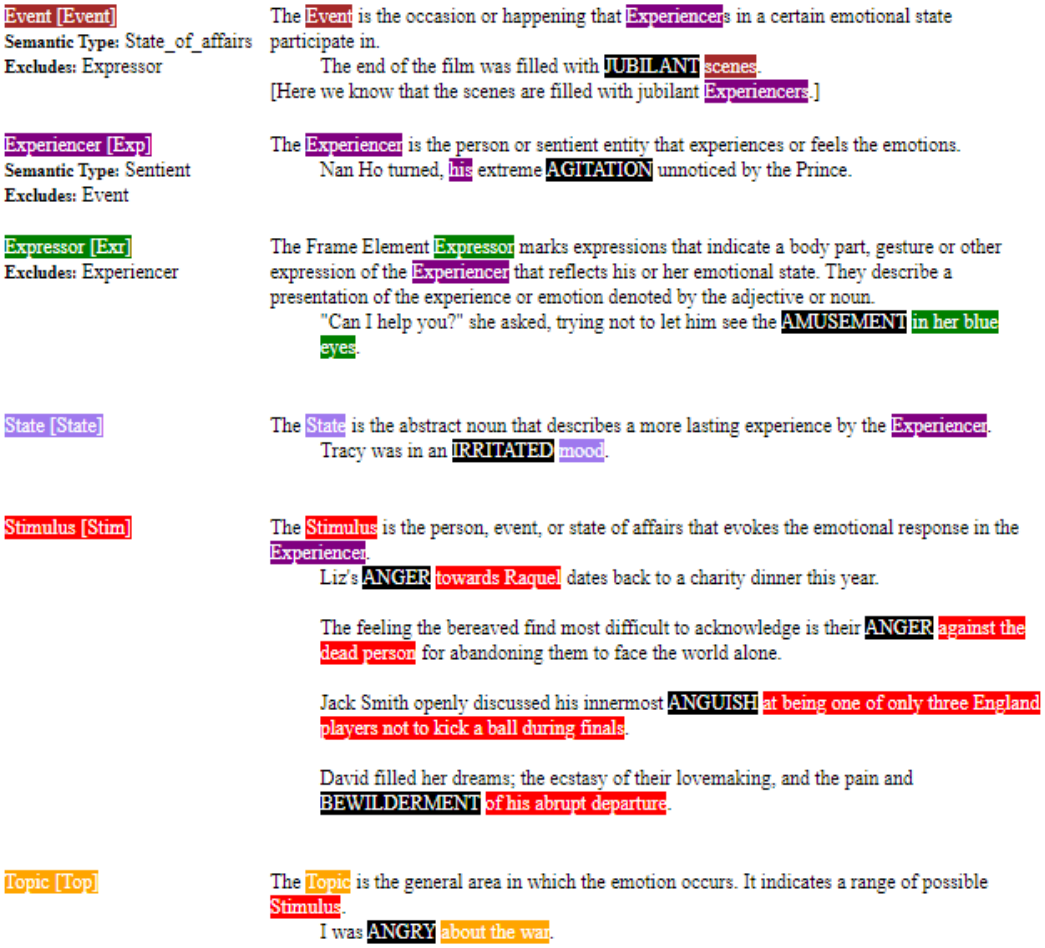


Figure 5.10: `Emotion_directed` core FEs.

As for the difference with `Experiencer_focus`, the question is longer and more complex and we will deal with it in a later in the chapter, after illustrating in more detail the characteristics of `Experiencer_focus`.

Experiencer_focus

This frame, similarly to the previous one, is not specific to a particular emotion. In fact, the focus is not on a specific emotion rather than on another but on the fact that an EXPERIENCER feels some emotion relative to a certain CONTENT.

It is defined in FN as follows: "The words in this frame describe an EXPERIENCER's emotions with respect to some CONTENT. A REASON for the emotion may also be expressed. Although the CONTENT may refer to an actual, current state of affairs, quite often it refers to a general situation which causes the emotion."

(7) Today , [millions of people $_{\text{EXPERIENCER}}$] **fear** [losing their job , their home or their business $_{\text{CONTENT}}$].

The fear related LUs of this frame in FN are: "afraid.a", "dread.n", "dread.v", "fear.v", "scared.a", "terrified.a", "worried.a". Its core FEs are: CONTENT, EVENT, EXPERIENCER, TOPIC; and its core unexpressed FEs are EXPRESSOR and STATE (Fig. 5.11).

Moreover, it holds the following relationships: it is *Inherited_by* `Desiring` and `Mental_stimulus_exp_focus`, it is *Used_by* the frames `Desirability` and `Tolerating` and represents a *Perspective_ on* `Emotions`.

As also argued in the previous subsection, these two frames are very close, and in some cases it is difficult to understand where the dividing line between one and the other lies. The first difference that divides the two frames is that while in `Emotion_directed` we find only adjectival and nominal LUs, in `Experiencer_focus` we also find verbal LUs. However, if we consider only the cases of nominal and adjectival LUs and look at some of the sentences of one and the other, the difference between the two frames does not appear absolutely clear, in fact two sentences such as those in the examples 8 and 9 are labeled the first with `Emotion_directed` and the second with `Experiencer_focus` even if they seem equivalent in terms of evoked frames.

(8) [He $_{\text{EXPERIENCER}}$] *was* still more **worried** [about the extensive rewriting of history that school text-books had been subjected to $_{\text{STIMULUS}}$].

(9) [I $_{\text{EXPERIENCER}}$] *was* more **worried** early on [about being compared to the Postcard groups like Josef K. $_{\text{CONTENT}}$].

Furthermore, within `Emotion_directed` there are also adjectives and nouns which, built with support verbs, perform the function of predicate. To try to shed light and better understand the difference between the two frames

Figure 5.11: `Experiencer_focus` core and core unexpressed FEs.

and thus be able to produce clearer annotations, I systematically compared the two frames with regard to their frame-to-frame relationships, their core and non-core FEs, the LUs that present and the PoS of their LUs, and finally also the syntactic patterns in which the various LUs appear in the SSs noted in the two frames.

Regarding the FEs, the first difference is that in `Emotion_directed` there is a STIMULUS while in EF there is a CONTENT, which are defined respectively as:

> CONTENT is what the EXPERIENCER's feelings or experiences are directed towards or based upon. The CONTENT differs from a STIMULUS because the CONTENT is not construed as being direcly responsible for causing the emotion.

and:

> The STIMULUS is the person, event, or state of affairs that evokes the emotional response in the EXPERIENCER.

Moreover, in the version of the resource that is currently accessible online we also see the FE Reason for `Emotion_directed` that we do not see in `Experiencer_focus`. Finally, in `Experiencer_focus` the FEs Expressor and State do not appear simply as a core but as an unexpressed core. As for the non-core FEs the difference is that only `Emotion_directed` has the FEs FREQUENCY and EMPATHY_TARGET while only `Experiencer_focus` has TIME.

The most notable thing that emerges from this comparison is precisely the different nature of the trigger of the emotion in the two frames. In `Emotion_directed` it is presented just as a STIMULUS, and therefore as what gives rise to the emotional experience, while in `Experiencer_focus` it is conceived as the CONTENT that motivates the emotional experience, but not as what causes it to start. Nevertheless, if we consider the SSs of the two frames the difference remains ambiguous and it is often hard to clearly state if the entity towards which the emotion is directed is a STIMULUS or a CONTENT, as in the examples previously illustrated.

Another difference we found between the two frames is the tendency of the frame `Emotion_directed` to represent episodes and of the frame `Experiencer_focus` to represent situations or states.

Experiencer_obj

The scene represented in this frame is described in the database as "Some phenomenon (the STIMULUS) provokes a particular emotion in an EXPERIENCER". The situation is therefore that of a non-volitional cause (the STIMULUS that triggers the beginning of an emotional experience). As said before it differs from `Cause_to_experience` in that we are here in front of a Cause and not a volitional Agent.

(10) It **scares** [me EXPERIENCER] [to think of it STIMULUS].

(11) [That wave of jealousy STIMULUS] had really **scared** [her EXPERIENCER] half to death.

Also this frame is not specific to the emotion of fear and in FN the fear-related LUs of this frame are: "alarm.v", "frighten.v", "petrify.v", "scare.v", "terrify.v", "worry.v". It appears in FN with only EXPERIENCER and STIMULUS as core FE. The relationship through which it is inserted into the frame network is the *Use* relationship, directed towards the frame `Emotion`.

Today this frame has been partially modified and in the FN online platform it is found with the name `Stimulate_emotion`, a name that emphasizes the act of causing a certain emotion rather than the type of realization of the Experienced.

Stimulus_focus

This frame is used to describe the property of an item to be trigger of an emotion (or the lack of that property). It is defined in FN as: "In this frame either a STIMULUS brings about a particular emotion or experience in the EXPERIENCER or saliently fails to bring about a particular experience. Some words indicate that the Stimulus is characterized by the experience it is likely to evoke in an EXPERIENCER and for these, the EXPERIENCER may rarely be present. There may also be a Degree to which the Stimulus affects the EXPERIENCER and CIRCUMSTANCES under which the experience occurs. There may also be a COMPARISON_SET to which the STIMULUS is compared and a PARAMETER that indicates the area in which the STIMULUS has its effect."

(12) That he did foully murder and commit the most **dreadful** [homicides STIMULUS].

(13) And [the tone of the letter STIMULUS] had definitely been very **frightening** .

The fear-related LUs of this frame in FN are: "alarming.v", "dreadful.a", "frightening.a", "scary.a", "terrifying.a", worrying.a", worrisome.a". The only core FE is the STIMULUS. In fact, even if logically the potential emotion will always be experienced by an EXPERIENCER, however what is represented here is not the emotional experience itself, but the characteristic of the stimulus as such. Finally, the frame *Is_inherited* by `Ineffability` and is a *Perspective_on* `Emotions`.

Fear

This frame, unlike the others on the list, focuses only on a specific emotion, namely fear. Its definition in FN is: "An EXPERIENCER, EXPRESSOR,

or STATE can be described as characterized as having an emotion of fear concerning a particular TOPIC or as evoked by a STIMULUS."

(14) The gossip among the servants is that [their master EXPERIENCER] is terribly **afraid** [of something STIMULUS].

(15) He in turn had friends among the indoor servants who unite in [their EXPERIENCER] **fear** and dislike [of their master STIMULUS].

The core FEs of `Fear` are: EXPERIENCER, EXPRESSOR, STATE, STIMULUS, and TOPIC.

All of its LUs pertain to the domain of fear and are: "afraid.a, "apprehension.n", "dread.n", "fear.n", "freaked.a", "frightened.a", "live in fear.v", "nervous.a", "scared.a", "terrified.a", "terror.n". Surprisingly, it does not have between its LUs the verb "fear.v", which is only in the dictionary of `Experiencer_focus`. This could be due both to the nature in-progress of FN and to differences between the two frames, for example in terms of the duration of the emotional experience. In this second case the `Experiencer_focus` frame would be used to characterize responsive emotions to certain contents as long as the content is presented, while the `Fear` frame would be used to describe a situation of fear, triggered by a certain stimulus, but prolonged over time. This second interpretation would also explain for example the presence in this frame of a multiword LU such as " live in fear.v " It appears anyway that this frame partially overlaps others. As we have seen, in fact, differently from some of the frames presented previously, the main characteristic of this frame is that of being linked to a specific emotional state, to a specific emotion rather than to a precise way in which this emotion is presented. The creation of this frame dates back to 7 years later than, for example, the frame `Experiencer_focus`, probably because, as noted by Ruppenhofer and Rehbein (2012), it was decided at some point to create not only frames that were more consistent with the theories of emotions and therefore were more specific to different emotions.

This frame *Inherits* from `Emotions_by_possibility` which in turn is child of `Emotion_by_stimulus`.

5.4.2 Other problematic aspects

As we have seen for the frames `Experiencer_focus` and `Emotion_directed`, and for the frame `Fear` sometimes the boundaries between the frames of this domain are fuzzy and not clearly defined.

On the one hand this is normal and reflects the fact that the meanings themselves are often nuanced rather than clearly defined and neatly separated from the contiguous ones. On the other hand, this is also due to the nature of FN and to the fact that the current resource is the result of stratifications of works that took place over several years and which respond to needs and criteria that have changed over time, as explained with regard

to the overlapping between Fear and several other emotion frames.

So far we have presented the emotion frames that are related with fear, anyway we also found interesting the frame Emotion_by_stimulus. According to its description, this frame (which appears as a direct child of Emotions) would be suitable to represent a wide range of emotions, however, as of today in FN we find that it is only linked to emotions related to happiness. In fact its only LUs are: "glad.a", "joyful.a", and "jubilant.a". One of the possible reasons why the only lexical units of this frame are those related to happiness is that this frame is mainly used to build the network of emotional frames. In fact, among his children we find Annoyance, Emotions_by_possibility, Just_found_out, Emotions_of_mental_activity, Emotions_success_or_failure, and Others_situation_as_stimulus which contain LUs relating precisely to various emotional experiences (as indicated by the names of the various frames). However, we can see that we do not find a frame for the emotions of happiness and this is perhaps the reason why those related to this area (unlike those of the areas for which there is a specific frame) appear as lexical units of Emotion_by_stimulus.

Furthermore, this frame looks very similar to Emotion_directed. Also in this case we can hypothesise a difference base on the presence/absence of EVENT as a core FE. In fact, (*cf.supra)* it seems to be absent in the core set of Emotion_directed, motivating the relationship of *Using* and not of *Inheritance* with the frame Emotions, whereas it is present in Emotion_by_stimulus.

Another problematic level is that of frame-to-frame relationships. An aspect that emerges from this first presentation of the fear-related frames is, for example, the asymmetry between the frames Experiencer_focus and Stimulus_focus. In fact, even if these are presented as symmetrical and both perspectives on the general Emotion frame we see that while one focuses on the characteristic of an element to be able to stimulate an emotion, the other does not focus on the characteristic of a sentient being to potentially be an EXPERIENCER, nor on the tendency of an entity to feel a certain emotion.

In our work we have focused only on the frames of fear, anxiety and worry for which we are unable to propose, even after our analysis and our study, a general restructuring of the emotional frames. However, in the light of the data that emerged, we will propose possible solutions to be able to annotate as consistently as possible the predications of fear. We will also try not to overturn the current structure of FN, but to present changes that can be integrated into the current resource in order to maintain alignment with this and with the other projects that have been developed on the basis of this.

Chapter 6

Fear domain and IFrameNet

Fear, anxiety and worry human experiences that are shared and present constantly at a intercultural level. It is linked to precise physiological patterns of arousal that are universal to humankind. Anyway, it is also an experience that is strongly linked to social and cultural aspects. We may then expect, on the one hand, the FN frames to be largely portable to the Italian language and largely suitable to represent the Italian situation, on the other hand, we also expect to find a need for minor changes.

Moreover, as we introduced in Chapter 5 and claimed by Ruppenhofer (2018), the treatment of emotions in FN is problematic. In fact, over time, the criteria for the development of emotional frames have changed and new frames have been developed and inserted. However, these new insertions have not been accompanied by a restructuring of this domain in the database. This results often in a lack of clarity of emotion frames and it makes it difficult to unambiguously annotate them. For example, we can see that alongside very generic and non-emotion-specific frames there are also frames that are relative only to a specific emotion, such as the case of `Fear` or `Annoyance`. Nevertheless, these specific frames do not correspond to a specific and coherent set of emotions (such as the basic emotions of Plutchik (2001) or the various emotion types of Ortony et al.(1990)). For instance, there are no frames specific for sadness or joy.

In order to investigate fear-related frames and their applicability to the Italian language we carried on a corpus analysis of the fear lexicon in the Italian language. We started from the NVdB lexicon for extracting the lemmas object of the analysis. For each word we annotated and analyzed 100 sentences, trying to understand if and to which point FN frames where suitable to represent this domain in Italian.

The possible scenarios are:

- The frames in FN and their relations are perfectly suitable for representing the fear domain in Italian;
- The frames in FN are suitable for representing the fear domain in Italian, but some changes need to be done only at the FEs' level;

- The frames in FN are quite suitable for representing the fear domain in Italian, but there are some phenomena that do not fall within the schemata of FN frames;

- In addition to the possible changes on the FEs and frames level there is also the need to revise the relations between frames.

In this chapter we will explain the methodology we exploited to investigate this domain, the data we focused on and how we analyzed them. Then we will present the results of the analysis and we will discuss them. All the sentences we will provide as examples are taken from the CORIS corpus and not made up for this thesis purpose.

6.1 Methodology

In order to analyse the domain of fear, as a first step we had to restrict the area we wanted to work on with regard both to the lexemes we wanted to take into account and to the kind of sentences we wanted to annotate.

6.1.1 Lexicon selection

With regard to the lexicon, this study focuses only on nouns, verbs and adjectives. This choice comes down to the fact that the only fear-related LUs in FN are nuons, verbs, and adjectives and that, moreover, these are the only PoS that, as of today, have been inserted in the IFN dictionary due to their greater centrality in the lexicon.

We decided to limit the range of words to the ones that appear in the Nuovo Vocabolario di Base (NVdB) (De Mauro et al., 2016).

This vocabulary collects two categories of words into a unitary set. First, it contains the words of greatest use in contemporary Italian (identified through frequency dictionaries). Second, it contains words that, even if not frequently used when speaking or writing, are perceived by the speakers as equally or even more available than the words of greater use. The most commonly used words are derived from the statistical analysis of texts or a sample of texts of a language. The most available words, instead, are obtained from surveys conducted on speakers of that language.

The choice of limiting our research over the lexicon of the NVdB is due to the fact that given the high frequency or high availability of these lemmas, they can be assumed to have a particular cognitive salience, i.e. they can be imagined as central, on a cognitive level, in relation to these concepts. Moreover, high frequency words are more likely to occur in a wider variety of context and to present a generic meaning rather than a specialised one.

We decided to focus only on what Cavalla (2006) calls *lexique* (lexicon), which corresponds to the predications of fear, worry and anxiety and

therefore to those expressions that evoke the fear-related frames in FN. Following the distinction in Cavalla (2006, p.4) we can, in fact, identify 4 types of lexicon:

1. *Le lexique* (the lexicon): nouns, verbs, and adjectives that directly refer to the emotion, for example: "fear", "fright", "to scare", "dreadful", etc.;

2. *le lexique élargi* (the extended lexicon): the lexicon of the emotional background in which the feeling appears, for example "tears" for the emotion of "sadness", or "ghosts" for the emotion of "fear";

3. *les expressions figées* (figurative expressions): for example "to chicken out" or, in italian, *"avere i capelli dritti", "farsela addosso", "avere il sangue che si gela"* (to have the hair standing on end, to wet oneself, to have the blood that freezes);

4. *les collocations* (the collocations) for example: "scared stiff", "pretty scary shit".

Moreover, for the same reason, we only considered what Pavlenko (2008) calls "emotion words" to distinguish them from "emotion-laden words". According to his definition:

> Emotion words are seen as words that directly refer to particular affective states ("happy", "angry") or processes ("to worry", "to rage") and function to either describe ("she is sad") or express them ("I feel sad"). Emotion-laden words are seen here as words that do not refer to emotions directly but instead express ("jerk", "loser") or elicit emotions from the interlocutors ("cancer", "malignancy") (Pavlenko, 2008, p.148).

Our study was, then, conducted only over the predications of fear, worry and anxiety and not over all the sentences that depict a fearful, scary or potentially worrying situation.

Finally, we did not aimed at describing how to discover fearful attitudes within texts or sentences (in this our research differentiates for example from works of emotion detection and sentiment analysis), but to analyse how the fear related frames are evoked in Italian and if these frames correspond to the FN ones.

As a first step we detected into the NVdB all the nouns, verbs, adjectives related to the domain of fear, worry and anxiety and checked their frequency in the CORIS corpus. Then we selected a core noun for each of the three subdomains in analysis, relying both on their frequency and on our knowledge of Italian as native speakers. We selected: *paura.n, preoccupazione.n* and *ansia.n* as the starting point. Then we searched the entries of these words in the Nuovo Grande Dizionario Analogico della Lingua Italiana

(DAU) (Simone, 2010) a wide coverage conceptual dictionary for Italian language.

We analysed the entries of *paura.n, preoccupazione.n* and *ansia.n* in the DAU and for each lemma we analysed its entry in order to verify the pre-selected NVdB entries and control if during the first inspection of the NVdB we did miss some fear-related terms. In particular we controlled:

1. The ***parole primarie*** **(primary words)** which are divided into various fields namely: synonyms, opposites, related and associated, more specific nouns, more specific nouns by function, symptoms, and more general nouns. In particular we did not focus on opposites and symptoms. In fact opposites of fear, worry and anxiety are no longer included in the realm of fear and their symptoms would not be included in Pavlenko's "emotion words";

2. The **verbs** section;

3. The **adjectives** section.

At the end of the process we came up with the following list (11 nouns, 6 verbs and 6 adjectives):

- **Nouns** - *affanno, agitazione, allarme, angoscia, ansia, panico, paura, preoccupazione, spavento, terrore, timore.*

- **Verbs** - *agitare, allarmare, intimidire, preoccupare, spaventare, temere.*

- **Adjectives** - *ansioso, inquietante, pauroso, preoccupato, spaventato, spaventoso.*

6.1.2 Sentences selection

Once we selected the lexicon, for each word we wanted to annotate and analyse 100 sentences taken from the CORIS corpus. We searched for the lemma without imposing any kind of restriction by querying the web interface of the CORIS corpus for the lemmas. For each lemma, we asked the system to provide up to 1000 sentences, randomly chosen among the available ones, and for each sentence we evaluated its suitability and acceptability based on different criteria for each PoS. Finally, we annotated the first 100 sentences that we considered to be acceptable according to different criteria (that will be explained later in the chapter).

In the case of *allarme.n* we had to use a slightly different methodology to retrieve the sentences. In fact, the lemma often does not occur with the meaning of anxiety or sudden worry or fear, but usually it appears with the meaning of system or device installed to detect and signal attempted thefts or break-in, with the meaning of tool or device used to indicate possible

dangers or with the meaning of military command or signal to order the troops to take up arms and be ready to face a danger. For this reason it was not possible to retrieve 100 valid sentences within the 1000 randomly proposed by the corpus web interface. Therefore, we did scan through all the 5,715 occurrences of the lemma in CORIS and we manually selected 100 sentences.

NOUNS

When the word under analysis was a noun we considered different aspects in order to evaluate the acceptability of the sentence, namely:

- The meaning of the noun;
- The grammatical function of the noun;
- The predicate of the sentence;
- The pragmatic function of the noun.

Meaning of the noun. In case of polysemous nouns we discarded all the sentences in which the noun under analysis had a meaning that was not relative to the fear domain. For this reason for example we discarded sentences in which the meaning of *angoscia.n* was pain instead of anxiety, or sentences in which *agitazione.n* was used with the meaning of revolt or rebellion instead of with the meaning of agitation or worry, or again sentences in which *allarme.n*, as mentioned before, was used with the meaning of device that makes a loud noise in order to warn about imminent danger (e.g. in expressions such as anti-theft alarm) or with the meaning of warning of danger instead of with the meaning of sudden worry or fear.

For example we discarded:

(1) Idee accattivanti ma pericolose , che tipicamente nascono nelle fasi di transizione tecnologica , quando l' **ansia** di recuperare il controllo dei fattori dinamici dello sviluppo prevale sulla necessità di "far lavorare" le forze di mercato .

Captivating but dangerous ideas, which typically arise during the phases of technological transition, when the ***anxiety*** *to regain control of the dynamic factors of development prevails over the need to "make market forces work".*

In this case the meaning of *ansia.n* is closer to the domain of desire rather than to the domain of fear and worry and the content towards which this emotion is directed is something that the Experiencer does not want to avoid, but something that he or she impatiently desires. It is true that

the word *ansia.n* colours the desire with a shade of fear, but it predicates a kind of desire rather than a kind of fear or worry. We also discarded sentences such as:

(2) Son già passati 5 anni buoni da quando una certa politica fu iniziata, con lo scopo ben preciso di porre un termine all'**agitazione** schiavista.
It has already been 5 years, since a certain policy was started, with the very specific purpose of putting an end to the slave ***agitation****.*

In this sentence the term *agitazione.n* describes not an emotional state but rather a rebellion movement. Again, we also discarded sentences such as:

(3) i piccoli con la loro voce acuta ed insistente davano l'**allarme**.
the little ones with their high-pitched and insistent voice gave the ***alarm****.*

(4) non hanno rubato niente perché l'**allarme** della macchina è subito scattato.
they did not steal anything because the car ***alarm*** *went on immediately.*

In sentence (3) in fact the meaning of *allarme.n* is that of signal of warning and imminent danger and in sentence (4) the meaning is that of device. In neither case the meaning of *allarme.n* lies within the range of senses we were working on.

We also discarded sentences in which the meaning of the word under analysis was within the fear domain, but was used as a specialised medical term. For example:

(5) Tra i centenari è bassa la percentuale di soggetti che soffrono di **ansia** e di depressione.
Among the centenarians, the percentage of subjects suffering from ***anxiety*** *and depression is low.*

Grammatical Function of the noun In our study we did not analyse the sentences where the noun was an adjunct, i.e. it was not part of the valence of the predicate. For this definition we relied on the categories proposed by the theory of the Valency Grammar. According to this theory, as explained in Sabatini et al. (2011), sentences are built upon the verb which determines the fundamental core arguments. The number of elements with which it combines constitutes its valence. The elements needed by the verb are called arguments (distinguishable in subject arguments and direct/indirect object arguments). The verb alongside with its arguments constitute the nucleus of the sentence. Both the verb and the core arguments

may be further specified through constituents that connect morphologically or syntactically to the nucleus. These constituents are called nucleus adjuncts. Finally, the sentence can be extended, beyond the limit of the nucleus and the adjuncts with other elements, which add information about the time, the cause, the purpose, etc. These elements are called expansions.

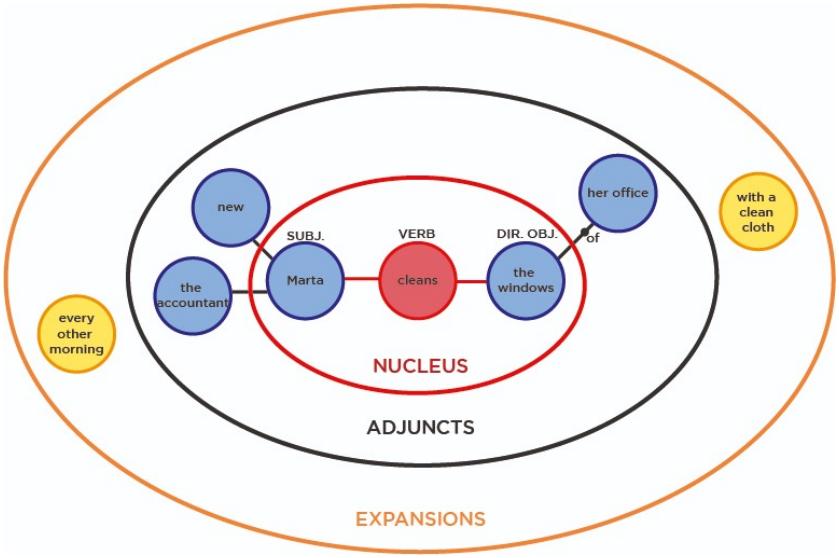


Figure 6.1: Valence representation of the sentence: *"Every other morning Marta cleans the windows of her office with a clean cloth"*.

We decided to discard the sentences where the noun was an adjunct because for the purposes of our study we are mainly interested in analysing words as potential frame evoking elements (FEEs) and, even if also adjuncts may be FEEs, the most salient frames in a sentence are usually evoked by the predicate or its arguments, which constitute the core of the sentence (adjuncts more frequently appear as instantiations of FEs).

Sentence predicate In our analysis we also discarded nominal phrases composed almost exclusively of the words being analyzed: e.g. *"Che paura!"* ("how scary!"). The reason behind this choice is that this type of sentence is extremely low in FEs and in most cases it is used as a unit that constitutes an interjection.

Pragmatic Function Another limit that we have set for the acceptability of sentences with a nominal target regards the pragmatic function. In fact we did not take into account sentences in which the nouns under analysis were used as hyperbolic intensifiers, i.e. adverbial or adjectival phrases that are used to modify the degree of the meaning of another lexical expression (Benigni et al., 2017; Méndez-Naya, 2008). In fact expressions such as *"Da paura"* ("Terrifying") do not predicate fear nor an emotion or an emotional

state, but they use the fear domain as a source domain to intensify the meaning of the sentence in which they are used:

(6) Qui d'inverno c'è un buio da **paura**.
Here in winter there is a ***wicked*** *darkness.*

ADJECTIVES

The parameters we used to assess the acceptability of sentences when the word under analysis was an adjective mirror the ones we used for the nouns with one exception. In fact, in this case we did not impose any limitation on the Grammatical Function that the target elements had to cover in the sentence, nor on the function that the names with which they agreed and which they were referred to must have.

This choice, which seems to go in the opposite direction compared to the criterion presented for nouns, is linked to the fact that if we limited our research to sentences in which the adjectives were part of the nucleus of the sentence we would have narrowed the field too much and in many cases we would have had very little material to work on. We also noticed that the characteristics of these adjectives, in terms of the frames they were able to evoke and the FEs that were realized in the various sentences, remained relatively stable regardless of the Grammatical Function both of the target adjective and of the name it referred to.

We applied restrictions over:

- The meaning of the adjective;
- The predicate of the sentence;
- The pragmatic function of the adjective.

Also for the adjectives we excluded sentences in which the target element was used with a meaning that did not pertain to our research area. This was much less frequent with adjectives than it was with nouns due to adjectives' much smaller polysemy.

Also in this case, when possible (i.e. when it was possible to find at least 100 valid sentences also applying this restriction) we discarded nominal sentences.

Moreover, such as for nouns we excluded the sentences in which the word under analysis was used as an intensifier such as in sentences like:

(7) è stata una festa **spaventosa**.
it was a ***wicked*** *party.*

In this case *spaventoso.a* is used not to predicate an emotion nor with the meaning of "scary.v", but to convey the idea of something out of the

ordinary, something exaggeratedly either good or bad. The evoked frame is not an emotion frame but rather the "Ineffability" frame (described in FN as follows: "A STIMULUS inspires a feeling of awe and interest in a (generally implicit or generic) EXPERIENCER due to desirable qualities which are difficult to explain").

VERBS

The restrictions we applied to sentences with verbal target regard:

- The meaning of the verb;
- The pragmatic function of the verb.

We considered only sentences where the verbs' meaning was within the domain of fear, anxiety and worry. For example, for the verb *preoccuparsi.v* (reflexive form of *preoccupare.v*) we discarded the sentences in which it meant *occuparsi.v*("to deal with") such as in (8) or the sentences in which it meant "commit to a certain purpose" such as (9):

(8) Unipol ha scelto di **preoccuparsi** esclusivamente degli infortuni.
*Unipol chose to **deal** only with injuries.*

(9) le Ferrovie dello Stato **si preoccupavano** che il viaggiatore non avesse pagato per errore una tariffa eccessiva.
*the State Railways **made sure** the traveler had not paid an excessive rate by mistake.*

Finally, sentences in which the fear verb was used as a form of politeness were discarded:

(10) Mi sento lusingato , signor Corelli, ma **temo** di non poter accettare il suo invito.
*I am flattered, Mr. Corelli, but **I am afraid** I will not be able to accept your invitation.*

6.1.3 Features design

After completing the selection of 100 sentences for each lemma, we annotated each sentence according to a number of features we designed in order to describe the situation profiled in each sentence and the characteristics of the predication.

The features we decided to annotate over the data can be subdivided into: a) features we annotated over all the sentences, b) features we annotated

only over the sentences that had a nominal or adjectival target, and c) features we annotated only for particular target lemmas.

The features we annotated over all the sentences are:

- **Scene** - With this term we indicate the situation profiled in the sentence that does not always correspond to a specific FN frame. In fact, sometime the same scene corresponds, in separate sentences, to different FN frames;
- **Frame** - The frame evoked by the target lemma;
- **FE Core** - The realized core FEs present in the sentence (with regard to the frame evoked by the target lemma);
- **FE core NULL** - The non linguistically realized, but understood FEs;
- **Experiencer** - The grammatical function of the constituent expressing the Experiencer;
- **Emotion** - The grammatical function of the constituent expressing the Emotion;
- **Stimulus** - The grammatical function of the constituent expressing the Stimulus;
- **Empathy_target** - The grammatical function of the constituent expressing the Empathy_target;
- **Predicate and Type of Predicate** - the predicate in the sentence and its type;
- **Phrase Type of the Stimulus**;
- **Phase of the emotional experience** - beginning of the experience, progress of the experience, end of the experience;
- **Type of situation**: state or process;
- **Diathesis**;
- **Metaphors** - any metaphor used to describe the emotional experience.

In sentences with nominal and adjectival target we also annotated the:

- **Frame evoked by the controlling predicate.**

And for specific lemmas only, which we will illustrate in the following sections, we annotated other features, namely:

- **Meaning** - when the lemma was polysemous and more than one meaning pertained to the fear domain;

- **Type of Stimulus** - when it was possible to find groupings of Stimuli that coherently shared a particular way of causing the emotional experience.

SHARED FEATURES (nouns, verbs and adjectives)

Scene Under the feature that we named "Scene" we annotated the type of situation profiled in each sentence, regardless of the FN frame evoked by the emotion term. This category of labels has been created in order to:

- Analyse how each situation is realized in terms of frames and FEs;

- Analyse which kinds of situations are represented by each frame.

Moreover, it proved to be useful also during the annotation process: in fact we did annotate this feature first, before choosing the frame label for the sentence. In this way, we relied also on this preliminary analysis in order to decide the most suitable frame.

Furthermore, this feature makes it possible to understand if all the situations can be adequately represented through the existent FN frames or if, instead, interventions may be necessary at both frames and FEs level.

This feature shares similarities to what Remijnse and Minnema (2020) call "inferred frames" since it makes it possible to "annotate event mentions that standard frame annotation would not be able to capture, while preserving a standard FrameNet layer" (Remijnse and Minnema, 2020, p.13).

The tagset we came up with is the following:

Cause_augment/decrease_of_emotion, Cause_to_end_emotion, Emotion_focus, Emotion_object_of_action/perception, Emotion_subject, Emotion_subject_other, Experience_emotion, Experiencer_characteristic, Stimulate_emotion, Stimulate_emotion_agent, Stimulus_focus.

Cause_augment/decrease_of_emotion An external Agent or Stimulus causes an increase or decrease in the strength of the emotional experience (usually this caused increase or decrease is reported by the predicate). For example:

(11) Quella visione gli toglieva il fiato , e aumentava ulteriormente la sua **agitazione**.
*The vision took his breath away, and further increased his/her **agitation**.*

Cause_to_end_emotion An external Agent or an external Cause brings about the end of an emotional state. In this case no distinction was made between sentient intentional agents and unintentional causes.
For example:

(12) [...] consola il cuore affaticato e dissolve l'**angoscia** dei pensieri.
[...] it consoles the tired heart and dissolves the ***anguish*** *of thoughts.*

Emotion_focus The sentences to which we applied this label predicate a characteristic of the emotion that is expressed by the target term and give information about its nature.
For example:

(13) [...] l'**agitazione** e l'**affanno** sono utili.
[...] ***agitation*** *and* ***anxiety*** *are useful.*

Emotion_object_of_action/perception We used this label only for the analysis of sentences with nominal target.

In these sentences the emotion is the object (direct or indirect) of the predicate and the predicate does not mean "feel" or "cause to feel" either directly or metaphorically[1].

In these sentences usually the primary predication is not the one regarding the emotion experience and the main frame is not the one evoked by the fear noun, but the one evoked by the predicate. Let's consider the following sentences:

(14) Ricordo ancora la mia **agitazione**.
I still remember my ***agitation****.*

(15) Tra le arti spicca la tragedia, che "esprime [...] l'**affanno** dell'umanità"
Among the arts, tragedy stands out, which "expresses [...] the ***anxiety*** *of humanity"*

In the example (14) the main frame is "Remembering_experience" that is evoked by "ricordo" and the emotion term instantiates the core FE Experience.

(16) **Ricordo** ancora [la mia agitazione $_{\text{Experience}}$].

In the example (15) the main frame is "Communication" and is evoked by "esprime" (expresses) and the emotion term instantiates the core FE Message.

[1] these cases would be labelled respectively as Experience_emotion and Stimulate_emotion(_agent) *(cf. infra)*

(17) Tra le arti spicca [la tragedia $_{\text{Medium}}$, che "**esprime** [...] [l'affanno dell'umanità $_{\text{Message}}$]"

Although it might seem that in cases like this the emotion term instantiates a slot filler rather than a FEE, nevertheless this situation is still different from the case in which the Grammatical Function of the emotion term is that of adjunct. In fact, in this case, the emotion term appears within the nucleus of the sentence and usually instantiates a core FE of the main frame in the sentence. For this reason here we may expect it to be more semantically central and then more worthy of attention as potential FEE and more interesting as subject of study.

Emotion_subject The sentences annotated with this label share the following characteristics: firstly they all predicate an emotional experience and this emotional experience is the main focus of the discourse, secondly the emotion is always construed as the logical subject[2].

There are 4 different possible scenarios:

- The sentence predicates the beginning of an emotional experience. It differs from Stimulate_emotion and Stimulate_emotion_agent in that the focus is not on the Stimulus or the Agent that causes or triggers the emotion but rather on the emotion itself. For example:

  (18) Il **terrore** si impadronì totalmente di lei.
  Terror *took hold of her totally.*

  The emotion is often described through metaphors:

  (19) Stanchissima, e mangiata dall'**ansia**, scese di nuovo al pianterreno e si girò tutte le stanze .
  Exhausted and eaten with ***anxiety****, she went downstairs again and wandered through all the rooms.*

- The sentence predicates an increase or decrease of the strength of the emotion expressed by the target lemma. It differs from Cause_augment/decrease_of_emotion with regard to the different scene profiling: in Cause_augment/decrease_of_emotion, in fact, the focus is on the cause or the agent that triggers, or deliberately causes, the variation, in Emotion_subject_augment/decrease the focus is on the variation itself and the cause may even be omitted. For example:

  (20) Ora cresce il numero e con esso la **paura**.

[2]Note: in the thesis we use the term subject to indicate the logical subject, i.e. the syntactic subject in case of an active proposition and the internalised complement in case of a passive proposition.

*Now the number increases and **fear** with it.*

- The sentence predicates the end of an emotional experience, regardless the causes that led to this end. This does not mean that the causes can not be expressed, but that it is not necessary to express them and that, when expressed, they usually fall within the adjuncts. For example:

  (21) Dovevo restare solo finché la **paura** non fosse passata.
  *I had to be alone until the **fear** was gone.*

- The sentence does not predicate the beginning, the end nor a significant variation in the emotional experience, and the emotion is simply characterised as ongoing. For example:

  (22) Non si può raggiungere la pace finché c'è il **terrore**.
  *Peace cannot be achieved as long as there is **terror**.*

Emotion_subject_other In this case, as in the previously analysed and as often for the scene Emotion_focus, the emotion corresponds to the logical subject of the sentence (6.1. Nevertheless, in this case the main predication here does not regard the emotion itself but rather the consequences of the emotional experience. The emotion here is in fact the cause or the trigger of other events, such as for example the breathlessness (Example 23) or the lack of appetite (Example 24):

(23) La **paura** mi serra la gola.
__Fear__ tightens my throat.

(24) Sin dal mattino, l'**ansia** gli ha imbrigliato le parole.
*Since that morning, **anxiety** has harnessed his words.*

Experience_emotion – This macro-category comprises three different labels: (i) Experience_emotion, (ii) Experience_emotion_start, and (iii) Experience_emotion_end. In this case the logical subject corresponds to the Experiencer.

Experience_emotion – This label is the more generic and describes sentences that describe an ongoing emotional experience and the possible variation the emotion can show. For example:

(25) Il padrone ha **paura** di commettere qualche errore.
*the owner is **afraid** of making some mistakes.*

SCENE	STATE /PROCESS	PHASE OF THE EMOTIONAL EXPERIENCE	CONTENT
Emotion_focus	State	NA	Nature of the emotion
Emotion_subject	Process	BEGINNING/END	Emotional experience
Emotion_subject_other	Process	ONGOING	Consequences of the emotional experience

Table 6.1: Possible scenarios when the Emotion corresponds to the subject.

Experience_emotion_start - The sentences that belong to this scene predicate the beginning of an emotion within an Experiencer or a group of Experiencers that appear as the logical subjects of the sentences themselves. For example:

(26) Santa Teresa **si preoccupava** per le sue suore solo quando vedeva che qualcuna perdeva la gioia.
*Saint Teresa **worried** about her sisters only when she saw that some of them were losing their joy.*

Experience_emotion_end – Finally, with this label we annotated the sentences that present the Experiencer (or Experiencers) as subject and that predicate the end of an emotional experience. For example:

(27) [...] dobbiamo smetterla di **preoccuparci** delle parole e dei loro significati.
*[...] we have to stop **worrying** about words and their meaning.*

Experiencer_characteristic These sentences describe the characteristic of an individual who is presented as prone to emotions of fear, anxiety or worry. For example:

(28) Lei si definisce tendenzialmente **ansiosa**, perfezionista , fin troppo scrupolosa.
*She defines herself as **anxious**, perfectionist and too scrupulous.*

(29) Tutti i rettili sono animali **paurosi**.
*All reptiles are **fearful** animals.*

Stimulate_emotion In this case the subject is not the Experiencer nor the Emotion but the Stimulus or the entity that causes or triggers the Emotion. This Stimulus can be either animate or inanimate, but in case of animate stimulus it is always a non-intentional, non-volitional Agent (in this it is different to the scene: Stimulate_emotion_agent *(cf. infra)*). For example:

(30) Preferisce la calma e non la **spaventa** la solitudine.
*She prefers the quiet and loneliness doesn't **scare** her.*

Stimulate_emotion_agent In these sentences the logical subject corresponds to the triggers of the emotion, which is always an animate being that intentionally provokes the Emotion. For example:

(31) Alcuni cercavano di **spaventarlo**.
*Some people tried to **frighten** him.*

Stimulus_focus I annotated this label on the sentences that present an entity as a potential Stimulus. Here the Experiencer may be omitted and the focus is on the Stimulus itself and on its characteristic of being a potential trigger of certain emotional states. For example:

(32) Ciò che ho visto è **spaventoso**.
*What I have seen is **frightening**.*

Predicate and Type of Predicate For each sentence we annotated the type of predicate of the proposition that contains the emotion term under analysis, which can also correspond to the predicate or to part of the predicate, such as in the following sentences:

(33) Non c'è niente che mi **fa paura**.
*There is nothing that **scares** me.*

(34) Mi hanno **spaventato** quando hanno detto che sarei bruciato all' inferno.
*They **scared** me when they said I was going to burn in hell.*

In order to establish the tagset we relied on the Enciclopedia dell'Italiano (Raffaele Simone, 2011).

There is more than reason for which we decided to annotate the predicates' types: first, in order to have a complete overview of the terms we are studying and of their use in context, second, because it can give additional information about the nature of frames and their realization, third and most important, because the type of predicate influences the frame annotation.

Let's consider the following examples:

(35) Mi ha *messo* **paura**
He ***scared*** *me*

and

(36) Incuteva molta **paura**
He instilled a lot of ***fear***

In the first sentence the predicate is formed by a support verb *(cf. infra)* and a nominal part (that can also be introduced by a preposition), and the nominal part corresponds to the emotion term under analysis (i.e. *paura*). In this case we considered the frame as evoked by the whole predication (i.e. support verb + nominal part). In this sentence, then the evoked frame is `Experiencer_obj` (cfr.supra). In the second sentence, instead, the predicate is an autonomous verb (i.e. *incuteva).* In this case our proposal (which we followed whithin our analysis) is to have two separate frame labels, one for the predicate and one for the target nominal LU. In this case `Cause_to_start` and `Fear`.

The types of predicate we annotated are:

Autonomous verb Under this label, in Italian *verbo predicativo autonomo*), we gathered the predicates consisting of only one verb. These verbs are presented as

> verbi che hanno significato lessicale pieno e possono dare luogo autonomamente a un predicato verbale di senso compiuto; essi sono in opposizione ai verbi copulativi, che necessitano di un complemento predicativo nominale [...] e a varie altre categorie di verbi, dal significato più o meno 'leggero' (i verbi ausiliari, i verbi fraseologici, i verbi supporto, ecc.[...]). Un altro termine per designarli è verbi lessicali[3] (Panunzi, 2011).

Under this label we also collected multiword causative verbs such as *fare/lasciare* (lit. make/let) + infinitive form.

Phraseological verb + lexical verb Phraseological verbs are verbs that are used in combination with another verb (lexical) which is presented in infinitive or gerundive form and serve to specify a particular temporal-aspectual modality of this lexical verb (Jansen, 2010).

[3]verbs that have full lexical meaning and can autonomously give rise to a full-meaning verbal predicate; they are in opposition to copulative verbs, which require a nominal predicative complement [...] and to various other categories of verbs, with a more or less 'light' meaning (auxiliary verbs, phraseological verbs, support verbs, etc. [...]). Another term to designate them is lexical verbs.

Support verb constructions Support verbs a limited number of verbs which, in addition to their autonomous use and autonomous meaning, can be used in combination with a noun to form a single predicate with it, performing a support function towards the noun. For the noun they express grammatical marks proper to verbs and which therefore cannot be expressed by the noun if used autonomously (Jezek, 2011).

We find different kinds of support verb constructions, in particular support verbs can be:

- light verbs semantically vacuous which role is "to project the syntactic positions where the noun predicate and its argument(s) are realized in the clause, and to provide tense, aspect, mood, person and number inflection, since only verbs, not nouns, can bear this morphological marking in Romance", e.g. *avere paura* (to be afraid, lit. to have fear)(Alba-Salas, 2007, p.208).

- Semantically non-vacuous and mark the aktionsart and focus on a specific phase of the experience of fear, e.g. *prendere paura* (to get scared, lit. to take fear);

- Semantically non-vacuous and introduce a causative meaning, e.g. *fare paura* (to scare, lit. to make fear).

Support verb constructions frequently appear with fear state nouns. This is true also for other Romance languages for example French (*avoir peur* to be afraid, lit. to have fear) and Spanish (*dar miedo* to scare, lit. to give fear). Ströbel (2015), for example, claims that in French immediate fear "is not communicated synthetically but with the help of an analytic construction of a noun or adjective and a copula or empty verb"(Ströbel, 2015, p. 12).

Copular verbs These verbs establish a predicative relationship between two nominal constituents, which correspond to a subject and a predicative complement. This complement is functional to the formation of a semantically interpretable predicate since copular verbs do not have an autonomous predicative value (in this they are opposed to lexical verbs).

Compound nominal predicate The compound nominal predicate, in Italian (*Predicato Nominale*), corresponds to a verb phrase composed of a form of the verb to be (the copula (Panunzi, 2010)) and a nominal (predicative noun) or adjectival constituent (predicative adjective).

Noun or Adjective This existence of this label seems to contradict the choice of discarding nominal sentences. Actually, these are extremely sporadic cases, and we have decided to accept these sentences for our

analysis only if otherwise it was not possible to reach 100 sentences for the word under analysis. This is the case, for example, of sentences like:

(37) Niente **panico**
*No **panic***

Implied Finally, there are also very few cases in which the predicate can be retrieved from the meaning of the sentence but is not explicitly expressed:

(38) Quanto alla questione della sicurezza , al primo posto nelle **preoccupazioni** degli italiani , lo Stato deve garantire l ' incolumità fisica e i beni dei suoi cittadini
*As for the issue of security, in first place in **concerns** of Italians, the State must guarantee the physical safety and property of its citizens*

Frames On the sentences we annotated the frame evoked by the target lemma under analysis. The frame labels we used correspond to the frames of the release 1.7 of the FN data.

Sometimes the frames in FN present in their description also indications about their possible grammatical realizations. In these cases we did not consider that part of the frame description, which is explicitly language specific, but only the first part.

This label is one of the last categories we annotated, in fact it constitutes the end of the analysis process and depends also on the other annotated features.

In some cases it was difficult to discriminate between two similar frames and it was not possible to decide which frame was the most suitable one, we therefore reported both frames. If, instead, no one of FN frames was suitable to represent the situation depicted in the sentence and the scenario evoked by the word under analysis, we applied the label Not Applicable (NA).

Frame annotation and predicate type The type of predicate, as mentioned before, influenced the frame annotation. In fact, in the case of target nominal lemmas: if they formed a predicate with support verb we considered the predicative unit as single FEE, otherwise we considered the controlling predicate and the nominal target as two separate FEEs.

(39) [**Fa** $_{\text{Support Verb}}$] tanta **paura** pensare di guidare per tutta la vita lo stesso tram.
It is so scary to think of driving the same tram all your life.

(40) né vi furono presagi, avvenimenti o distruzioni rilevanti al punto da sollecitare tali **paure**.
nor were there any omens, events or destructions relevant to the point of arousing such ***fears***.

In the example (39) *fa paura* acts as a whole in evoking the frame `Experiencer_obj`. In the example (40) *sollecitare* evokes `Cause_to_start` and *paure* evokes `Fear`.

FE Core For each sentence we also noted which FEs, relative to the emotional frame evoked by the word under analysis, were present. If the same constituent did correspond to more than one FE we have noted only the core one

FE core NULL We separately annotated the core FEs that were implicit in the sentence.

This feature does not include the cases in which a core FE consists of the so-called implied subject (allowed in Italian). In fact, in these cases there is a linguistic realization of the FE constituted by the information of person and number provided by the predicate. The only cases we have noted are those in which an FE could not be recognized in the linguistic material, but was still implicitly invoked.

Emotion, Experiencer, Stimulus, Empathy_target We annotated for each sentence, when possible, the syntactic function of the Experiencer, the Emotion and the Stimulus, which we individuate as key elements of the emotional experience. We also annotated the grammatical function of the Empathy_target that corresponds to the target of danger in the allocentric structures described in Cislaru (2009) and often appears as a core FE within the fear-related frames.

When one of these elements was the nominal part of a predicate (e.g. in case of support verb + noun phrase or propositional phrase) we annotated that element as "nominal part of the predicate" or, for the nominal predicate (copula + noun phrase), "predicate's noun".

We decided to use generically the labels "Experiencer, Emotion, Stimulus, Empathy_target" instead of the FE names in FN in order to facilitate the annotation process (6.2). First, by doing this, it was not necessary to choose the frame before noting this feature. Second, this allowed us not to have an excessive number of labels but to limit them has the fundamental elements of the emotional experience presented in the previous chapter. Moreover, the Emotion never corresponds to a FN FE, but is expressed by the LU.

Emotion Given that our work focuses on and analyses emotion terms, the emotion will always correspond to the constituent that contains the

Name of the feature	Frame Elements
Emotion	NA
Experiencer	EXPERIENCER EXPRESSOR
Stimulus	AGENT CONTENT STIMULUS TOPIC
Empathy_target	EMPATHY_TARGET

Table 6.2: Correspondences between features' labels and FN FEs names.

term under analysis and constitutes the LU which evokes the fear frame.

Experiencer As explained in the previous chapter the experiencer is the individual who is experiencing, or who experienced, a particular emotion. Linguistically it shares characteristics of both agent and patient
In most cases it corresponds to the homonymous FE.

Stimulus Corresponds to the entity or the living being that triggers or causes the emotion experience. It may also correspond to the general area in which the emotion occurs. Under this category fall both the inintentional stimuli and the agents that intentionally bring about the emotion.
In FrameNet this stimulus category corresponds to the following FEs:

- AGENT for the frame `Cause_to_experience`;
- TOPIC for the frame `Emotion_active`;
- STIMULUS or TOPIC for the frame `Emotion_directed`;
- CONTENT or TOPIC for the frame `Experiencer_focus`;
- STIMULUS for the frame `Experiencer_obj`;
- STIMULUS for the frame `Stimulus_focus`;
- STIMULUS or TOPIC for the frame `Fear`.

Empathy_target It indicates the person for which the Experiencer is concerned or worried, is the one with whom the Experiencer empathises. It corresponds to non core FEs and it is often not present.

Phase of the emotional experience For each sentence we annotated the phase of the emotional experience choosing one of these labels:

- Beginning - if the phase depicted was the entering or initial phase.

  (41) Mi sono preso **paura**
  I got ***scared***

- Ongoing - if the emotional experience is in its unfolding. This may include cases in which there is a variation of the intensity of the emotion (increase or decrease), but there is not entering or leaving an emotional state. This label is used also for the cases in which the emotion is depicted as a stable characteristic of an Experiencer or regularly evoked by a Stimulus.

  (42) Sia ben chiaro, le **preoccupazioni** sono reali e neppure nuove
  Let us be clear, ***concerns*** *are real and even not new*

- End - if the sentence depicts the end of an emotional experience.

  (43) La scuola deve smantellare il **panico** da computer.
  School needs to destroy the computer ***fright***

- Not applicable(NA) - if none of the previous labels was applicable to the sentence, since it was impossible to define the phase of the emotional experience, For instance are annotated with this label the sentences that describe general characteristics of the emotion or the absence of a certain emotion.

Type of situation: state or process Another feature we decided to add is the one informing about the type of the situation described, choosing between "state" and "process". The reason for adding this label is to provide, jointly with the information about the phase of the emotion experience, a more detailed description of the situation profiled by the sentence. Different phases and types of situation correspond in fact to different scenes and can help in choosing the most suitable frame or, if no suitable frames can be found, can help in building new frames alongside with their frame-to-frame relationships.

Diathesis For each sentence we annotated its diathesis. We applied the following labels:

- Active voice: The verb that governs the emotion term (or which corresponds to the emotion term) is active;

- Passive voice: The verb that governs the emotion term (or which corresponds to the emotion term) is used within a passive construction, as explained in Grandi (2010, 2011);

- Reflexive middle voice: Here the focus is on the dynamic participant which consciously gives rise to the actions expressed by the verb, but also focuses on the fact that the consequences of the action. This coreferentiality of the two entities (subject and direct object) is marked by a reflexive marker. In Italian it roughly corresponds to the reflexive use of the verbs Cennamo (2011); Grandi (2011).

FEATURES ANNOTATED ON NOUNS AND ADJECTIVES

Frame evoked by the controlling predicate Within this category we labelled the sentences with the frame evoked by the predicate that controlled the nominal or adjectival target. For emotion nouns and adjectives we always annotated the frame evoked by their controlling predicate, except when it was impossible to find in FN a suitable frame. With the label of controlling predicate we indicate the verb that in these propositions governs the target emotion noun or adjective.

(44) Il cane può divenire nuovamente **pauroso**
The dog can become ***fearful*** *again*

In this case the copulative verb *divenire.v* (become) is the controlling predicate and evokes the frame `Becoming`.

(45) In questo caso la vittima è riuscita a controllare il **panico**
In that case the victim managed to control the panic ***panic***

Here the controlling predicate is *controllare.v* (to control) and the frame it evokes is `Dominate_competitor`.

We did not try to annotate the frame evoked by the verb *essere* (to be) when used as copula in a compound nominal predicate.

Moreover, for adjectives we also did not annotate the frame evoked by the verb when the adjective is not directly governed by the verb, but is dependent of a noun that governs it as in the following example:

(46) fino a che una voce flebile e **spaventosa** si leva da sotto terra
until a feeble and ***scary*** *voice rises from underground*

The reason for annotating this kind of information is that often a single Scene is encoded via more than one frame. For example it is often the case that the scene Stimulate_emotion is encoded via an emotion frame combined with a causation one. This can happen both with autonomous verbs (first example) and with support verbs (second example):

(47) i desideri e le ambizioni che mi animavano **incutevano paura**
The desires and the ambitions that galvanized me ***provoked fear***

(48) non c'è cosa che mi **faccia paura**
there is nothing that ***scares*** *(lit. makes fear, i.e. causes fear) me*

FEATURES ANNOTATED ON NOUNS

Metaphors We also annotated if the emotion term was presented with or within a metaphor such as for example: EMOTION as ENEMY, EMOTION as DEVOURER. This might seem in contrast with what we stated above, however we are referring here to two extremely different things. In fact, what we claimed to have excluded are the cases in which the metaphor is used to replace the lexicon of fear, i.e. "to chicken out" rather than "to fear". In this case, instead, the proper lexicon of fear appears, but it is constructed with verbs that are not proper to the domain of emotions and which contribute to metaphorically present fear as something else, comparing fear, for example, to an enemy or a monster.

(49) Quando il bambino rompe tutto , è assalito dall' **angoscia** profonda di rimanere solo in un mondo distrutto e senza amore.
When the child breaks everything, he is assailed by the deep ***anguish*** *of being alone in a broken and loveless world.*

Here anguish is presented as an enemy that attacks the Experiencer, the word *assalito* (assailed), in fact, evokes the frame `Taking_captive`.

6.2 Results

In this section we will present an outline of the results we obtained, with particular attention to the frames evoked by each lemma.

6.2.1 Nouns

AFFANNO.

Affanno.n (concern) can indicate:

- Cause of concern;
- State of mind/mood;
- Thought that causes worry or concern.

The scenes and frames that are evoked by this lemma are presented in table 6.3.

Scenes		Frames	
5	Emotion_focus	1	Cause_to_experience
11	Cause_to_end_emotion	84	Emotion_directed
2	Stimulate_emotion_agent	12	Experiencer_obj
12	Stimulate_emotion	3	Emotion_active
14	Emotion_object_of_action/perception		
23	Experience_emotion		
2	Experience_emotion_start		
6	Experience_emotion_end		
7	Emotion_subject_other		
13	Emotion_subject		
2	Cause_augment/decrease_of_emotion		
2	Stimulus_focus		

Table 6.3: Occurrences of frames and scenes for the lemma *affanno.n*.

It is represented through the following metaphors: *affanno* as ENEMY (that captures and from which one must be freed), *affanno* as FLAME THAT GOES OUT.

Scenes The scenes represented in the sentences are:

- **Emotion_focus.** It appears 5 times and corresponds 3 times to the FN frame `Emotion_directed` and twice to `Emotion_active`.
- **Experience_emotion_end.** It appears 6 times and always corresponds to the frame `Emotion_directed`.
- **Cause_to_end_emotion.** It appears 11 times and is always represented by the FN frame `Emotion_directed`.
- **Stimulate_emotion_agent.** It appears 2 times and is once represented by the frame 'Cause_to_experience' and once 'Emotion_directed'.
- **Stimulate_emotion.** It appears 12 times and is always paired with the frame `Experiencer_obj`.
- **Emotion_object_of_action/perception.** It appears 14 times and is always paired with the frame `Emotion_directed`.
- **Experience_emotion_start.** It appears 2 times always corresponding to the frame `Emotion_directed`.

- **Emotion_subject_other.** It appears 7 times and is always represented by the frame `Emotion_directed`.
- **Experience_emotion.** It appears 23 times and is always represented by the frame `Emotion_directed`.
- **Emotion_subject.** It appears 13 times and always corresponds to the frame `Emotion_directed`.
- **Cause_augment/decrease_of_emotion.** It appears 2 times. This scene is always (also for the other words we analysed) represented in FN by the union of two frames, one of which is an emotion frame and another which conveys the idea of caused increase or decrease. It can be for example `Cause_expansion`, as in the following sentence:

  (50) Heinrich ne limita le sortite e ne [**amplifica** $_{\texttt{Cause\_expansion}}$] gli [**affanni** $_{\texttt{Emotion\_directed}}$].
  Heinrich limits their sorties and [**amplifies** $_{\texttt{Cause\_expansion}}$] their [**worries** $_{\texttt{Emotion\_directed}}$].

  With regard to the emotion frames it always corresponds to `Emotion_directed`.
- **Stimulus_focus.** It appears 2 times and in one sentence it corresponds to the frame `Emotion_directed` and in the other one it corresponds to `Emotion_active`.

Frames The evoked frames are:

- **`Cause_to_experience`** - It appears only once with the following expressed core FEs: Experiencer, Stimulus (Agent);
- **`Emotion_directed`** - It appears 84 times and presents the following core FEs:
  - Experiencer, Topic 2 times;
  - None 2 times (in these cases it is overlty expressed only the Emotion);
  - Experiencer unexpressed 5 times;
  - Experiencer, Stimulus 4 times;
  - Stimulus expressed and Experiencer unexpressed 5 times;
  - Experiencer 64 times;
  - Experiencer, Stimulus (Circumstances) once;
  - Experiencer, Agent once.

We can see that in one case we have CIRCUMSTANCES in round brackets: in this case we used this notation to indicate that the constituent that instantiates the STIMULUS also instantiates the CIRCUMSTANCES. In such cases, where a single constituent instantiates more than one FE, we annotated the most important FE[4] and added the other(s) inside round brackets.

- **`Experiencer_obj`** - it appears 12 times with the following core FEs:
  - EXPERIENCER, STIMULUS 7 times;
  - STIMULUS expressed and EXPERIENCER unexpressed 3 time;
  - STIMULUS 2 times.
- **`Emotion_active`** - it appears 3 times with the following core FEs: EXPERIENCER, TOPIC once, EXPERIENCER 2 times.

AGITAZIONE.

Agitazione.n (agitation, worry) is close in meaning to anxiety, even if it often indicates a milder condition, and presents the emotion by focusing on one of its consequences, the agitation.

The scenes and frames that are evoked by this lemma are presented in table 6.4.

Scenes		Frames	
1	Stimulate_emotion_agent	65	Emotion_directed
33	Stimulate_emotion	30	Experiencer_obj
1	Cause_to_end_emotion	5	Emotion_active
13	Emotion_object_of_action/perception		
5	Experience_emotion_start		
8	Emotion_subject_other		
16	Experience_emotion		
20	Emotion_subject		
3	Cause_augment/decrease_of_emotion		

Table 6.4: Occurrences of frames and scenes for the lemma *agitazione.n*.

It is metaphorically represented as a PLACE in which the Experiencer enters and as an ENEMY that holds the Experiencer captive.

[4]Where core is more important than non-core and Peripheral is more important than Extra thematic

Scenes The scenes represented in the sentences are:

- **Stimulate_emotion_agent.** It appears once and is paired with the frame `Emotion_active`.
- **Stimulate_emotion.** It appears 33 times and it is paired with the following frames: `Emotion_directed` 3 times and `Experiencer_obj` 30 times.
- **Cause_to_end_emotion.** It appears once and is paired with the frame `Emotion_directed`.
- **Emotion_object_of_action/perception.** It appears 13 times and is always paired with the frame `Emotion_directed`.
- **Experience_emotion_start.** It appears 5 times and is always paired with the frame `Emotion_directed`.
- **Emotion_subject_other.** It appears 8 times and is paired with the following frames: `Emotion_directed` 5 times and `Emotion_active` 30 times.
- **Experience_emotion.** It appears 16 times and is always paired with the frame `Emotion_directed`.
- **Emotion_subject.** It appears 20 times and is paired with the frame `Emotion_directed` 119 times, and `Emotion_active` once.
- **Cause_augment/decrease_of_emotion.** It appears 3 times and is always paired with the frame `Emotion_directed`.

Frames The evoked frames are:

- **`Emotion_directed`** - it appears 65 times with the following core FEs:
  - EXPERIENCER 50 times;
  - EXPERIENCER, STIMULUS 2 times;
  - EXPERIENCER unexpressed 12 times;
  - STIMULUS onces.
- **`Experiencer_obj`** - it appears 30 times with the following core FEs:
  - EXPERIENCER, STIMULUS 25 times;
  - STIMULUS expressed and EXPERIENCER unexpressed 3 times;
  - STIMULUS 2 times.
- **`Emotion_active`** - it appears 5 times with the following core FEs:

- EXPERIENCER 2 times;
- EXPERIENCER, TOPIC once;
- EXPERIENCER unexpressed 2 times.

It was sometimes difficult to decide which frame was evoked between `Emotion_active` and `Emotion_directed`. In general, the structure of FN proved to be suitable for representing the situations evoked in the sentences.

ALLARME.

Allarme.n (alarm, anxiety) is close in meaning to anxiety and indicates the situation of enhanced attention due to the prediction of the imminence of something bad.

The scenes and frames that are evoked by this lemma are presented in table 6.5.

Scenes	Frames
4 Cause_augment/decrease_of_emotion	30 Emotion_directed
1 Cause_to_end_emotion	64 Experiencer_obj
64 Stimulate_emotion	6 Fear/Emotion_directed
5 Emotion_object_of_action/perception	
4 Experience_emotion_start	
2 Emotion_subject_other	
12 Experience_emotion	
7 Emotion_subject	
1 Emotion_focus	

Table 6.5: Occurrences of frames and scenes for the lemma *allarme.n*.

The metaphors used to represent this emotional experience are: *allarme* as ENEMY once, *allarme* as SLEEPING ENTITY THAT IS AWAKENED 6 times.

Scenes The scenes represented in the sentences are:

- **Cause_augment/decrease_of_emotion.** It appears 4 times and is always paired with the frame `Emotion_directed`.
- **Cause_to_end_emotion.** It appears once and is paired with the frame `Emotion_directed`.

- **Stimulate_emotion.** It appears 64 times and is always paired with the frame `Experiencer_obj`.
- **Emotion_object_of_action/perception.** It appears 5 times and is always paired with the frame `Emotion_directed`.
- **Experience_emotion_start.** It appears 4 times and is always paired with the frame `Emotion_directed`.
- **Emotion_subject_other.** It appears twice and is paired with the following frames: once with `Emotion_directed` and once with `Fear/Emotion_directed`.
- **Experience_emotion.** It appears 12 times and is always paired with the frame `Emotion_directed`.
- **Emotion_subject.** It appears 7 times and is paired with the following frames: `Emotion_directed` 2 times and `Fear/Emotion_directed` 5 times.
- **Emotion_focus.** It appears only once and is paired with the frame `Emotion_directed`.

Frames The evoked frames are:

- **`Emotion_directed`** - it appears 30 times with the following core FEs:
  - Experiencer, Stimulus 3 times;
  - Experiencer unexpressed 6 times;
  - Stimulus expressed and Experiencer unexpressed 2 times;
  - Expressor expressed and Experiencer unexpressed 2 times;
  - Experiencer 17 times;
  - Experiencer, Expressor once.
- **`Experiencer_obj`** - it appears 64 times with the following core FEs:
  - Experiencer, Stimulus 61 times;
  - Stimulus expressed and Experiencer unexpressed once;
  - Stimulus 2 times.
- **`Fear/Emotion_directed`** - it appears 6 times with the following core FEs:
  - Experiencer 2 times;
  - Experiencer unexpressed 3 times;
  - Stimulus expressed and Experiencer unexpressed once.

ANGOSCIA.

Angoscia.n (anguish) presents the emotional experience as something painful. It appears with the following meanings:

- State of mind/mood;
- Thought that causes the emotional experience.

The scenes and frames that are evoked by this lemma are presented in table 6.6.

Scenes	Frames
2 Cause_augment/decrease_of_emotion	64 Emotion_directed
2 Experience_emotion_end	16 Stimulate_emotion
8 Cause_to_end_emotion	20 Fear/ Emotion_directed
1 Stimulate_emotion_agent	
17 Stimulate_emotion	
7 Emotion_object_of_action/perception	
13 Emotion_subject_other	
13 Experience_emotion	
34 Emotion_subject	
3 Emotion_focus	

Table 6.6: Occurrences of frames and scenes for the lemma *angoscia.n*.

Angoscia is metaphorically presented as an ENEMY.

Scenes The scenes represented in the sentences are:

- **Cause_augment/decrease_of_emotion.** It appears 2 times and is always paired with the frame `Emotion_directed`.
- **Experience_emotion_end.** It appears 2 times and is always paired with the frame `Emotion_directed`.
- **Cause_to_end_emotion.** It appears 8 times and is paired with the following frames: `Emotion_directed` 7 times, and `Fear/Emotion_directed` once.
- **Stimulate_emotion_agent.** It appears once and is paired with the frame `Emotion_directed`.

- **Stimulate_emotion.** It appears 17 times and is paired with the following frames: `Emotion_directed` once, and `Experiencer_obj` 16 times.
- **Emotion_object_of_action/perception** It appears 7 times and is paired with the following frames: `Emotion_directed` 5 times, and `Fear/Emotion_directed` 2 times.
- **Emotion_subject_other** It appears 13 times and is paired with the following frames: `Emotion_directed` 10 times, and `Fear/Emotion_directed` 3 times.
- Experience_emotion It appears 13 times and is paired with the following frames: `Emotion_directed` 12 times, and `Fear/Emotion_directed` once.
- **Emotion_subject** It appears 34 times and is paired with the following frames: `Emotion_directed` 24 times, and `Fear/Emotion_directed` 10 times.
- **Emotion_focus** It appears 3 times and is paired with the following frames: `Emotion_directed` once, and `Fear/Emotion_directed` 2 times.

Frames The evoked frames are:

- **`Emotion_directed`** - it appears 64 times with the following core FEs:
  - None 2 times;
  - EXPERIENCER unexpressed 12 times;
  - EXPERIENCER, STIMULUS unexpressed once;
  - EXPERIENCER, STIMULUS 10 times;
  - STIMULUS expressed and EXPERIENCER unexpressed 2 times;
  - EXPERIENCER 37 times.
- **`Stimulate_emotion`** - it appears 16 times with the following core FEs:
  - EXPERIENCER once;
  - EXPERIENCER, STIMULUS 13 times;
  - STIMULUS 2 times.
- **`Fear/Emotion_directed`** - it appears 20 times with the following core FEs:
  - None once;

- EXPERIENCER 10 times;
- EXPERIENCER, STIMULUS 2 times;
- STIMULUS expressed and EXPERIENCER unexpressed 2 times;
- EXPERIENCER unexpressed 5 times.

ANSIA.

The scenes and frames that are evoked by *ansia.n* (anxiety) are presented in table 6.7.

Scenes		Frames	
9	Cause_augment/decrease_of_emotion	18	Experiencer_obj
2	Cause_to_end	2	Emotion_directed /Emotion_active
1	Cause_to_end_emotion	60	Emotion_directed
18	Stimulate_emotion	1	NA (Emotion_directed)
1	Emotion_object_of_action/perception	18	Emotion_active
2	Experience_emotion_start	1	Fear/Emotion_active
6	Emotion_subject_other		
26	Experience_emotion		
32	Emotion_subject		
3	Emotion_focus		

Table 6.7: Occurrences of frames and scenes for the lemma *ansia.n*.

The metaphors used to represent the emotional experience are: *ansia* as: an ENEMY, a DEVOURING MONSTER, a FEROCIOUS OR WILD ANIMAL (that needs to be tamed), a BURDEN, and a LIQUID.

Scenes The scenes represented in the sentences are:

- **Cause_augment/decrease_of_emotion.** It appears 9 times and is always paired with the frame `Emotion_directed`.
- **Cause_to_end.** It appears 2 times and is always paired with the frame `Emotion_directed`.
- **Cause_to_end_emotion.** It appears once and is paired with the frame `Emotion_active`.
- **Stimulate_emotion.** It appears 18 times and is always paired with the frame `Emotion_directed`.

- **Emotion_object_of_action/perception.** It appears once and is paired with the frame `Emotion_directed`.
- **Experience_emotion_start.** It appears 2 times and is always paired with the frame `Emotion_directed`.
- **Emotion_subject_other** It appears 6 times and is paired with the following frames: `Emotion_directed` 5 times and `Emotion_active` once.
- **Experience_emotion.** It appears 26 times and is paired with the following frames: `Emotion_directed` 18 times. `Fear/Emotion_active` once and `Emotion_active` 7 times.
- **Emotion_subject.** It appears 32 times and is paired with the following frames: `Emotion_directed` 22 times, `Emotion_directed/Emotion_active` once, and `Emotion_active` 9 times.
- **Emotion_focus.** It appears 3 times and is paired with the following frames: `Emotion_directed` 2 times and `NA/Emotion_directed`.

Frames The evoked frames are:

- **`Experiencer_obj`** - it appears 19 times with the following core FEs:
  - EXPERIENCER, STIMULUS 16 times;
  - STIMULUS expressed and EXPERIENCER unexpressed 2 times.
- **`Emotion_directed/Emotion_active`** - it appears 2 times with the following core FEs:
  - EXPERIENCER once;
  - EXPERIENCER unexpressed 2 times.
- **`Emotion_directed`** - it appears 60 times with the following core FEs:
  - None once;
  - EXPERIENCER 37 times;
  - EXPERIENCER, STIMULUS 13 times;
  - STIMULUS expressed and EXPERIENCER unexpressed 5 times;
  - EXPERIENCER unexpressed 4 times.
- **NA(`Emotion_directed`)** - it appears once and does not present expressed FEs.
- **`Emotion_active`** - it appears 17 times with the following core FEs:

  - Experiencer 7 times;
  - Experiencer, Topic 5 times;
  - Experiencer expressed and Topic unexpressed 2 times;
  - Topic expressed and Experiencer unexpressed 2 times;
  - Topic once.

- **`Fear/Emotion_active`** - it appears once with the core FEs: Experiencer.

Also for *ansia.n* we can see that it is difficult and sometimes impossible to draw precisely the distinction between some frames, namely

- `Fear` and `Emotion_active`;
- `Emotion_directed` and `Emotion_active`.

Nevertheless, all the sentences can be annotated using FN frames.

PANICO.

Panico.n (panic) refers to a sudden and uncontrolled strong fear.

The scenes and frames that are evoked by this lemma are presented in table 6.8.

Scenes		Frames	
3	Cause_to_end_emotion	78	Fear
2	Stimulate_emotion_agent	21	Stimulate_emotion
21	Stimulate_emotion	1	Emotion_active
3	Emotion_object_of_action/perception		
17	Experience_emotion_start		
6	Emotion_subject_other		
13	Experience_emotion		
30	Emotion_subject		
3	Emotion_focus		

Table 6.8: Occurrences of frames and scenes for the lemma *panico.n*.

The metaphors used to represent the emotional experience are: *panico* as: an ENEMY, a SEED, a PHYSICAL PLACE, a WAVE, WRAPPING FABRIC, an ENTITY THAT TAKES POSSESSION OF THE EXPERIENCER.

Scenes The scenes represented in the sentences are:

- **Cause_to_end_emotion.** It appears 3 times and is always paired with the frame `Fear`.
- **Stimulate_emotion_agent.** It appears 2 times and is always paired with the frame `Fear`.
- **Stimulate_emotion.** It appears 21 times and is always paired with the frame `Experiencer_obj`.
- **Emotion_object_of_action/perception.** It appears 3 times and is always paired with the frame `Fear`.
- **Experience_emotion_start.** It appears 17 times and is always paired with the frame `Fear`.
- **Emotion_subject_other.** It appears 6 times and is always paired with the frame `Fear`.
- **Experience_emotion.** It appears 13 times and is always paired with the frame `Fear`.
- **Emotion_subject.** It appears 31 times and is paired with the following frames `Fear` 30 times and `Emotion_active` once.
- **Emotion_focus.** It appears 3 times and is always paired with the frame `Fear`.
- **Emotion_subject_end.** It appears only once and is paired with the frame `Fear`.

Frames The evoked frames are:

- **`Fear`** - it appears 78 times with the following core FEs:
  - None 3 times;
  - Experiencer unexpressed 16 times;
  - Experiencer, Stimulus 10 times;
  - Stimulus expressed and Experiencer unexpressed 2 times;
  - Experiencer 46 times;
  - Experiencer, Expressor once.
- **`Stimulate_emotion`** - it appears 21 times with the following core FEs:
  - Experiencer, Stimulus 9 times;

  - Stimulus expressed and Experiencer unexpressed 11 times;
  - Stimulus once.

- **Emotion_active** - it appears only once and has the following core FEs: Experiencer

PAURA.

Paura.n (fear) appears with the meaning of:

- State of mind/mood;
- Thought that causes the emotional experience.

The scenes and frames that are evoked by this lemma are presented in table

Scenes		Frames	
2	Cause_augment/decrease_of_emotion	71	Fear
1	Stimulate_emotion_agent	12	Experiencer_obj
13	Stimulate_emotion	11	Experiencer_focus
2	Cause_to_end_emotion	6	Fear/Experiencer_focus
9	Emotion_object_of_action/perception		
7	Emotion_subject		
2	Experience_emotion_start		
7	Emotion_subject_other		
54	Experience_emotion		
3	Emotion_focus		

Table 6.9: Occurrences of frames and scenes for the lemma *paura.n*.

Scenes The scenes represented in the sentences are:

- **Cause_augment/decrease_of_emotion.** It appears 2 times and is always paired with the frame `Fear`.
- **Stimulate_emotion_agent.** It appears only once and is paired with the frame `Fear`.
- **Stimulate_emotion.** It appears 13 times and is paired with the following frames: `Experiencer_focus` once and `Experiencer_obj` 12 times.

- **Cause_to_end_emotion.** It appears 2 times and is always paired with the frame `Fear`.
- **Emotion_object_of_action/perception.** It appears 9 times and is always paired with the frame `Fear`.
- **Emotion_subject.** It appears 7 times and is always paired with the frame `Fear`.
- **Experience_emotion_start.** It appears 2 times and is always paired with the frame `Fear`.
- **Emotion_subject_other.** It appears 7 times and is always paired with the frame `Fear`.
- **Experience_emotion.** It appears 54 times and is paired with the following frames: `Fear` 38 times, `Experiencer_focus` 10 times and `Fear/Experiencer_focus` 6 times.
- **Emotion_focus.** It appears 3 times and is always paired with the frame `Fear`.

Frames The evoked frames are:

- **`Fear`** - it appears 71 times with the following core FEs:
  - None 2 times;
  - Experiencer unexpressed 10 times;
  - Experiencer, Stimulus 18 times;
  - Stimulus expressed and Experiencer unexpressed 5 times;
  - Experiencer 35 times;
  - Stimulus unexpressed once.
- **`Experiencer_obj`** - it appears 12 times with the following core FEs:
  - Experiencer, Stimulus 6 times;
  - Stimulus once;
  - Stimulus expressed and Experiencer unexpressed 5 times.
- **`Experiencer_focus`** - it appears 11 times with the following core FEs:
  - Content, Experiencer 9 times;
  - Experiencer 2 times.
- **`Fear/Experiencer_focus`** - it appears 6 times with the following core FEs:

– Experiencer, Stimulus 5 times;

– Experiencer once.

Also in this case it was sometimes difficult to choose between close frames. In particular for the frames `Fear` and `Experiencer_focus` in few cases it was impossible to decide which frame was most suitable.

PREOCCUPAZIONE.

Preoccupazione.n (worry) appears with the meaning of:

- State of mind/mood;
- Thought that causes to be afraid;
- Constant thought.

The scenes and frames that are evoked by this lemma are presented in table 6.10.

Scenes	Frames
3 Cause_augment/decrease_of_emotion	96 Emotion_directed
5 Stimulus_focus	1 Experiencer_obj
26 Stimulate_emotion	3 Emotion_active
1 Emotion_focus	
1 Cause_to_end_emotion	
31 Emotion_object_of_action/perception	
13 Emotion_subject	
9 Emotion_subject_other	
3 Experience_emotion	
8 Emotion_focus	

Table 6.10: Occurrences of frames and scenes for the lemma *preoccupazione.n.*

The metaphors used to represent the emotional experience are: *preoccupazione* as: ENEMY that holds the Experiencer captive, and BURDEN.

Scenes The scenes represented in the sentences are:

- **Cause_augment/decrease_of_emotion.** It appears 3 times and is always paired with the frame `Emotion_directed`.

- **Stimulus_focus.** It appears 5 times and is always paired with the frame `Emotion_directed`.
- **Stimulate_emotion.** It appears 26 times and is paired with the following frames: `Emotion_directed` 25 times and `Experiencer_obj` once.
- **Emotion_focus.** It appears once and is paired with the frame `Emotion_directed`.
- **Cause_to_end_emotion.** It appears once and is paired with the frame `Emotion_directed`.
- **Emotion_object_of_action/perception.** It appears 31 times and is always paired with the frame `Emotion_directed`.
- **Emotion_subject.** It appears 13 times and is always paired with the frame `Emotion_directed`.
- **Emotion_subject_other.** It appears 9 times and is paired with the following frames: `Emotion_directed` 8 times and `Emotion_active` once.
- **Experience_emotion.** It appears 3 times and is paired with the following frames: `Emotion_directed` 2 times and `Emotion_active` once.
- **Emotion_focus.** It appears 8 times and is paired with the following frames: `Emotion_directed` 7 times and `Emotion_active` once.

Frames The evoked frames are:

- **`Emotion_directed`** - it appears 96 times with the following core FEs:
  - Emotion, Experiencer expressed and Topic unexpressed 10 times;
  - Emotion, Experiencer, Topic 25 times;
  - Emotion once;
  - Emotion expressed and Experiencer unexpressed 3 times;
  - Emotion expressed and Experiencer, Topic unexpressed 3 times;
  - Emotion, Experiencer, Stimulus 9 times;
  - Emotion, Stimulus 2 times;
  - Emotion, Stimulus expressed and Experiencer unexpressed 20 times;

  - Emotion, Experiencer 9 times;
  - Emotion, Topic 3 times;
  - Emotion, Topic expressed and Experiencer unexpressed 10 times;
  - Experiencer, Expressor once.

- **Experiencer_obj** - it is evoked in only one sentence and appears with the following core FEs: Emotion, Experiencer, Topic.

- **Emotion_active** - it appears 3 times with the following core FEs:

  - Emotion, Experiencer, Topic once;
  - Emotion, Experiencer, Stimulus once;
  - Emotion, Experiencer expressed and Topic unexpressed once.

We did not encounter, for this frame, particular problems in the annotation with FN frames.

SPAVENTO.

Spavento.n (fright) indicates an emotional experience linked to a particular situation or event, it often refers to a specific event.

The scenes and frames that are evoked by this lemma are presented in table 6.11

Scenes		Frames	
1	Cause_augment/decrease_of_emotion	5	Cause_to_experience
5	Stimulate_emotion_agent	23	Fear/Emotion_directed
36	Stimulate_emotion	35	Stimulate_emotion
8	Emotion_object_of_action/perception	28	Emotion_directed
12	Emotion_subject	9	Fear
12	Experience_emotion_start		
7	Emotion_subject_other		
16	Experience_emotion		
3	Emotion_focus		

Table 6.11: Occurrences of frames and scenes for the lemma *spavento.n*.

The metaphors used to represent the emotional experience are: *spavento* as ENEMY that holds the Experiencer captive and *spavento* as SEED.

Scenes The scenes represented in the sentences are:

- **Cause_augment/decrease_of_emotion.** It appears once and is paired with the frame `Emotion_directed`.
- **Stimulate_emotion_agent.** It appears 5 times and is always paired with the frame `Cause_to_experience`.
- **Stimulate_emotion.** It appears 36 times and is paired with the following frames: `Fear` once and `Experiencer_obj` 35 times.
- **Emotion_object_of_action/perception.** It appears 8 times and is paired with the following frames: `Fear/Emotion_directed` 2 times and `Emotion_directed` 6 times.
- **Experience_emotion_start.** It appears 12 times and is paired with the following frames: `Fear/Emotion_directed` 4 times and `Emotion_directed` 8 times.
- **Emotion_subject_other.** It appears 7 times and is paired with the following frames: `Fear/Emotion_directed` 3 times and `Emotion_directed` 4 times.
- **Experience_emotion.** It appears 16 times and is paired with the following frames: `Fear/Emotion_directed` 7 times and `Emotion_directed` 9 times.
- **Emotion_subject.** It appears 12 times and is paired with the following frames: `Fear/Emotion_directed` 7 times and `Fear` 5 times.
- **Emotion_focus.** It appears 3 times and is always paired with the frame `Fear`.

Frames The evoked frames are:

- **`Cause_to_experience`** - it appears 5 times with the following core FEs:
  - Experiencer, Agent 4 times;
  - Stimulus expressed and Experiencer unexpressed once;
  - Experiencer 9 times;
  - Topic 3 times;
  - Topic expressed and Experiencer unexpressed 10 times;
  - Experiencer, Expressor once.
- **`Fear/Emotion_directed`** - it appears 23 times with the following core FEs:

  - EXPERIENCER 17 times;
  - EXPERIENCER, STIMULUS 3 times;
  - STIMULUS expressed and EXPERIENCER unexpressed 2 times;
  - EXPERIENCER unexpressed once.

- **Stimulate_emotion** - it appears 35 times with the following core FEs:
  - STIMULUS 3 times;
  - EXPERIENCER, STIMULUS 21 times;
  - STIMULUS expressed and EXPERIENCER unexpressed 10 times;
  - EXPERIENCER once.

- **Emotion_directed** - it appears 28 times with the following core FEs:
  - EXPERIENCER 22 times,
  - EXPERIENCER, STIMULUS 4 times;
  - EXPERIENCER unexpressed 2 times.

- **Fear** - it appears 9 times with the following core FEs:
  - EXPERIENCER 5 times,
  - EXPERIENCER, STIMULUS once;
  - None once;
  - STIMULUS expressed and EXPERIENCER unexpressed once.

Such as for other words previously illustrated, it was impossible in some cases to choose one frame over the other.

TERRORE.

Terrore.n (terror) indicates a strong fear emotion. It appears with the meaning of:

- State of mind/mood;
- Thought that causes the emotional experience.

The scenes and frames that are evoked by this lemma are presented in table 6.12.

The metaphors used to represent the emotional experience are: *terrore* as: ENEMY, SEED, ENTITY THAT TAKES POSSESSION OF THE EXPERIENCER, SOMEONE THAT PLAYS with the Experiencer.

Scenes		Frames	
1	Emotion_stimulus	5	Cause_to_experience
1	Cause_augment/decrease_of_emotion	2	Fear
6	Stimulate_emotion_agent	13	Experiencer_obj
13	Stimulate_emotion	80	Fear/Emotion_directed
9	Emotion_object_of_action/perception		
1	Experience_emotion_start		
11	Emotion_subject_other		
33	Experience_emotion		
23	Emotion_subject		
2	Emotion_focus		

Table 6.12: Occurrences of frames and scenes for the lemma *terrore.n*.

Scenes The scenes represented in the sentences are:

- **Emotion_stimulus.** It appears once and is paired with the frame `Fear/Emotion_directed`.
- **Cause_augment/decrease_of_emotion.** It appears once and is paired with the frame `Fear/Emotion_directed`.
- **Stimulate_emotion_agent.** It appears 6 times and is paired with the following frames: `Cause_to_experience` 5 times and `Fear/Emotion_directed` once.
- **Stimulate_emotion.** It appears 13 times and is always paired with the frame `Experiencer_obj`.
- **Emotion_object_of_action/perception.** It appears 9 times and is paired with the following frames: `Fear/Emotion_directed` 8 times and `Fear` once.
- **Experience_emotion_start.** It appears once and it is paired with `Fear/Emotion_directed`.
- **Emotion_subject_other** It appears 11 times and is always paired with the frame `Fear/Emotion_directed`.
- **Experience_emotion.** It appears 33 times and is always paired with the frame `Fear/Emotion_directed`.
- **Emotion_subject.** It appears 23 times and is paired with the following frames: `Fear/Emotion_directed` 22 times and `Fear` once

- **Emotion_focus.** It appears 2 times and is always paired with the frame `Fear/Emotion_directed`.

Frames The evoked frames are:

- **`Cause_to_experience`** - it appears 5 times with the following core FEs:
  - AGENT expressed and EXPERIENCER unexpressed 2 times;
  - EXPERIENCER, AGENT 2 times;
  - AGENT once.
- **`Fear`** - it appears 2 times with the following core FEs:
  - EXPERIENCER, STIMULUS once;
  - EXPERIENCER, EXPRESSOR once.
- **`Stimulate_emotion`** - it appears 13 times with the following core FEs:
  - EXPERIENCER, STIMULUS once;
  - STIMULUS expressed and EXPERIENCER unexpressed 11 times;
  - STIMULUS once.
- **`Fear/Emotion_directed`** - it appears 80 times with the following core FEs:
  - None once;
  - EXPERIENCER unexpressed 11 times;
  - EXPERIENCER, STIMULUS 31 times;
  - STIMULUS expressed and EXPERIENCER unexpressed 5 times;
  - STIMULUS 4 times;
  - EXPERIENCER 28 times.

If we consider the frames `Fear` and `Emotion_directed`, in 80% of cases it is impossible to decide which of the two frames to assign to the sentence under analysis.

TIMORE.

Timore.n (fear, dread) often refers to a less intense situation than fear and appears in the sentences with the meaning of:

- State of mind/mood;

Scenes	Frames
3 Cause_augment/decrease_of_emotion	13 Experiencer_obj
3 Cause_to_end_emotion	87 Fear/Emotion_directed
15 Stimulate_emotion	
10 Emotion_object_of_action/perception	
21 Emotion_subject_other	
11 Experience_emotion	
22 Emotion_subject	
14 Emotion_focus	

Table 6.13: Occurrences of frames and scenes for the lemma *timore.n*.

- Thought that causes the emotional experience.

The scenes and frames that are evoked by this lemma are presented in table 6.13.

The metaphors used to represent the emotional experience are: *timore* as ENEMY.

Scenes The scenes represented in the sentences are:

- **Cause_augment/decrease_of_emotion.** It appears 3 times and is always paired with the frame `Fear/Emotion_directed`.
- Cause_to_end_emotion. It appears 3 times and is always paired with the frame `Fear/Emotion_directed`.
- Stimulate_emotion. It appears 15 times and is paired with the following frames `Stimulate_emotion` 13 times and `Fear/Emotion_directed` 2 times.
- Emotion_object_of_action/perception. It appears 10 times and is always paired with the frame `Fear/Emotion_directed`.
- Emotion_subject. It appears 21 times and is paired with the following frames: `Emotion_directed` once and `Fear/Emotion_directed` 20 times.
- Emotion_subject_other. It appears 11 times and is always paired with the frame `Fear/Emotion_directed`.
- Experience_emotion. It appears 22 times and is always paired with the frame `Fear/Emotion_directed`.

- Emotion_focus. It appears 14 times and is always paired with the frame `Fear/Emotion_directed`.

Frames The evoked frames are:

- **`Stimulate_emotion`** - it appears 13 times with the following core FEs:
  - STIMULUS expressed and EXPERIENCER unexpressed 10 times;
  - EXPERIENCER, STIMULUS once;
  - STIMULUS 2 times.
- **`Fear/Emotion_directed`** - it appears 87 times with the following core FEs:
  - None 5 times;
  - EXPERIENCER unexpressed 13 times;
  - EXPERIENCER, STIMULUS 28 times;
  - STIMULUS 9 times;
  - STIMULUS expressed and EXPERIENCER unexpressed 16 times;
  - TOPIC expressed and EXPERIENCER unexpressed 2 times;
  - EXPERIENCER 14 times.

Such as for *terror.n* in many cases it is impossible to decide which one of the frames `Fear` and `Emotion_directed` is the most suitable.

6.2.2 Verbs

AGITARE.

The scenes and frames that are evoked by *Agitare.v* (to upset, to distress) are presented in table 6.14.

Scenes	Frames
77 Experience_emotion	77 Emotion_active
2 Stimulate_emotion_agent	21 Cause_to_experience
21 Stimulate_emotion	2 Stimulate_emotion

Table 6.14: Occurrences of frames and scenes for the lemma *agitare.v*.

When it is used the reflexive middle voice it always means "to feel the emotion" and corresponds to the scene "Experience_emotion", otherwise it means "to make someone feel the emotion", it can correspond to the scenes "Stimulate_emotion" and "Stimulate_emotion_agent".

Scenes The scenes represented in the sentences are:

- **Experience_emotion.** It appears 77 times and is always paired with the frame `Emotion_active`.
- **Stimulate_emotion_agent.** It appears 2 times and is always paired with the frame `Cause_to_experience`.
- **Stimulate_emotion.** It appears 21 times and is always paired with the frame `Cause_to_experience`.

Frames The evoked frames are:

- **`Cause_to_experience`** - it appears 2 times with the following core FEs: EXPERIENCER, AGENT.
- **`Stimulate_emotion`** - it appears 21 times with the following core FEs: EXPERIENCER, STIMULUS.
- **`Emotion_active`** - it appears 77 times with the following core FEs:
  - EXPERIENCER 66 times;
  - EXPERIENCER, STIMULUS 11 times.

ALLARMARE.

The scenes and frames that are evoked by *Allarmare.v* (to alarm, to worry) are presented in table 6.15.

Scenes	Frames
38 Experience_emotion	38 Emotion_active
2 Stimulate_emotion_agent	2 Cause_to_experience
60 Stimulate_emotion	60 Stimulate_emotion

Table 6.15: Occurrences of frames and scenes for the lemma *allarmare.v*.

Also in this case when it is used the reflexive middle voice it always means "to feel the emotion" and corresponds to the scene "Experience_emotion", otherwise it means "to make someone feel the emotion", it can correspond to the scenes "Stimulate_emotion" and "Stimulate_emotion_agent".

Scenes The scenes represented in the sentences are:

- **Experience_emotion.** It appears 38 times and is always paired with the frame `Emotion_active`.
- **Stimulate_emotion_agent.** It appears 2 times and is always paired with the frame `Cause_to_experienc`.
- **Stimulate_emotion.** It appears 60 times and is always paired with the frame `Experiencer_obj`.

Frames The evoked frames are:

- **`Cause_to_experience`** - it appears 2 times with the following core FEs:
  - AGENT expressed and EXPERIENCER unexpressed once;
  - EXPERIENCER, AGENT once.
- **`Experiencer_obj`** - it appears 60 times with the following core FEs:
  - STIMULUS expressed and EXPERIENCER unexpressed 12 times;
  - EXPERIENCER, STIMULUS 48 times.
  - EXPERIENCER 66 times
- **`Emotion_active`** - it appears 38 times with the following core FEs:
  - EXPERIENCER 34 times;
  - EXPERIENCER, TOPIC 4 times.

INTIMIDIRE.

The scenes and frames that are evoked by *Intimidire.v* (to frighten) are presented in table 6.16

Scenes	Frames
2 Experience_emotion	75 Cause_to_experience
75 Stimulate_emotion_agent	2 Experiencer_obj
23 Stimulate_emotion	23 Experiencer_focus

Table 6.16: Occurrences of frames and scenes for the lemma *intimidire.v.*

As for the two verbs already presented, when it is used the reflexive middle voice it always means "to feel the emotion" and corresponds to the

scene "Experience_emotion", otherwise it means "to make someone feel the emotion", it can correspond to the scenes "Stimulate_emotion" and "Stimulate_emotion_agent".

Scenes The scenes represented in the sentences are:

- **Experience_emotion.** It appears 2 times and is always paired with the frame `Experiencer_focus`.
- **Stimulate_emotion_agent.** It appears 75 times and is always paired with the frame `Cause_to_experience`.
- **Stimulate_emotion.** It appears 23 times and is always paired with the frame `Experiencer_obj`.

Frames The evoked frames are:

- **`Cause_to_experience`** - it appears 75 times with the following core FEs:
  - EXPERIENCER expressed and AGENT unexpressed 22 times;
  - EXPERIENCER, AGENT 53 times.
- **`Experiencer_focus`** - it appears 2 times with the following core FEs:
  - EXPERIENCER once;
  - EXPERIENCER, STIMULUS once.
- **`Stimulate_emotion`** - it appears 23 times with the following core FEs:
  - EMOTION, STIMULUS expressed and EXPERIENCER unexpressed 2 times;
  - EMOTION, EXPERIENCER, STIMULUS 21 times.

PREOCCUPARE.

The scenes and frames that are evoked by *Preoccupare.v* (to alarm, to worry) are presented in table 6.17.

Also in this case with regard to the alternation refelxive/non reflexive we found the same situation as we did for *agitare, allarmare*, and *intimidire*.

Scenes The scenes represented in the sentences are:

- **Experience_emotion.** It appears 72 times and is always paired with the frame `Emotion_active`.
- **Stimulate_emotion.** It appears 28 times and is always paired with the frame `Experiencer_obj`.

Scenes	Frames
72 Experience_emotion	72 Emotion_active
28 Stimulate_emotion	28 Experiencer_obj

Table 6.17: Occurrences of frames and scenes for the lemma *preoccupare.v*.

Frames The evoked frames are:

- **`Experiencer_obj`** - it appears 28 times with the following core FEs:
  - EXPERIENCER, STIMULUS 15 times.
  - STIMULUS expressed and EXPERIENCER unexpressed once;
  - STIMULUS 12 times.
- **`Emotion_active`** - it appears 72 times with the following core FEs:
  - EXPERIENCER, TOPIC 25 times.
  - EXPERIENCER 47 times.

SPAVENTARE.

The scenes and frames that are evoked by *Spaventare.v* (to frighten) are presented in table 6.18.

Scenes	Frames
28 Experience_emotion	28 Fear
19 Stimulate_emotion_agent	19 Cause_to_experience
53 Stimulate_emotion	53 Experiencer_obj

Table 6.18: Occurrences of frames and scenes for the lemma *spaventare.v*.

This verb behaves like the previous ones in relation to the reflexive/non-reflexive alternation.

Scenes The scenes represented in the sentences are:

- **Experience_emotion.** It appears 28 times and is always paired with the frame `Fear`.

- **Stimulate_emotion_agent.** It appears 19 times and is always paired with the frame `Cause_to_experience`.

- **Stimulate_emotion.** It appears 53 times and is always paired with the frame `Experiencer_obj`.

Frames The evoked frames are:

- **`Cause_to_experience`** - it appears 19 times with the following core FEs: Experiencer, Agent.

- **`Fear`** - it appears 28 times with the following core FEs:
  - Experiencer 16 times.
  - Experiencer, Stimulus (Circumstances) 12 times.

- **`Experiencer_obj`** - it appears 53 times with the following core FEs:
  - Experiencer, Stimulus 52 times.
  - Stimulus expressed and Experiencer unexpressed only once.

TEMERE

The scenes and frames that are evoked by *Temere.v* (to fear) are presented in table 6.19

Scenes	Frames
100 Experience_emotion	91 Experience_focus/Fear 9 Fear

Table 6.19: Occurrences of frames and scenes for the lemma *temere.v*.

In the analysed sentences it always occurred as non-reflexive and had the meaning "to feel the emotion" which corresponded to the scene "Experience_emotion".

Scenes The only scene represented in the sentences is:

- **Experience_emotion.** It appears 100 times and is paired with the following frames: `Fear`, `Experiencer_focus/Fear`.

Frames The evoked frames are:

- **`Fear`** - it appears 9 times with the following core FEs:
  - EXPERIENCER 4 times.
  - EXPERIENCER, STIMULUS 5 times.
- **`Experiencer_focus/Fear`** - it appears 91 times with the following core FEs:
  - EXPERIENCER 2 times;
  - EXPERIENCER, STIMULUS 88 times.
  - STIMULUS once.

6.2.3 Adjectives

ANSIOSO.

The scenes and frames that are evoked by *ansioso.a* (anxious) are presented in table 6.20.

It is important to notice that in this case we did not discard the meanings linked to the area of Desiring since in many cases the distinction is rather subtle and the two meanings (worry and desire) are often interrelated.

Scenes	Frames
35 Experiencer_characteristic	1 Experiencer_focus/Emotion_directed
62 Experience_emotion	4 Stimulus_focus
2 Stimulate_emotion	2 Experience_obj
4 Stimulus_focus	10 Emotion_directed
	25 NA (Emotion_directed)
	57 Desiring

Table 6.20: Occurrences of frames and scenes for the lemma *ansioso.a*.

Scenes The scenes represented in the sentences are:

- **Experiencer_characteristic.** It appears 35 times and is paired with the following frames: `Emotion_directed`, `NA (Emotion`$_d$*irected*).
- **Experience_emotion.** It appears 59 times and is paired with the following frames: `Experiencer_focus/Emotion_directed` once, `Desiring` 60 times.

- **Stimulate_emotion.** It appears 2 times and is paired with the following frames: `Experiencer_obj` 2 times.

- **Stimulus_focus.** It appears 4 times and is paired with the following frames: `Stimulus_focus` 4 times.

Frames The evoked frames are:

- **`Experiencer_focus/Emotion_directed`** - it appears once with the following core FEs: EXPERIENCER, STIMULUS.

- **`Stimulus_focus`** - it appears 4 times with the following core FEs: Stimulus.

- **`Experiencer_obj`** - it appears 2 times with the following core FEs: Experiencer, Stimulus.

- textbf`Emotion_directed` - it appears 10 times with the following core FEs: Experiencer.

- textbfNA`Emotion_directed` - it appears 25 times with the following core FEs: Experiencer.

- textbf`Desiring` - it appears 57 times with the following core FEs: Experiencer, Stimulus.

We can notice that sometimes it is hard to decide which frame is the most suitable one, in particular in one case it is impossible to decide between the frames `Experiencer_focus` and `Emotion_directed`.

Moreover, for 25 sentences it is not possible to find a completely suitable frame and the closest one is the frame `Emotion_directed`.

INQUIETANTE.

Inquietante.a (disquieting) evokes always the frame `Stimulus_focus` and represents the scene "Stimulus_focus".

The core FEs that appear in these sentences are:

- STIMULUS in 99 sentences;

- EXPERIENCER, STIMULUS in only 1 sentence.

It is always well represented by FN frames.

PAUROSO.

The scenes and frames that are evoked by *pauroso.a* (fearsome/fearful) are presented in table 6.21.

Scenes	Frames
20 Experiencer_characteristic	4 Emotion_directed
80 Stimulus_focus	80 Stimulus_focus
	16 NA (Emotion_directed)

Table 6.21: Occurrences of frames and scenes for the lemma *pauroso.a*.

Scenes The scenes represented in the sentences are:

- **Experiencer_characteristic.** It appears 20 times and is paired with the following frames: `Emotion_directed` 4 times, `NA (Emotion`$_d$*irected*)16*times*.
- **Stimulus_focus.** It appears 80 times and is paired with the following frames: `Stimulus_focus`.

Frames The evoked frames are:

- **`Emotion_directed`** - it appears 4 times with the following core FEs:
  - EXPERIENCER 3 times;
  - EXPERIENCER, STIMULUS once.
- **NA(`Emotion_directed`)** - it appears 16 times with the following core FEs: Experiencer.
- **`Stimulus_focus`** - it appears 80 times with the following core FEs: Stimulus.

When it means "fearful" it is impossible, such as for *ansioso.a*, to find completely suitable frames. In fact, even the closest frame, `Emotion_directed`, does not represent it perfectly.

PREOCCUPATO.

The scenes and frames that are evoked by *preoccupato.a* (worried) are presented in table 6.22.

Scenes The scenes represented in the sentences are:

- **Experiencer_characteristic.** It appears 54 times and is paired with the following frames: `Emotion_directed` 53 times, `NA (Experiencer_focus)` once.

Scenes	Frames
54 Experiencer_characteristic	65 Emotion_directed
46 Experiencer_emotion	35 Experiencer_focus

Table 6.22: Occurrences of frames and scenes for the lemma *preoccupato.a*.

- **Experience_emotion.** It appears 46 times and is paired with the following frames: `Emotion_directed` 12 times, `NA (Experiencer_focus)` 34 times.

Frames The evoked frames are:

- **`Emotion_directed`** - it appears 65 times with the following core FEs:
  - EXPERIENCER 55 times;
  - EXPERIENCER, STIMULUS 10 times.
- **NA(`Experiencer_focus`)** - it appears 35 times with the following core FEs: EMOTION, EXPERIENCER, CONTENT.

SPAVENTATO.

Spaventato.a (frightened) evokes always the frame `Emotion_directed` and represents the scene "Experience_emotion".

The core FEs that appear in these sentences are:

- EXPERIENCER, STIMULUS in 12 sentences;
- EXPERIENCER expressed and STIMULUS unexpressed 85 times;
- EXPERIENCER, EXPRESSOR expressed and STIMULUS unexpressed 3 times.

It is always well represented by FN frames.

SPAVENTOSO.

Spaventoso.a (frightening) evokes always the frame `Stimulus_focus` and represents the scene "Stimulus_focus".

In these sentences appears always only the FE STIMULUS.

It is always well represented by FN frames.

6.3 Discussion

The analysis process highlighted that FN frames have proven to be usually adequate to represent the Italian lexicon of fear, worry and anxiety. Nevertheless, in some cases it is impossible to choose between two frames, in particular between: `Emotion_active` and `Emotion_directed`, `Experiencer_focus` and `Emotion_directed`, `Fear` and `Emotion_directed`, `Fear` and `Experiencer_focus`. This may be due to multiple factors such as the fact that FN frames partially overlap for the reasons explained in the previous chapter (section 5.4.1), and the fact that the lack of general context made it more difficult to fully understand the sentences.

Moreover, we find that in order to allow a more correct and complete annotation it would be necessary to make some modifications on three different layers:

- Frames Layer;
- Frame Elements layer;
- Frame to frame relations layer.

6.3.1 Changes at frames layer

With regard to the frames layer the first problem we can address is the ambiguity between frames which is due to the fact that, as pointed out earlier, some frames present overlaps and sometimes their boundaries are not clear.

In particular we can see that it is often hard to disambiguate between the frame `Fear` and other more general emotion frames that present fear terms. The existence of the frame `Fear` is in line with the proposal of (Ruppenhofer, 2018) which proposes to go towards more specific frames for the various emotions. However, in order to follow this path it would be necessary to create emotional frames that cover all the possible emotions and that do not present the aforementioned overlaps. In this scenario the current general frames could be Non-Lexical SuperFrames of the emotion-specific ones.

Moreover, the analysis shows that three missing frames can be identified: two of them would allow a more precise labelling of LUs that can already be annotated with the current FN frames, the last one, instead, would make it possible to annotate also LUs that cannot be labeled with the current FN frames (those marked as NA/`Emotion_directed` in the previous section).

We therefore propose to introduce the following new frames:

- `Start_to_experience`;
- `Cause_fear`;
- `Experiencer_characteristic`.

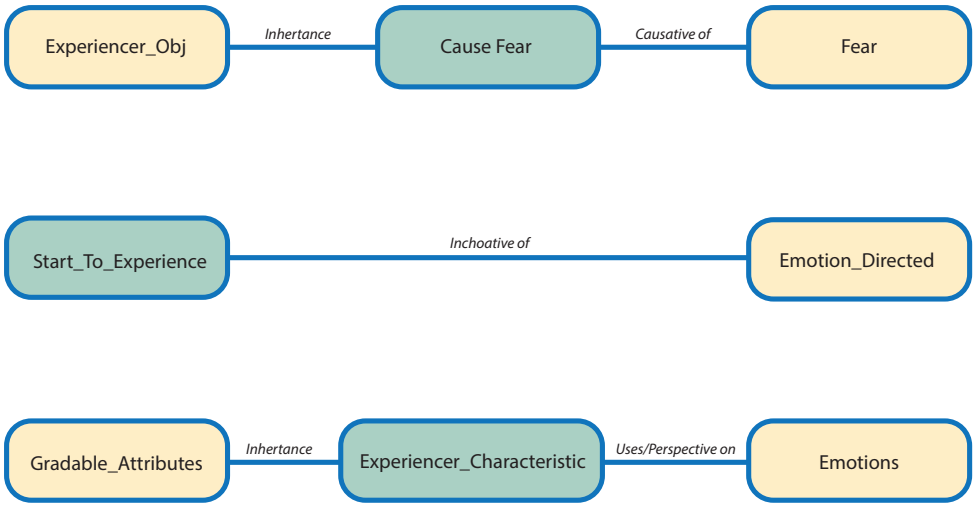


Figure 6.2: Frame-to-frame relations for the new proposed frames.

Start_to_experience

We noticed that FN lacks a frame that covers the meaning of "becoming scared"and that, moreover, this "inchoative frame" is missing not only for fear-related frames, but also for the other emotive frames. In fact, there are no frames in FN that predicate the beginning of a certain emotive experience. Nevertheless, we find that there are many Italian LUs that evoke this kind of frame, both fear-related and non- fear-related.

(51) **Si innamorò** di lei.
*He **fell in love** with her*

(52) Mi dispiace di **essermi arrabbiato** tanto.
*I'm sorry I **got** so **angry**.*

(53) Dylan **si è spaventato** a morte.
*Dylan **got scared** to death*

We therefore propose to create a new frame with the name `Start_to_experience` structured as follows:

- **Definition** - "An EXPERIENCER starts to feel a certain emotion in response to a certain STIMULUS or about a TOPIC."
- **FEs** - We propose to adopt the same FEs of the frame `Emotion_directed`.
- **Frame-to-frame relations** - We propose to link it to the frame `Emotion_directed` through the *Inchoative_of* relation directed from `Start_to_experience` to `Emotion_directed` (Figure 6.2.

Cause_fear

We have also observed that alongside frames that generically refer to the emotional experience, such as `Emotion_directed` and `Experiencer_focus`, it has been inserted also a frame specifically for the experience of fear.

Given this premise, we propose to create a specific fear-related frame also next to the frame `Experiencer_obj`, which generically refers to the situations in which a certain emotion is stimulated, regardless of the kind of emotion. We propose to call this frame `Cause_fear` and to structure it as follows:

- **Definition** - "A STIMULUS provokes a fear emotion in an EXPERIENCER. The emotion may be directed towards the EXPERIENCER him/herself or towards an EMPATHY_TARGET".
- **FEs** - We propose to adopt all the `Experiencer_obj` FEs and to add also the non-core FE EMPATHY_TARGET that we find in the frame `Fear`.
- **Frame-to-frame relations** - We propose to link it to the frame `Fear` via the relationship *Causative_of* and to the frame `Experiencer_obj` via the *Inheritance* relation (Figure 6.2.

Exeriencer_characteristic

Finally, we find that in some cases no FN frames are suitable to represent the situation depicted in some sentences and evoked by some fear related lemmas (in particular adjectives). In fact, FN lacks completely a frame to annotate the cases in which the word denotes an intrinsic characteristic of the Experiencer and depicts it as "potentially and easily subject of a certain emotion".

(54) Si definisce tendenzialmente **ansiosa**, perfezionista, fin troppo.
*She defines herself as naturally **anxious**, perfectionist, even too much.*

The FN frame that seems more suitable to label sentences like the one in (54) is the frame `Emotion_directed`, however it does not appear to be completely adequate, in fact it does not describe a feature of the Experiencer per se, but always as an answer to a certain stimulus or topic or, anyways, in relation to a specific situation as in (55).

(55) Ora non sono più così **agitato** all'idea che mia sorella sia lasciata da sola col Señor Mitchell.
*I am not now so **anxious** about my sister being left with Señor Mitchell.*

For this reason we propose to insert a new frame, that we would call `Exeriencer_characteristic`, with the following features:

- **Definition** - "The LUs in this frame describe the tendency of an EXPERIENCER to feel a certain emotion".
- **FEs** - Core: only the FE EXPERIENCER. Non core: DEGREE, COMPARISON_SET, CIRCUMSTANCES, PLACE, STIMULUS, TIME (Figure 6.3).
- **Frame-to-frame relations** - We propose to link it to the frame `Gradable_attributes` via the *Inheritance* relationship and to the frame `Emotion` via the *Perspective_on* relation (Figure 6.2).

Degree [Degr] **Semantic Type:** Degree	Degree to which the tends to feel the emotion.
Circumstances [cir]	This FE marks expressions that indicate a set of conditions under which the Experiencer tends to feel the emotion.
Place [pla]	The location where the Experiencer tends to feel the emotion to a certain Degree.
Stimulus [Stim]	The Stimulus is the object or event which brings about the emotion in the Experiencer.
Time [] **Semantic Type:** Time	The Time during which the the Experiencer tends to feel the emotion to a certain Degree.
Comparison_set [C_set]	The Comparison_set is the set of individuals the Experiencer is compared to when evaluating the Degree of the tendential emotional reaction.

Figure 6.3: Definitions of the non core FEs of the newly proposed frame `Exeriencer_characteristic`.

6.3.2 Changes at Frame Elements Layer

When someone is said to fear something. this can correspond to: (i) an entity, or (ii) an event, a situation. In the first case it will always correspond to what we may call the "Stimulus *tout court*", i.e. something that triggers the emotion because the Experiencer fears the potential negative consequences of the presence of this Stimulus. For example:

(56) Mia fears the lion.

In this case the Experiencer (Mia) experiences the emotion of fear as triggered by the lion because of the possible negative consequences of the

encounter with a lion in terms of personal safety. We could say that she fears the lion because she foresees that it might hurt her or kill her. In the second case, instead, the Stimulus can also correspond directly to this future negative consequence that the Experiencer foresees. For example:

(57) Mia is afraid of getting hurt.

Here the Stimulus does not correspond to something that is feared "because of the negative consequences it can have", but it corresponds to the negative projection in the future.

This situation can be graphically represented as in figure 6.5.

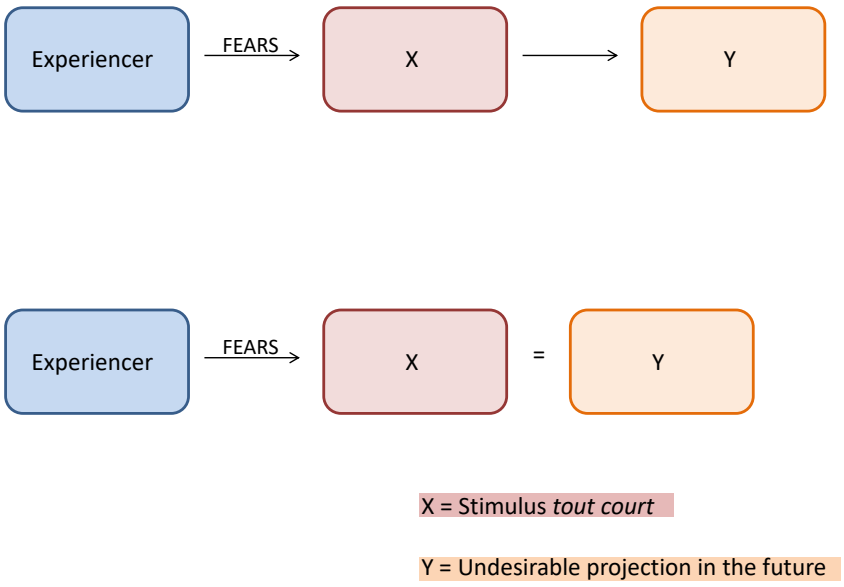


Figure 6.4: Stimulus types. The schema on top represents the situation of the Stimulus as "something that is feared because of the negative consequences it can have" and can be linguistically instantiated by sentences such as "Mia fears the lion because it can kill her". The bottom schema represents the situation in which the Stimulus corresponds to the negative projection in the future, e.g. "Mia is afraid of getting hurt".

We noticed that in the current FN frames it is not possible to distinguish between these two different situations and that moreover it is impossible to annotate some sentences that present both the Stimulus *tout court* and the negative projection.

For example:

(58) [la contaminazione delle colture $_{\text{Stimulus tout court}}$] ha portato al

preoccupante timore [che un agricoltore non - GM potrebbe essere accusato da una multinazionale biotecnologica di coltivare colture GM senza licenza $_{\text{Future undesirable projection}}$].

[crop contamination $_{\text{Stimulus tout court}}$] has led to worrying **fears** []that a non-GM farmer could be accused by a biotech multinational of growing unlicensed GM crops $_{\text{Future undesirable projection}}$].

If we analyse the FEs in FN frames we can see that the FE REASON of the frame `Emotion_directed` or the FE EXPLANATION of the frames `Experiencer_focus, Experiencer_obj, Fear` present some similarities with the projection in the future. Nevertheless, we find that when the sentence is construed with only the negative projection as Stimulus it is always labelled as STIMULUS and not REASON. In sentences of that kind it is therefore hard if not impossible to distinguish between the two kinds of Stimuli. Moreover, REASON is a non core FE, but for the fear frames the undesirable projection should be a core FE, linked to STIMULUS in a Coreness set.

6.3.3 Changes at frame-to-frame relations layer

Finally, with regard to the frame-to-frame relations layer we can highlight that `Experiencer_focus` and `Stimulus_focus`, that are presented as two perspectives over the same frame (`Emotion`) do not appear to be one the counterpart of the other.

In fact, while `Stimulus_focus` describes a characteristic of an entity, which is depicted as potentially and easily able to evoke a certain emotion, `Experiencer_focus` does not describe the characteristic of a potential Experiencer, which is easily subject of certain emotions, but it rather describes an actual emotional experience.

For this reason we propose also to modify frame-to-frame relationships in order to overcome these problems. There are different possible interventions we could do, in particular, there are three viable solutions:

1. Do not modify the current relationships and simply add:
   - The relationships of the newly presented frames;
   - Add a *Causative_of* relation from the frame `Experiencer_obj` and `Experiencer_focus`.

   This solution would not solve the problematic situation presented above, but it would allow to maintain the alignment with Berkeley's FN;

2. Propose the `Experiencer_characteristic` frame as a counterpart to the `Stimulus_focus` frame, instead of the frame `Experiencer_focus`,

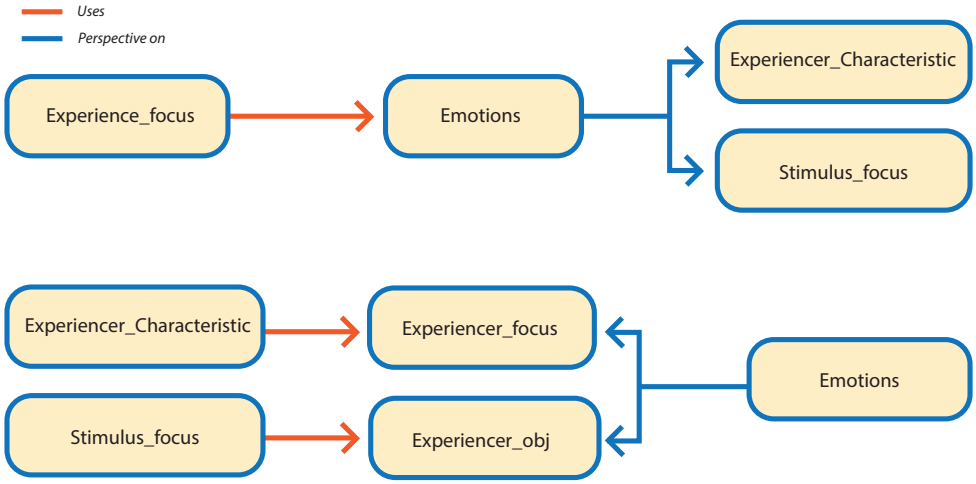


Figure 6.5: The diagram on the top represents the second proposed possible scenario. The diagram on the bottom represents the third proposed possible scenario.

and link the frame `Experiencer_focus` to `Emotion` through the *Using* relationship;

3. Propose the frame `Experiencer_obj` as a counterpart to the `Experiencer_focus` frame, instead of the frame `Stimulus_focus`, and link the `Stimulus_focus` frame to `Experiencer_obj` through the *Using* relationship.

As for now, given the importance of maintaining the resource aligned with FN, the solution that seemed to be more viable is the first one. In fact, this solution would be the only one capable of maintaining the alignment with FN since it would not modify FN existing relations, but it would add new relations.

This choice reflects our goal, which is to obtain a resource that is as complete as possible and suitable for representing Italian, while remaining aligned with the American resource and therefore with the other multilingual resources that have developed on it.

Chapter 7

Conclusions

In this thesis we have presented the ongoing IFN project which started in 2016 and aims at the creation of a large-scale FN-like resource for the Italian language by adopting FN structure and populating it with language-specific information.

This resource, which as for today focused only on nouns, verbs, and adjectives, currently covers the vast majority of FN frames. For each frame (with very few exceptions as discussed above) it contains at least one LU and presents at least 5 SSs, sampled from the CORIS corpus, that exemplify the concrete linguistic realizations of the various frames. Moreover, as for today we integrated in the dictionaries the adjectives of the NVdB and we plan to do the same also for nouns and verbs in order to guarantee a large coverage and a greater completeness.

As stated by Gilardi and Baker (2018), when enlarging FN to new languages it is often necessary to partially modify FN structure in order to make it more suitable for representing the target language. For this reason, various researches have been carried out in the University of Bologna on different fields: the motion domain, the medical domain, the change of state domain, the communication domain and about the treatment of meronymy.

In this thesis we have presented in particular the field of emotional frames and more specifically of fear frames. We chose this field given its extreme topicality, in particular in this historical period that Bauman (2007, 2013) the age of fear and uncertainty, and because of the help that a well-constructed linguistic resource could bring, for example, in the treatment of pathologies related to these emotions. Furthermore, it seemed particularly interesting to analyze this area in relation to FN and the expansion of FN to Italian due to the peculiarities of the fear domain and of the emotional domain in general.

In fact, emotions, and fear in particular, appear to be common to all mankind, but at the same time are deeply rooted in the various cultures. For this reason, given that the American FN structure proved to be particularly suitable for representing, even at an inter-linguistic level, human basic experiences, we can expect FN frames to be, on the one hand, suitable

and highly applicable to the Italian language, but on the other hand, we may also expect to find that some modifications and some interventions are necessary.

In order to investigate this field we conducted an analysis of 100 occurrences of 23 fear-related lemmas (11 nouns, 6 verbs, 6 adjectives) in the corpus CORIS trying to verify if and to which extent FN frames were suitable to represent the Italian situation.

As expected, we found that in the vast majority of cases FN frames are suitable to annotate Italian sentences, even if in many cases it is hard, if not impossible, to disambiguate between close frames. This it is mainly due to the fact that FN frames have been developed in very different moments and times, responding to different needs and criteria. For this reason, it is possible to find in FN frames that focus on different aspects, but that show partial overlaps.

Nevertheless, we also find that some changes might be necessary on three separate layers: (i) the frames layer, (ii) the FEs layer, and (iii) the frame-to-frame relations layer.

With regard to the frame layer, we proposed to add three new frames. Two of them would allow a better representation of LUs that can be already annotated with FN frames, and the last one would instead allow the annotation of LUs that cannot be represented by the current FN frames. The frames we propose to introduce are:

- `Start_to_experience` - to represent the ingressive phase of a given emotional experience;
- `Cause_fear` - to specifically represent the cases in which a certain stimulus causes an emotion of fear in an Experiencer;
- `Experiencer_characteristic` - to represent situations in which it is predicated the tendency of an individual to feel certain emotions.

With regard to the FEs layer, we proposed to introduce a new frame in order to account for the ontological difference between two kinds of Stimuli: (i) Stimuli *tout court* that correspond to the trigger of the fear experience, and (ii) Stimuli intended as the projection in the future that the Experiencer does want to avoid.

With regard to the frame-to-frame relations layer, we noticed the asymmetry of the two frames `Stimulus_focus` and `Experiencer_focus` that are presented as different perspectives on the general frame `Emotions`. However, in order to maintain the alignment between IFN and FN we propose not to modify these relationships, despite their problematic nature, and instead we simply propose to add:

1. The relationships of the new frames;
2. A *Causative_of* relation from the frame `Experiencer_obj` and `Experiencer_focus`.

7.1 Future work

For the future, we propose to work on the development of the resource focusing both on sentences and dictionary. With regard to the SSs, a first goal will be to complete the annotation of all the sentences that have already been labelled with at least one frame. In fact, in many cases we find that IFN SSs are annotated only in relation to some of the possible FFEs and that often also the annotated frames do not present all the possible FEs labels. We therefore propose, as a future goal, to annotate all the possible LUs in each sentence already in the resource and to fully annotate also the projected FEs.

With regard to the dictionary, we propose first to integrate the nouns and verbs of the NVdB and second to enlarge it by starting the analysis also of different PoS.

We also propose to systematically analyze the *Causative_of* and *Inchoative_of* relations and the possible lack both of explicit relations in the net of frames and of causative and inchoative frames themselves.

Moreover, we think that, as already underlined by Ruppenhofer (2018), it would be necessary to restructure the entire emotional domain in FN. In fact, as of today, it does not follow a unitary schema, but rather single frames respond to different criteria. Furthermore, in FN do not exist separate frames for all the different emotions, but only for some of them. This incompleteness of the resource leads to problems and ambiguities in the annotation process and makes it difficult to build precise and correct frame-to-frame relationships.

As for the domain of fear, it would first be necessary to enrich the labeling work presented in chapter 6 with the annotation by other annotators as well. In this way it would become possible to calculate the inter-annotator agreement and therefore to give greater importance and strength to the considerations that have been drawn.

Moreover, this work also opens the doors to a systematic analysis of this domain, no longer simply for the purpose of improving IFN and FN, as in the case of this thesis, but for the purpose of a deeper understanding of the domain of fear, of how this is linguistically encoded and how this linguistic representation varies according to different languages.

Finally, an interesting relationship that we noticed during the analysis process is that between Desire (and Hope) and Fear, linked by the fact of being connected to a future event, to a possibility in the future, in the first case a desirable situation, something that the Experiencer wants to happen and in the second case an undesirable situation, something that the Experiencer wants to avoid. We therefore believe that it may be interesting to study their relations in terms of FS and with regard to their FN and IFN representations.

Appendix A

Annotation Guidelines

In this Appendix we aim to define and describe the annotation of Italian sentences with frame information, using the platform developed by Rome Tor Vergata researchers. In particular, we will explain, on the one side, from a theoretical point of view what to annotate and with which information and, on the other side, from a more practical point of view, how to interact with the platform.

In the first section we will explain the aim of the annotation and the annotation workflow, emphasizing both the objectives that the resource wants to achieve and how to proceed with the labeling work. In the second section, instead, we will provide a practical example of a short sentence annotation.

A.1 Annotation workflow

In order to have a database that is as balanced as possible and to ensure a wide coverage, for the moment, the goal we have set out to achieve is to obtain, for each frame, at least 5 example sentences. Each of these sentences, in order to be useful for computational tasks, must be completely annotated, both as regards the possible evoked frames and as regards the FEs that appear for each frame.

Once our initial goal of 5 sentences per frame has been reached, we will increase the goal by 5 sentences per frame every time we reach our goal (i.e. when we reach 5 sentences per frame the goal will be to reach 10, then 15 and so on).

The annotation will proceed frame by frame and for each frame we will start from the non-validated sentences that have already been annotated with the frame under analysis, both automatically and by manual annotators.

For each pre-annotated sentence the annotator will have to check if the sentence actually constitutes an instance of the frame being analysed and, if so, he will have to:

- Check if also the other annotated frames are correct and if necessary clean them from errors;
- Check if it is possible to identify in the sentence other evoked frames and annotate them;
- Fully annotate the sentence with regard to the FEs realised for each evoked frame.

In case there are not enough correct sentences among those annotated but not yet validated, suitable SSs will be searched among the sentences present on the platform and still without annotations. It will therefore be necessary to search for the sentences in which the LUs of the frame under analysis (previously inserted in the dictionary of the resource) appear using the keyword search as in fig. A.1.

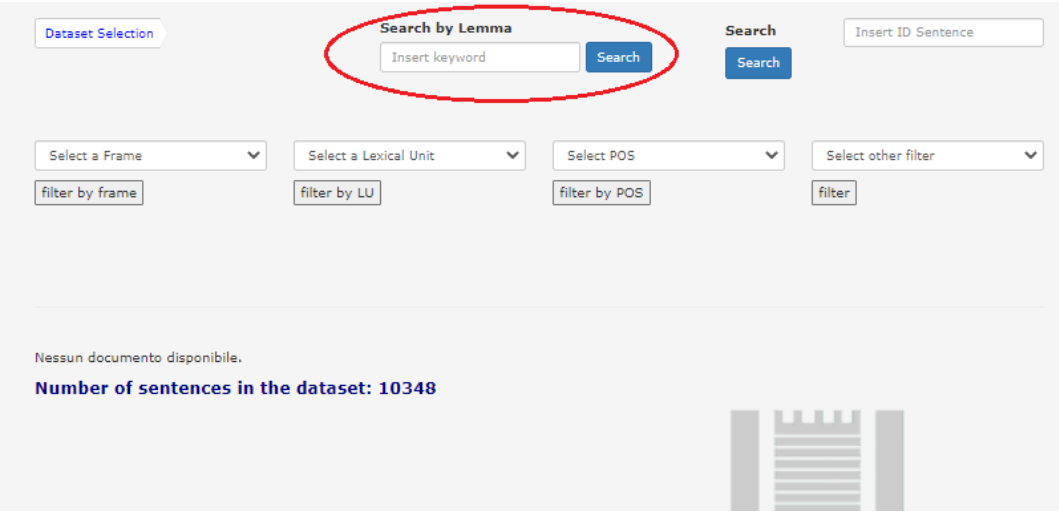


Figure A.1: Annotation platform. Within the red circle we can see the keyword search box.

When trying to fully annotate the sentence with regard to the evoked frames it is possible that it is necessary to label as LUs elements that do not (yet) appear in the dictionary of Italian LUs. In this case it will be necessary to first add the missing LU to the dictionary of the frame in question and then proceed with the normal labeling of the frame on the target.

N.B. As of today it is not possible to insert new frames, and the frames present in the platform, as well as the FEs accompanying them, correspond to those of FrameNet 1.7.

A.1.1 Frame annotation

Once an occurrence of a frame has been recognized in a sentence, it will be labeled on the target that evokes it.

For example in the following sentence we can identify the frame BLABLA which is evoked by *blabla italiano* (blabla inglese).

figura

We will then label the frame name on the target and specify in the appropriate slot the dictionary LU to which the target corresponds, in this case *blabla italiano* (blabla inglese).

When the frame evoking element consist of a single word the label is, of course, placed on that word. Otherwise:

- If the LU is a noun or an adjective construed with a light verb or a support verb we will annotate as LU only the noun and the adjective. As for today, however we don't have specific labels for support and light verbs.

  For example in a sentence like:

  (1) Per questo ho **paura** dei coccodrilli.
  *That's why I'm **afraid** of crocodiles.*

  We will not annotate the entire light verb construction *ho paura* (I am afraid), but only the supported item, in this case *paura*.

- When the target lexical item is a multiword verb we chose not to annotate the auxiliary verb, but only the word that bears the lexical information.

  For example:

  (2) Non aveva **prodotto** nessuna conseguenza.
  *it had not **produced** any consequences.*

  Here the frame `Causation` is labelled only on *prodotto* (produced) instead of *aveva prodotto* (had produced).

  (3) Hanno **preso** i loro soldini.
  *They did **take** their money.*

  Here the frame `Taking` is labelled only on *preso* (take) instead of *hanno preso* (did take).

  (4) I trasferimenti dello Stato erano **aumentati**.
  *State transfers had **increased**.*

  Here the frame `Change_position_on_a_scale` is labelled only on *aumentati* (increased) instead of *erano aumentati* (had increased).

(5) Carl Trudeau avrebbe semplicemente **telefonato**.
*Carl Trudeau would simply have **phoned**.*

Here the frame `Contacting` is labelled only on *telefonato* (phoned) instead of *avrebbe telefonato* (would have phoned).

- If the LU is a **pronominal verb** we can have three different possibilities:

  1. The pronoun is intrinsically linked to the lemma and there is no non-pronoun form of the verb - in this case we annotate also the pronoun, and the LU basic form appears as pronominal. For example *ammalarsi* (to get sick).

     (6) Luca **si ammala** sempre in questa stagione.
     *Luca always **gets sick** this season.*

  2. The pronoun is not intrinsically linked to the lemma but is found in alternation with non-pronoun forms and these two forms evoke, in a stable way, two distinct frames - In this case we will have two separate LUs (a pronominal one and a non-pronominal one) in the dictionary and we will annotate also pronouns within the sentences. For example *scaldare* (to heat up) and *scaldarsi* (to get warm/ to warm up) do both exist and evoke two differen frames, respectively `Apply_heat` and `Absorb_heat`.

     (7) Moses **scalda** una pentola di riso e piselli.
     *Moses **heats** a pot of rice and peas.*

     (8) Il mare **si scalda** più lentamente della terra.
     *The sea **warms up** more slowly than the earth.*

  3. The pronoun is not intrinsically linked to the lemma and the pronominal form and the non-pronominal evoke the same frame - in this case we will have only a non-pronominal LU in the dictionary and we will not annotate the pronoun within the LU boundaries but instead we will annotate it as FE.

     (9) Mi **aspetteranno** qui.
     *They will**wait** me here.*

Frame choice

To decide whether a sentence is actually an instance of a frame, it is necessary to check the following aspects:

1. Carefully read the description of the frame and check its relevance for the considered sentence;

2. Check which FEs are indicated as Core and which as Non Core in FN and evaluate if they are consistent with those that the LU projects in the sentence under analysis. (this type of FE analysis can be very useful for discriminating in the case of very similar frames.)

   For example, the frames `Statement` and `Telling` appear to be very close, but differ with respect with their FEs. In fact, while both have the core FEs MEDIUM,MESSAGE, SPEAKER, and TOPIC only TELLING has the FE ADDRESSEE as core (tab.A.1).

Statement	Telling
	Addressee [Add]
Medium [Medium]	Medium [Medium]
Message [Msg]	Message [Msg]
Speaker [Spkr]	Speaker [Spkr]
Topic [Top]	Topic [Top]

Table A.1: Comparison between `Statemet` FEs and `Telling` FEs.

   This difference is useful in noting a sentence such as:

   (10) Ma Danglard non poteva **informare** nessuno di quel genere di prodezza .
   *But Danglard could not **inform** anyone of that kind of feat.*

   At a first glance, this sentence might appear a good example of both `Statement` and `Telling`, but once its FEs have been analysed, it can be better classified as an instance of the second, since the ADDRESSEE FE - here expressed by "*nessuno*"(none), is not inessential (Non Core), but fundamental (Core).

3. In the event that the assignment continues to be problematic, possible help could come from a comparison with the SSs already present in FN.

A.1.2 Frame Elements annotation

Once that the frame label has been added to the target, the platform allows to add FEs labels on the other tokens of the sentence. When selecting a token the platform automatically gives the possibility to select a FE label in a list of FEs that correspond to those present in FN for that frame. It is important to notice that FEs have to be annotated on the whole constituent.

As stated by Tonelli and Riccardi (2010, p.15) "Generally speaking, no frame element occurs necessarily. There may be frames which don't have a single realised frame element and are attested only by the target. On the other hand, multiple occurrences of the same frame element are allowed in specific cases. The most frequent case involves repetitions, redundancies, discontinuous constituents, etc." In these cases, since the same FE label can be applied also on discontinuous text, the annotator will have to re-annotate the same label on multiple constituents.

A.1.3 Peculiar Cases - Clitics

Since, as for today, the platform does not allow to add labels only to a part of the tokens, and given that the clitics constitute a single token with the word they are linked to, it is necessary to describe in more detail how to annotate this particular case. First of all, we need to consider that there are several different cases and situations. The first distinction that can be made is between words that have only one clitic and words that cumulate more than one clitic (typically two).

Only one clitic per word

- The clitic does not instantiate nor a LU nor a FE: in this case the clitic will be neglected, regardless the status of the word it is linked to (i.e. LU, FE or other).
- The clitic does instantiate a FE and it is linked to the word that constitutes the target: in this case it will be neglected and only the LU is labeled.

  For example:

  (11) non è affatto detto che **attraversarla** a bordo di un camper lo sia altrettanto.
  *It is not certain that **crossing it** aboard a camper is the same.*

  In this sentence the token *attraversarla* (crossing it) contains both *attraversare* (cross) which is LU evoking the `Traversing` frame and the clitic *-la* (it) which is the realization of the FE Area, but it will only have to be labeled as LU.

- The clitic instantiates a FE and so does the word it is linked to: in this case we will label the word-clitic token only with the FE which is instantiated by the word. Of course if it does correspond to the one instantiated by the clitic no problem will arise.

- 4.The clitic instantiates a FE but the word it is linked to does not: in this case we will label the token in which the clitic appears with the FE that is instantiated by the clitic itself.

Two clitics on the same word

- The clitics are linked to a word that has the function of LU: in this case only the LU will be labeled regardless of whether the clitics may or may not be an instance of FEs.

- The clitics are linked to a word that instantiates a FE: in this case, only the word that has a function of FE will be labeled regardless of whether the clitics may or may not be an instance of FEs.

- The clitics are linked to a word that has no function of either LU or FE and only one of them is FE: in this case the token will be labelled according to the FEs that is instantiated by that one clitic.

- The clitics are linked to a word that has no function of either LU or FE and they both instantiate a FE: in this case only the outermost one will be labeled (e.g. if in a token like *portargliela* (bring it to him) *portare* bring) was neither FE nor LU and both *gli* (to him) sia *la* (it) were instances of FE, *portargliela* would be labeled only according to the FE instantiated by *la*.

A.2 Practical example

In order to better understand how the annotation concretely works we will present a practical example of sentence selection and frame annotation.

A.2.1 Corpus selection and sentence selection

First of all we need to select the corpus within which we want to work. As for now we are adding annotations only on the sentences contained in the datasets referring to the CORIS corpus.

At this point it is possible to browse through the sentences entered in the platform to select one to annotate. It is possible to search sentences through their ID or using keywords. Moreover (as stated in chapter 4), it is possible to apply filters, for example on the frames that have to be previously annotated on the sentence (either automatically or by a manual annotator).

For example if we would need to annotate a sentence for the frame `Achieving_first` we should first search the sentences applying the frame filter `Achieving_first` to see if there are sentences that have been annotated with this frame but that have not been validated yet.

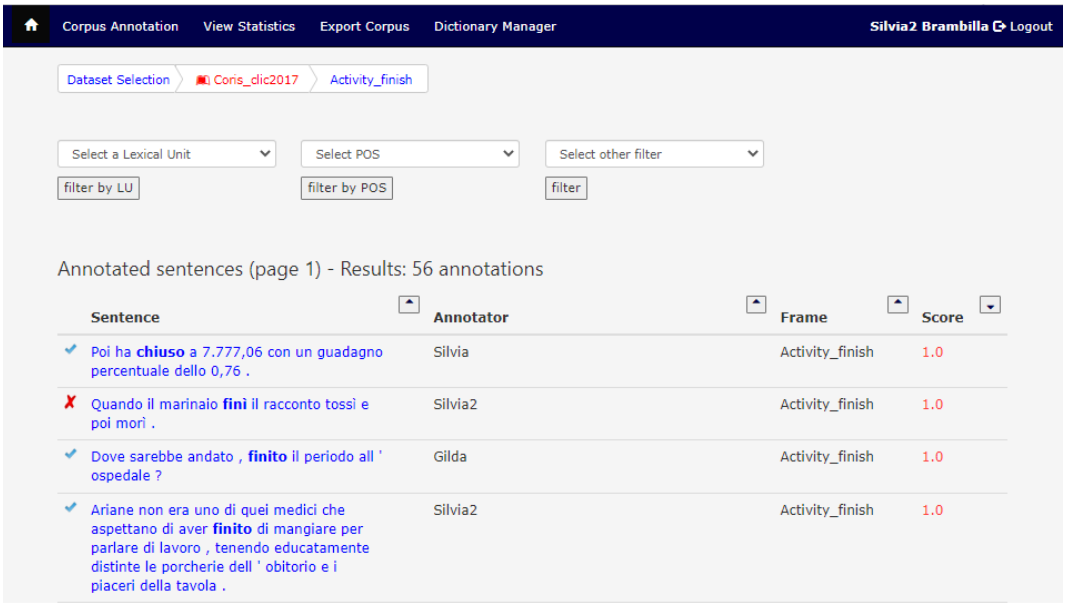


Figure A.2: Sentences displayed for the corpus Coris_clic2017 when applying the frame filter `Achieving_first`.

Here we could choose the sentence:

(12) Quando il marinaio finì il racconto tossì e poi morì.
When the sailor finished the tale he coughed and then died.

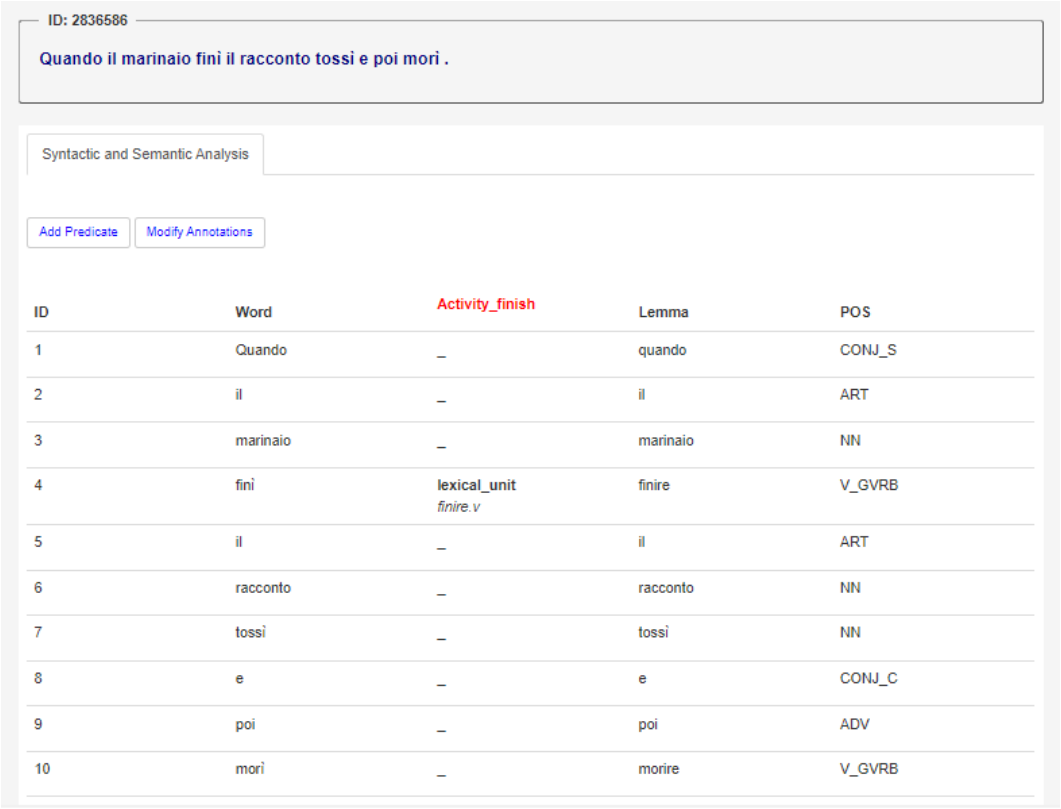
A.2.2 Sentence annotation and validation

Once the sentence we want to work on has been selected we need first to control if the already inserted annotations are correct or incorrect, checking if the annotated frames are actually evoked in the sentence and if the FE labels have been added correctly.

In order to add or modify FEs information we need first to press on the "Modify annotations" button and then select the frame annotations we want to work on, in this case the frame `Activity_finish` then press on the "EDIT" button below the name of the frame.

At this point a space will appear next to each token in which it will be possible to insert a FE label by choosing it from a drop-down menu as in fig.A.4.

In this drop-down menu the platform will automatically display all the possible FE label for that frame, which correspond to its FEs in FN.



ID: 2836586

Quando il marinaio finì il racconto tossì e poi morì .

Syntactic and Semantic Analysis

Add Predicate | Modify Annotations

ID	Word	Activity_finish	Lemma	POS
1	Quando	_	quando	CONJ_S
2	il	_	il	ART
3	marinaio	_	marinaio	NN
4	finì	lexical_unit *finire.v*	finire	V_GVRB
5	il	_	il	ART
6	racconto	_	racconto	NN
7	tossì	_	tossì	NN
8	e	_	e	CONJ_C
9	poi	_	poi	ADV
10	morì	_	morire	V_GVRB

Figure A.3: Sentence visualization.

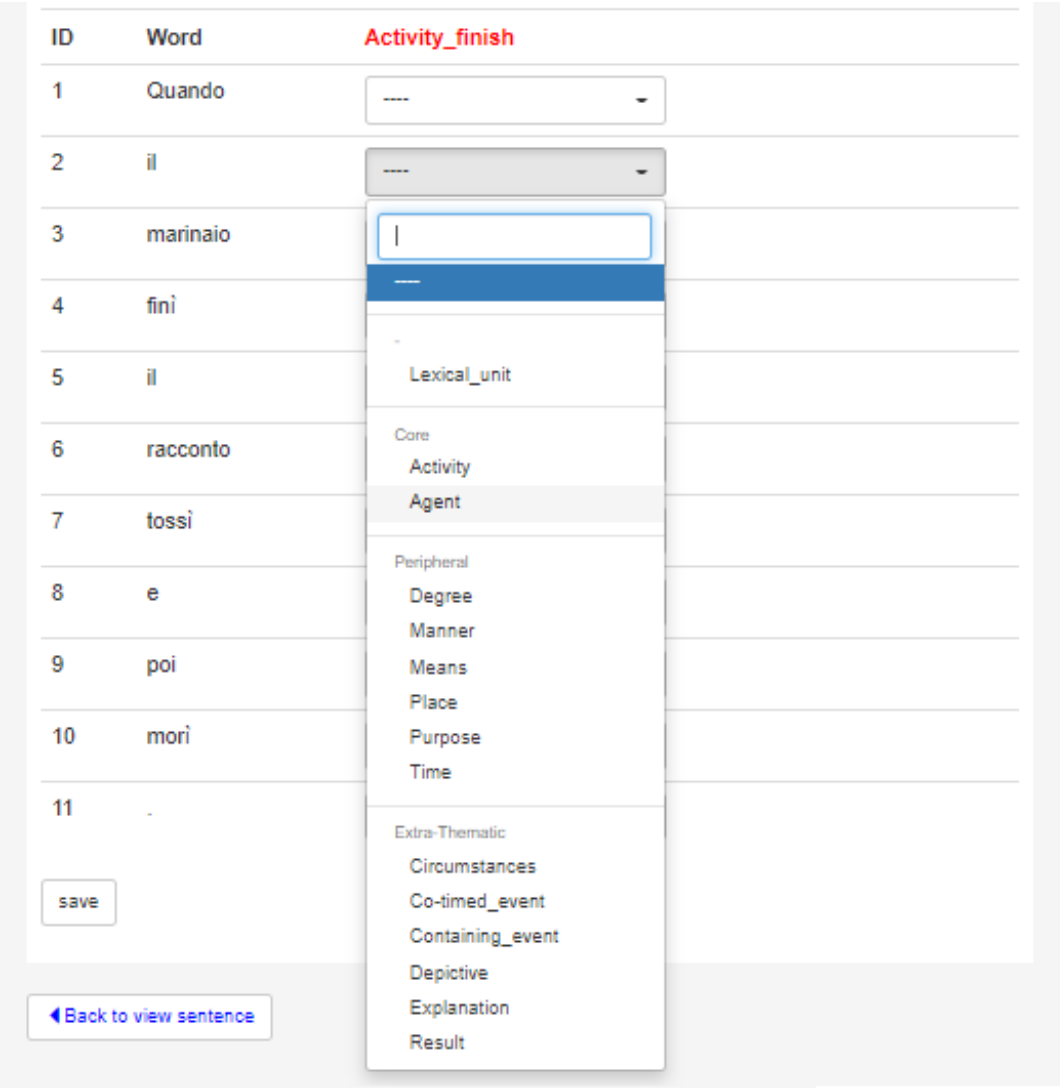


Figure A.4: Drop-down menu for the selection of LU and FEs labels.

After adding FE information in relation to the already annotated frame(s) we need to check if there are other annotations and if these annotations are correct.

Once this operation has been completed (or if there are no other annotations - as in this case) it is necessary to check if it is possible to identify other FEEs in the sentence. In the sentence under analysis, in particular. we can recognize the FEEs *marinaio, tossì, morì* (sailor man, coughed, died).

In order to add new frames it is necessary to select "Add Predicate" and then select i) the evoked frame ii) the LUs that corresponds to the FEE. If the FEE corresponds to a LU which is not yet been linked to that frame in the dictionary, it will be necessary first to add it to the dictionary and then to proceed to the annotation of that LU in the sentence.

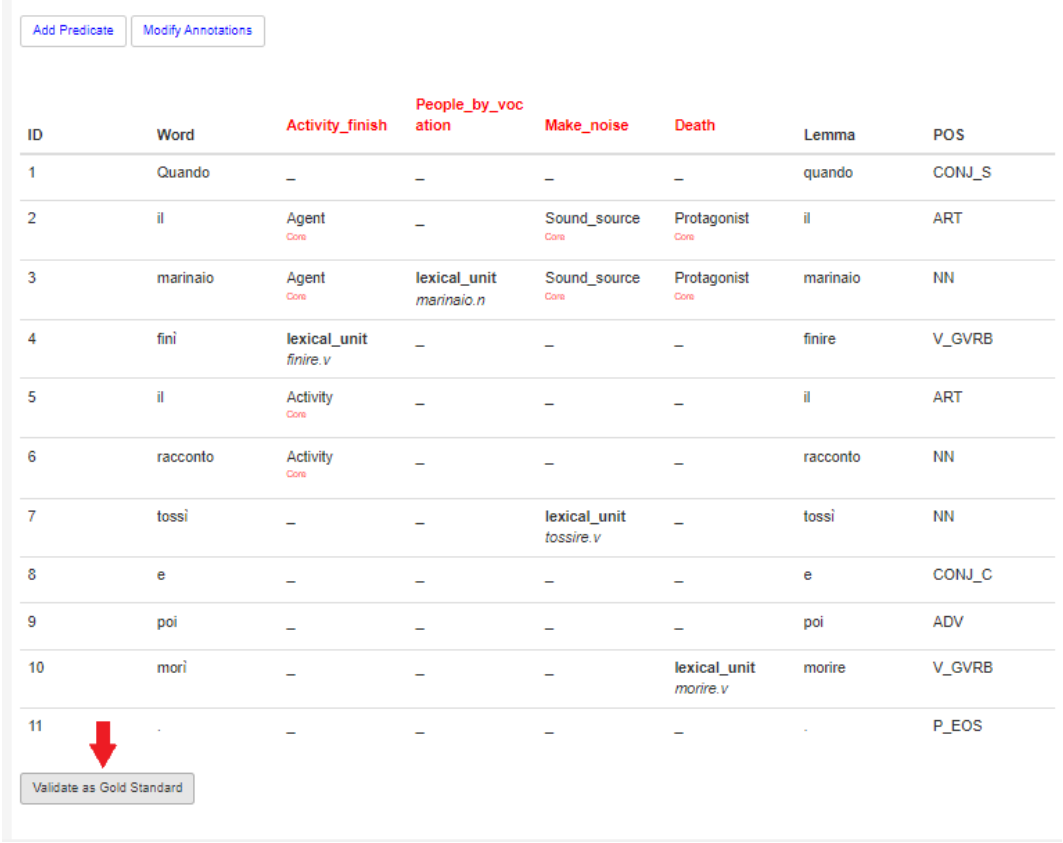
Then it will be necessary to add the correct labels to the relevant token, choosing from the mentioned drop-down menu.

In this case we need to add three frames: `People_by_vocation`, `Make_noise` and `Death`.

For each frame we will need to label also its instantiated FEs. In this case:

- `People_by_vocation` - does not present any FE;
- `Make_noise` - does present the FE SOUND_SOURCE instantiated by *il marinaio* (the sailor man);
- `Death` - does present the FE PROTAGONIST instantiated by *il marinaio* (the sailor man).

When the sentence is fully annotated with regard to both frames and FEs we can validate it. Doing this the sentence becomes part of the gold standard (fig.A.5).



ID	Word	Activity_finish	People_by_vocation	Make_noise	Death	Lemma	POS
1	Quando	_	_	_	_	quando	CONJ_S
2	il	Agent Core	_	Sound_source Core	Protagonist Core	il	ART
3	marinaio	Agent Core	lexical_unit *marinaio.n*	Sound_source Core	Protagonist Core	marinaio	NN
4	finì	lexical_unit *finire.v*	_	_	_	finire	V_GVRB
5	il	Activity Core	_	_	_	il	ART
6	racconto	Activity Core	_	_	_	racconto	NN
7	tossì	_	_	lexical_unit *tossire.v*	_	tossì	NN
8	e	_	_	_	_	e	CONJ_C
9	poi	_	_	_	_	poi	ADV
10	morì	_	_	_	lexical_unit *morire.v*	morire	V_GVRB
11	.	_	_	_	_	.	P_EOS

Figure A.5: Fully annotated sentence. The red arrow indicates the validation button.

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