Preprint of Mattiello, E. (2019). A corpus-based analysis of scientific TED Talks: Explaining cancer-related topics to non-experts. *Discourse, Context & Media* 28: 60-68. DOI: 10.1016/j.dcm.2018.09.004.

A corpus-based analysis of scientific TED Talks
Explaining cancer-related topics to non-experts

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1. Introduction

TED Talks is an innovative genre of knowledge dissemination that has recently attracted the attention of many scholars investigating popularization discourse. In particular, Scotto di Carlo (2013, 2014) and Mattiello (2017a) have investigated its linguistic features, including figurative language (especially, humour and simile), whereas Caliendo & Compagnone (2014), D'Avanzo (2015), and Scotto di Carlo (2015) have explored its use of subjective adjectives to express the author's stance and identity. Moreover, Meza & Trofin (2015) and Masi (2016) have studied the role of digital genres such as TED videos in expert to non-expert communication in ESP/EAP contexts.

In the pertinent literature, TED Talks has been described as a "hybrid genre" (Caliendo 2012: 101) displaying features of various others. For instance, like conference presentations or symposia, TED talks have a limited time slot, which generally does not exceed twenty minutes. However, unlike research talks presented at specialized Conferences or Workshops, where the audience includes mainly specialist recipients and the style is typically formal and close to written language, TED Talks address both specialists/professionals and non-specialists (or experts in other fields). As a result, TED presenters adopt an informal register that is similar to spontaneous conversation and meant to encourage participation and increase proximity with hearers (Hyland 2010).

Moreover, like academics in university lectures (Crawford Camiciottoli 2008), TED speakers (or 'TEDsters') use second person pronouns and questions to engage their audience, and epistemic lexical verbs, such as *see* or *think*, to express their stance (Caliendo &

Compagnone 2014; Compagnone 2014). In addition, not dissimilarly from university lecturers (Crawford Camiciottoli 2015, 2016), TEDsters often employ multimedia resources, such as images, photographs, or short video clips, which can help improve comprehension and avoid misunderstanding. Multimodal strategies in these genres also include gesturing, especially used to reinforce the meanings of abstract notions (metaphoric-referential), or to increase interpersonal engagement (deictic-social), thus helping reduce the asymmetry between expert speakers and a non-expert audience (Masi 2016).

Furthermore, TED Talks share some features with other web-mediated forms of communication, such as science blogs (Garzone 2012), social networking sites (Mattiello 2017b), or Google Talks (Mattiello forth.).[1] For instance, in both science blogs and TED Talks, there is a reduced technicality in content and vocabulary. In these web genres, the language is simplified, accessible to a wide audience, and sector-specific terms are only given occasionally. In addition, in both TED and Google Talks, the tone adopted is often humorous (Scotto di Carlo 2013; Mattiello 2017a, forth.). Humour may indeed derive from a pleasant psychological shift of incongruity or contrast, from a sense of superiority or derision, but, above all, from a release reaction, i.e. when laughter is used to release tensions deriving from taboo or serious topics, such as economic crises, diseases, or political problems.

By contrast, a feature that typically characterizes TED Talks is the use of axiological (fully subjective) adjectives, such as *amazing* or *remarkable* (Scotto di Carlo 2015). Experts use evaluative and emotive adjectives as a means to convey judgements and personal positions and to engage with the audience. In particular, TED speakers seem to express positive evaluations, especially aesthetic appreciation and emotive reactions. According to Scotto di Carlo (2015: 214), "these aesthetic and emotive adjectives are crucial in knowledge dissemination, as they appeal to the audience's sense of identity, self-interest, and emotions".

Another characterizing feature of the TED Talks genre is the use of narration (Mattiello 2017a). By introducing specialized topics via personal narratives and anecdotes, TED speakers create a concrete scenario that can, on the one hand, facilitate the interlocutor's comprehension and, on the other, appeal to emotions and feelings. This favours the direct involvement of the audience and inspires discussion both with primary (co-present) recipients and with secondary

[1] Google Talks consist of a series of presentations by invited speakers given at various Google offices throughout the world and available on the website *Talks at Google* (https://talksat.withgoogle.com/). They are generally longer than TED Talks, delivered by famous experts or celebrities in various fields, and often include dialogic (Q&A) parts, with a moderator who mediates between the speaker and the audience.

recipients, i.e. non-expert web-users, who access the talks as recorded speech events embedded in the TED website, and can be involved in public online conversations.

The worldwide accessibility of TED Talks through an online platform has contributed to their widespread dissemination and encouraged educators to use them for pedagogical purposes in EFL teaching (Dummett et al. 2016). Takaesu (2013), for instance, has suggested using TED lectures as authentic material in EAP courses, envisaging their potentiality to improve listening comprehension skills. Wingrove (2017) has similarly demonstrated the suitability of TED Talks for a range of academic listening applications in EAP contexts, especially because of their low academic vocabulary list representation and fast speech rate compared to university lectures.

This paper investigates TED Talks pertaining to the medical area and inspects the explanation strategies used by experts to disseminate scientific knowledge addressed to both experts and laypersons (cf. Laudisio 2013). As Calsamiglia & van Dijk (2004: 372) remark, explanation is "a discursive activity that has a theoretical status that is similar to – but different from – that of narration, argumentation and description". In the literature, various types of explanation have been identified, including denomination, definition, description (Candel 1994), and reformulation or paraphrase (Loffler Laurian 1983, 1984; Gülich & Kotschi 1987; Ciapuscio 2003). These types of explanation will be the object of our corpus-based analysis.

The corpus consists of TED Talks concerned with cancer topics (hereinafter, TED_MED Corpus). Whether it is called 'cancer', 'malignant tumour', or 'carcinoma', this is one of the most debated topics among physicians, oncologists, surgeons, experts in radio- or chemotherapy, psycho-oncologists, and other specialists facing this as the greatest illness of our century. However, the way experts address their colleagues is clearly not the same as the way they address an audience of semi- or non-experts such as TED's receivers, who need more detailed, but simplified information about the disease, its causes, effects, and possible cures. In general, we can envisage that, in TED Conferences, TEDsters use a simpler – that is, less abstract, less technical, more familiar – vocabulary. However, the specific techniques that are used to explain, reformulate, and simplify medical content deserve a finer-grained analysis, in both qualitative and quantitative terms.

The analysis is both qualitative and quantitative in nature. The qualitative analysis investigates the clarifying functions of denominations, definitions, and descriptions in a small collection of scientific TED Talks delivered by experts. The quantitative analysis focuses on the term 'cancer' and its collocates in the same corpus. It inspects the relevance of some

collocational patterns to the elucidation of the disease, its causes and effects, and to the encouragement of patients affected with carcinoma.

The study aims, first, to identify the linguistic strategies that TEDsters use to transfer scientific knowledge between specialists and non-specialists (Caliendo 2012; Scotto di Carlo 2013; Compagnone 2014; Mattiello 2017a), and, second, to show the positive encouraging stance that they adopt when dealing with cancer (cf. Caliendo & Compagnone 2014; D'Avanzo 2015; Scotto di Carlo 2015). From the viewpoint of popularization discourse, the study confirms the relevance of TED Talks to science popularization (Myers 1990; Calsamiglia & van Dijk 2004; Garzone 2006; Gotti 2011, 2013, 2014).

2. Material and method

The material selected for this study is freely downloadable from the website *TED. Ideas Worth Spreading* (https://www.ted.com/). As is well known nowadays, TED is a non-profit organization devoted to spreading ideas in the form of influential talks of around twenty minutes' duration. It began in 1984 as a conference where Technology, Entertainment, and Design converged, and today covers an extremely wide range of topics – from science to business to global issues – in more than one hundred languages. The topic selected for this study belongs to medicine/science and the language we are interested in is English.

More precisely, for the selection of relevant TED Talks, the filter 'cancer' was used. This advanced search by topic gave us forty-nine talks (posted between October 2006 and November 2017) as result. This time span of more than eleven years was considered significant, in that it confirmed the relevance of the subject to the scientific debate of the last decade. However, after close examination of the talks, nineteen of them were excluded from the analysis because they had been delivered by non-specialists, while our focus in this paper is on the techniques used by expert speakers addressing laypersons. By 'expert speaker' we specifically mean cancer researchers, doctors, (cancer) physicians, oncologists, research scientists, surgeons, biomedical engineers, or anyone who can provide an expert consultation on cancer. Although cancer sufferers can be viewed as experts in the field, because of their personal experience of the illness, talks by non-specialists were excluded from the corpus.

The corpus is made up of thirty TED Talks belonging to the medical area, with thirty-two expert speakers. Not all experts are native speakers of English, but this was not considered a discriminatory criterion for selection, since we are interested in the genre strategies and not

in culture or language-specific aspects. The selected TED Talks last from 04:11 to 23:44 minutes, with an average duration of 14:17. The corpus totals 63,789 words (74,070 tokens, 3,684 sentences). For the analysis of the talks, the transcripts provided on the website were used.

As for the methodology, this study adopts a discourse perspective (Myers 1990) to investigate how 1) denomination, 2) definition, and 3) description are differently realized in scientific TED Talks. In the literature on popularizing science, these categories are generally regarded as strategies of 'translation' or 'recontextualization' of science for lay audiences (Loffler Laurian 1983, 1984; Gülich & Kotschi 1987; Candel 1994; Ciapuscio 2003; Gotti 2014). In particular, in this study, we investigate the linguistic strategies that are used by TEDsters to make science accessible to a wider audience, also including non-specialists. In this sense, our investigation is in line with research on the discourses of science popularization by several other authors (Jacobi 1986, 1999; Calsamiglia & van Dijk 2004; Caliendo 2012).

For the qualitative analysis, the selection of the linguistic structures characterizing the categories 1–3 above in our corpus was mainly made manually, via close reading of the video transcripts. Admittedly, the detection and categorization tasks were not straightforward, especially because of the unconventional structures of denominations, definitions, etc., which in TED Talks appear to be more informal than in scientific research journals or conferences.

The qualitative analysis was then integrated with quantitative results on 'cancer' collocations. In particular, for the investigation of concordances, this study adopts a corpus perspective (Sinclair 1991; Gledhill 2000). For the search of concordances, Adam Kilgarriff's *Sketch Engine* was used.[2] Sketch Engine offers the possibility to search concordances with a selected word or lemma in available corpora or in your own corpus. In the quantitative analysis, concordances with the word 'cancer' were searched in the TED_MED Corpus purposely created for this study and uploaded on the Sketch Engine website. Quantitative results allowed us to single out some collocational patterns which are especially used when explaining types of cancer, their possible origins, and potential cures to semi-experts (e.g. students) or to non-experts (patients).

3. Results and discussion

[2] Sketch Engine is a corpus manager and text analysis software developed by Lexical Computing Limited since 2003. The software is accessible from the website https://www.sketchengine.eu/.

Definitions abound in the TED_MED Corpus, with 70 instances identified. Descriptions are rather frequently used (47 instances), followed by denominations (33 instances). This data suggests that terminological denomination is less relevant in popularization discourse than the definitional or descriptive functions. TED experts indeed prefer using plainer vocabulary, familiar words or even figurative, but concrete, language to explain specialized concepts. They even do not need to reformulate, because their definitions or descriptions can be accessed without difficulty. Despite these quantitative results on category frequency in our corpus, we decided to start with the category of denomination, and then proceed with definition, and description, which represent progressive levels of complexity in the explanation of science.

3.1 Denomination

As regards the denominational function – i.e. providing a name or label for something, such as a disease or treatment – the research carried out in this study has shown that terminological denominations, though varied, are not very common in the TED Talks explored. Indeed, in popularization discourse, speakers generally avoid using specialized or technical terminology, and prefer using vocabulary that is more familiar.

Table 1. Examples of denomination in the TED_MED Corpus

Pattern	**Example**
(It's) a process/factor/type of cancer called X/"X"	cancer tumors require *a process called* angiogenesis skeletal muscle has *a factor in it called* "MyoD" It's *a* very, very deadly *type of cancer called* an angiosarcoma
This drug/protein called X	*this drug called* Cisplatin *this protein called* AMP kinase
There's something called X	*there's something called* the chemokine network
What is called "X" Y, which is called X, Y, called X,	There's none of *what is called* the "chemo head" mammary gland, *which is called* an "acinus", … one of the most potent neurostimulants that we know, *called* nicotine, … *in the language of our field, that's called* the undruggable genome
Y – so-called X This is in so-called X	And those Post-it notes involve this and other proteins of its class – *so-called* bromodomains That's a lot of people to have a lot of problems – and *this is even in so-called* nerve-sparing surgery
Also known as "X"	The second revolution is precision medicine, *also known as* "personalized medicine"
Y – specifically X – It was Y, the X	The hidden danger is heterocyclic amines – *specifically* phenomethylimidazopyridine, or PhIP – … It was a virus carrying a gene, *the* src oncogene

what we call X We call this/that X	And you can see this PET scan of a mouse – *what we call* a pet PET *We call this* antiangiogenic therapy in engineering, *we call that* one-to-a-thousand ratio
I call it "X"	It was the first cancer virus discovered, and when *I call it* "oncogene"
Mr./Dr. Y called this "X"	*Dr. Judah Folkman*, who was my mentor and who was the pioneer of the angiogenesis field, *once called this* "cancer without disease"
I'd like to tell you a story about Y called X	*I'd like to tell you today a story about* a very rare cancer *called* midline carcinoma, *about* the undruggable protein target that causes this cancer, *called* BRD4, and *about* a molecule developed at my lab at Dana-Farber Cancer Institute, *called* JQ1, which we affectionately named for Jun Qi, the chemist that made this molecule
– let's call it "X" –	Usually, doxorubicin – *let's call it* "dox" – is…

The linguistic strategies adopted by TED speakers range from impersonal forms (e.g. *so-called nerve-sparing surgery, also known as "personalized medicine"*) to the use of personal pronouns, both exclusive 'we' (e.g. *what <u>we</u> call a pet PET*, *<u>we</u> call that one-to-a-thousand ratio*) and 'I' (*<u>I</u> call it "oncogene"*). As for the frequency distribution of personal and impersonal forms, first person pronouns (*I* 771 occurrences, *we* 995 occurrences) appear to prevail in the narrative sections, whereas third person ones (*it* 662 occurrences, *they* 416 occurrences) especially occur in the informative or descriptive sections. The name of the expert coining the label is rarely specified (e.g. *<u>Dr. Judah Folkman</u> […] once called this "cancer without disease"*), and only when the terminology is neither widely used nor accepted by the disciplinary community.

The verb *to call* can also be used in the passive voice (e.g. *what <u>is called</u> the "chemo head"*), or in narratives (e.g. *I'd like to tell you today a story about a very rare cancer <u>called</u> midline carcinoma*).[3] A higher level of familiarity is created when the speaker abbreviates specialized vocabulary to ease the hearer's memorization or understanding (e.g. *doxorubicin – let's call it <u>"dox"</u>*). In traditional forms of specialized discourse, abbreviations, such as shortenings or acronyms, are used among specialists only when amply widespread and effortlessly accessible (Mattiello 2012).

Another strategy which is commonly adopted by TEDsters is juxtaposition – a process whereby a definition is followed by the specialized term naming it, with the two often separated by a pause. In our corpus, juxtaposition occurs 57 times, typically in denominations. In writing, the pause is graphically marked by a comma (e.g. *It was a virus carrying a gene, the src*

[3] By contrast, the participle *named* (occurring five times in the corpus) is not followed by specialized terms, but by personal names.

oncogene, *the deadly brain cancer, GBM* 'Glioblastoma'), or a long dash (e.g. *heterocyclic amines – specifically phenomethylimidazopyridine, or PhIP*).

The specialized field of the term is often highlighted (e.g. *in the language of our field, in engineering, the angiogenesis field*). This can be viewed as an attempt from the speaker's part to justify the non-expert's unawareness of specialized vocabulary. Remarkably, denomination generally occurs as anaphoric reference to the definition or description of the referred disease, process, cell, molecule, etc. This is a common practice among medical experts addressing non-experts: i.e. first, they explain the referent and, only afterwards, do they provide a scientific label to refer to it.

3.2 Definition

As regards the definitional function, terminological definition explaining the meaning of a word or phrase, often using periphrases or longer phrases, is not pervasive in specialized discourse, where the meaning of certain expressions is taken for granted within the disciplinary community. In specialized discourse, authors only employ definition when a new term is coined. By contrast, in popularization discourse, terminological definitions are more profuse and necessary, as demonstrated by the instances reported in Table 2, where the same referent (e.g. cancer) is differently and variously defined by using either more technical vocabulary or simpler lexis.

Table 2. Examples of definition in the TED_MED Corpus

Pattern	**Example**
X is P	*cancer is* a direct result to injury
Xs are P	*Cancer is* an interaction of a cell that no longer is under growth control with the environment
	Cancer is a disease that affects millions of people around the world every year
	cancer is a disease of altered gene expression. It is the uncontrolled regulation of genes
	Cancer is a very clever disease
	The genome is a composition of all the genetic information encoded by DNA in an organism
	angiogenesis is a hallmark of cancer
	the Tasmanian devil, and *it's* the world's largest carnivorous marsupial
	A marsupial is a mammal with a pouch
	It's the oldest mammalian-derived life form that we know of

	Sarcoma is a very rare form of cancer. *It's* the cancer of flesh and bones *Now, BRD4 is* an interesting protein *Now, TP53 is* the most important tumor suppressor gene. It is the most frequently turned off tumor suppressor gene in almost every kind of cancer *siRNA are* short sequences of genetic code that guide a cell to block a certain gene *chemokines are* essentially chemical attractants, and *they're* the stop and go signals for cancer We're developing *new medicines that are* basically cell-surface lawnmowers
X is a type of Y	*It's a* very, very deadly *type of cancer*
I've/'d heard of X as P X could be thought of as P	*I'd heard of cancer as* the most feared disease of our time stem cells, and *I'd heard of them as* the panacea of the future *So cancer could be thought of as* a strange, short-lived, self-destructive life form *We can think of these very aggressive forms of cancer as* kind of supervillains in a comic book
What X are – they are… What X are is when…	*what stem cells are – they're* these phenomenal cells that really have the ability to differentiate into any type of tissue *what metastases are is when* the tumor […] breaks off and travels through the blood stream
That's why X is P	*That's why cancer is* such a difficult disease to treat. It evolves
X is/are like…	*blood vessels are like highways* for the tumor cells
X – P – … X, P, involves...	what causes chemokines – *these signals saying, "Cancer, you can come to me"* – … antiangiogenic therapy – *here, an experimental drug for a glioma* – Chemotherapy, *one of the most effective ways used to treat cancer today,* involves giving patients really high doses of chemicals to try and kill off cancer cells
X, which is Xs, which are	*glioma, which is* a type of brain tumor *heterocyclic amines, which is* the immunogenic or carcinogenic compound *probiotic bacteria, which are* safe bacteria that have a health benefit
This is X: …	*This is a tumor:* dark, gray, ominous mass growing inside a brain
Xs – things that we know are P	Diabetes, cancer, Parkinson's, Alzheimer's, heart failure, lung failure – *things that we know are* debilitating diseases, for which there's relatively little that can be done
The thing about X is that it's P	*So, the thing about cancer is that it's* a disease of the aged
X is not just P X is not P… It is Y Not only can X be P, but it can also…	*cancer isn't just* a molecular defect, *it's something more* *Successful innovation is not* a single breakthrough. *It is not* a sprint. *It is* not an event for the solo runner. *Successful innovation is* a team sport, it's a relay race *not only can cancer be* a contagious disease, *but it can also* threaten an entire species with extinction
Y says that X is P	*the National Cancer Institute says that cancer is* a genetic disease
X, which means that P X, meaning P By X we mean	*nerve-sparing surgery, which means that* the surgeon is aware of the problem, and they are trying to avoid the nerves *"oncogene", meaning* "cancer gene"

	By genetic disease we mean that cancer is caused by oncogenes that are turned on in cancer and tumor suppressor genes that are turned off to cause cancer
P called X P: X	a very rare cancer *called midline carcinoma* the undruggable protein target that causes this cancer, *called BRD4* one of the fastest-growing diseases on Earth*: cancer*
making X P	*making microRNAs* a perfect, highly sensitive biomarker
I will not tell you that X is P, but X is Y	*Now, I will not tell you that src is* the most important oncogene. *I will not tell you that src is* the most frequently turned on oncogene in all of cancer. *But it was* the first oncogene
X. P	*Cancer.* Many of us have lost family, friends or loved ones to this horrible disease
"X". Some of you might know	*"cancer immune therapy". And some of you might even know* people who are benefiting from these very new ways of treating cancer

Most of these definitions display the typical form in which the specialized term is followed by its periphrasis (e.g. *cancer is a disease of altered gene expression*, *The genome is a composition of all the genetic information encoded by DNA in an organism*, *siRNA are short sequences of genetic code that guide a cell to block a certain gene*). Plainer forms of definition in the corpus involve the verb *to mean*, as in *"oncogene", meaning "cancer gene"* or *By genetic disease we mean that cancer is caused by oncogenes*. Another conventional form of definition entails an official subject, as in *the National Cancer Institute says that cancer is a genetic disease*.

In addition, popularization discourse such as TED also boasts a large number of more emphatic forms of definition (see Table 3 for an overview). For instance, the periphrasis can precede the specialized term, as in *the undruggable protein target that causes this cancer, called BRD4*, or in hyperbolic *one of the fastest-growing diseases on Earth: cancer*. Forms that are even more emphatic are introduced by demonstratives or pronouns: e.g., *this* in *This is a tumor: dark, gray, ominous mass growing inside a brain*, *what* in *what metastases are is when the tumor […] breaks off*, or relative *which* in *glioma, which is a type of brain tumor*. Negation can be similarly used to stress concepts, as in *cancer isn't just a molecular defect, it's something more*, or *not only can cancer be a contagious disease, but it can also threaten an entire species with extinction*.

In TED Talks' definitions, the use of specialized lexis is limited, in that definitions require clear language accessible to everybody. Periphrases include basic vocabulary (e.g. *Cancer is an interaction of a cell that no longer is under growth control with the environment*, *Sarcoma is a very rare form of cancer. It's the cancer of flesh and bones*). Some definitions use extremely simplistic language that can be understood by non-specialists without difficulty (e.g. *A marsupial is a mammal with a pouch*). However, simple vocabulary may result in a lower

degree of precision or ambiguity (*cancer is a direct result to injury*, cf. a bruise). The language that is used may even sound odd for defining specialized terminology: e.g., in *Now, BRD4 is an interesting protein*, the subjective adjective used by the speaker is uncommon for a definition.

It is worth noting that TED_MED language often involves figuration, such as metaphor, as a strategy to present novel and abstract ideas in terms of something familiar and concrete (Lakoff & Johnson 1980), or hyperbole, as a strategy to attract the audience's attention through exaggeration. Metaphors and similes have already been described in early work on popular science (see, e.g., Fahnestock 1986). The use of simile in TED Talks has been also explored (Scotto di Carlo 2014) and the present research confirms previous findings. Normally, the particles *as* or *like* mark the comparison: e.g., *So cancer could be thought of as a strange, short-lived, self-destructive life form*, *We can think of these very aggressive forms of cancer as kind of supervillains in a comic book*, and *blood vessels are like highways for the tumor cells*.

Moreover, to define diseases, processes, treatments, etc., TED speakers often recur to superlative or hyperbolic expressions (e.g. *the world's largest carnivorous marsupial*, *the oldest mammalian-derived life form that we know of*, *the most important tumor suppressor gene*). Sometimes, hyperbolic forms are necessary to define the devastating effects of cancer (e.g. *Cancer is a disease that affects millions of people around the world every year*), with no added exaggeration.

Metaphor is another figure of speech that TED speakers often use to provide a concrete definition of abstract concepts. For instance, in *angiogenesis is a hallmark of cancer*, the term *hallmark* metaphorically designates 'a signal, an indicator', and in *chemical attractants […] are the stop and go signals for cancer*, the expression *stop and go signals* alluding to traffic lights is similarly used to indicate 'what regulates cancer'. A more concrete expression is in *new medicines that are basically cell-surface lawnmowers*, in which the latter indicates 'what cuts the cells' surface'. In the TED video, the latter expression is accompanied by the photograph of a lawnmower, which clearly helps comprehension and memorization.

Another type of metaphor is personification, i.e. when inanimate objects or abstract notions are attributed human qualities: e.g., in *Cancer is a very clever disease*, cancer is said to possess a human characteristic (i.e. cleverness). The conceptual metaphor CANCER IS A HUMAN AGENT may be used to stress the strength and power of the illness, or may be connected with the fact that, as we will see, cancer is often viewed as an enemy to fight (see Section 3.4).

A very suggestive case of extended metaphor is instead in this passage: *Successful innovation is not a single breakthrough. It is not a sprint. It is not an event for the solo runner. Successful innovation is a team sport, it's a relay race*. The parallelism compares successful innovation with a team sport, where we win only if we race together and to the same aim. Informal definitions involving figuration and concrete language are clearly more effective and accessible than abstract terminological definitions commonly provided by specialists in scientific discourse.

Table 3 provides a clearer idea of the occurrences and percentages of the above-mentioned linguistic strategies of definition used in the overall corpus. Some of them (e.g. metaphor and hyperbole, or the use of demonstratives and negation) may also co-occur:

Table 3. Frequency of the different linguistic strategies of the definitions in the TED_MED Corpus

Linguistic Strategy	**Occurrences**	**Percentage**
Hyperbole	26	37.1%
Metaphor/Personification	22	31.4%
Periphrasis	13	18.6%
Demonstratives/Pronouns	12	17.1%
Negation	5	7.1%
Simile	3	4.3%
Juxtaposition	2	2.8%

All these unconventional forms of defining specialized terms, on the one hand, cause lack of technicality and precision, but, on the other, facilitate the audience's understanding and reduce the distance between expert speaker and non-expert hearer.

3.3 Description

As regards the descriptive function, the act of description is generally related to that of definition: i.e. when the object of analysis is depicted in a more detailed and extensive explanation. Therefore, descriptions are generally longer than mere definitions, in that they provide superfluous non-defining details, which are however necessary and useful to non-specialists. For reasons of space, only a representative sample of the descriptions identified in the TED_MED Corpus are reported in Table 4.

Table 4. Examples of description in the TED_MED Corpus

Pattern	**Example**
So, …	*So* a tumor expresses chemokine receptors, and another organ – a distant organ somewhere in the body – will have the corresponding chemokines, and the tumor will see these chemokines and migrate towards it
But…	*But* cancers don't start out like this, and in fact, cancers don't start out with a blood supply. They start out as small, microscopic nests of cells
And…	*And* this is actually how a cancer goes from being harmless, to being deadly. […] *And* once those vessels invade the cancer, it can expand, it can invade local tissues
Well, …	*Well,* if one has a mass or an abnormal blood value, you go to a doctor, they stick a needle in. The way we make the diagnosis today is by pattern recognition: Does it look normal? Does it look abnormal?
If… you know… But	*If* cancer was localized, we could likely remove it, or somehow – *you know*, it's contained. It's very contained. *But* once it starts moving throughout the body, that's when it becomes deadly
… piece of bad news But, there is a problem	*The first piece of bad news* with pancreatic cancer is that your pancreas is in the middle of your belly, literally *But, there is a problem*. siRNA works well inside the cell. But if it gets exposed to the enzymes that reside in our bloodstream or our tissues, it degrades within seconds *But* once in a while, *a cell might taste bad*. Hopefully, that's the cancer cell, and when those immune cells get the bad taste, they launch an all-out strike and kill those cells
An amazing fact is that … is quite remarkable	*An amazing fact is that*, given the right environment and the right nutrients, a cancer cell has the potential to go on growing forever But this dog cancer *is quite remarkable*, because it spread all around the world
Let me explain	*Let me explain*. Even a cancer as small as one centimeter in diameter harbors over a hundred million different cells
This happens because…	*This happens because* typically tumors are areas where the immune system has no access, and so bacteria find these tumors and use them as a safe haven to grow and thrive
X – D – X – D,	the number of dying cells – *those colored dots* – they're going down The cancer cells – *small, round and rapidly dividing*, grew these arms and extensions
Figurative description: Metaphor	We can think of a cell from an electrical perspective as if it's a *mini space station* Tumor cells can travel through the blood vessels. And you think, the more *highways* there are in a tissue, the more likely it is to get cancer or to get metastases cancer, like every cell in the body, places little molecular *bookmarks*, little *Post-it notes*, that remind the cell, "I'm cancer; I should keep growing."
Figurative description: Simile	It's a horrible term of trade. But what it means is that we've failed to identify a greasy pocket in these proteins, into which we, *like molecular locksmiths*, can fashion an active, small, organic molecule or drug substance

	But sentinel lymph node, the way that we do it today, is kind of *like having a road map* just to know where to go that pathologist is just *like looking at this plastic bottle*. This is a normal cell. This is a cancer cell

In the TED_MED Corpus, descriptions rarely occur in the form of juxtapositions (4 instances), as when adjectives are attributed to nouns in parenthetic phrases (e.g. *The cancer cells – small, round and rapidly dividing, grew…*). In general, there are indicators of descriptive parts in the talks, the most evident of which are discourse markers. In particular, TED speakers tend to introduce their descriptive parts by using *And* (e.g. *And this is actually how a cancer goes from being harmless, to being deadly*), *So* (e.g. *So a tumor expresses chemokine receptors…*), *But* (e.g. *But cancers don't start out like this*), or *Well* (e.g. *Well, if one has a mass or an abnormal blood value, you go to a doctor…*). The marker *But* generally introduces a contrast, or signals the presence of danger (e.g. *But once in a while, a cell might taste bad*).

Table 5 shows the types of discourse marker used in descriptions, ordered by frequency.

Table 5. Frequency of the discourse markers used in descriptions in the TED_MED Corpus

Discourse Marker	**Occurrences**	**Percentage**
And	27	30%
So	20	22.2%
But	13	14.4%
If	8	8.9%
And so/And you see	7	7.8%
Well	5	5.5%
Because	2	2.2%
In fact	2	2.2%
Now	2	2.2%
Then	2	2.2%
Yet	1	1.1%
You know	1	1.1%

TEDsters also tend to attract the attention of their audience by using formulaic language (e.g. *Let me explain, But, there is a problem, The first piece of bad news […] is…*) or subjective adjectives that may arouse the audience's interest (e.g. *An amazing fact is that, But this dog cancer is quite remarkable*).

Descriptions, like definitions, may be finally interspersed with the language of figuration. The use of simile is clearly marked by *like* (e.g. *like molecular locksmiths*, *like having a road map*). In one of the most effective simile – *like looking at this plastic bottle* – the speaker compares a cell to a 'plastic bottle': that is, a normal cell is like the intact bottle, whereas a cancer cell can be compared to a crumpled bottle. This strategy used to describe a cancer cell can be easily understood by anyone, including non-specialists. TED speakers indeed integrate all available media in their effective presentations (e.g. projected slides, photographs), or use concrete objects to support their talks.

Metaphorical language is also present in descriptions. For instance, blood vessels are described as *highways* where tumour cells can travel, or cancer is said to place *bookmarks* or *Post-it notes* on cells to remind them that they are cancerous. Finally, cancer cells are referred to as *mini space stations* when describing their uncontrolled growth. Thus, speakers employ concrete or familiar objects to describe the functioning of basic units in our organism. This facilitates the comprehension of non-specialists of even more abstract processes or notions.

3.4 'Cancer' collocates

This section is devoted to the quantitative analysis of the lemma *cancer* in the TED_MED Corpus. A word sketch of this lemma shows its frequency (727 or 9,815.03 per million words/pmw) as well as its collocational patterns. The concordances resulting from a Sketch Engine search provide the results reported in Table 6. Frequency of collocates is provided in brackets both as token frequency and as normalized (pmw) frequency.

Table 6. 'Cancer' concordances in the TED_MED Corpus

Collocation pattern	**Concordances**
MODIFIER + CANCER	breast (28/11.89), pancreatic (15/11.20), lung (16/11.19), ovarian (10/10.66), prostate (7/10.18), brain (7/10.09), devil (6/9.94), tasmanian (5/9.58), stomach (4/9.40), microscopic (4/9.39), rare (4/9.37), advanced (3/8.99), metastatic (3/8.98), cancer (5/8.63), triple-negative (2/8.42), colon (2/8.42), cervical (2/8.41), dog (2/8.41), contagious (2/8.41), deadly (2/8.38), bone (2/8.37), common (2/8.35), first (2/8.12), other (2/8.04), different (2/7.94)
CANCER + NOUN	cell (75/12.33), research (15/10.93), researcher (11/10.55), patient (10/10.27), doctor (8/10.10), institute (7/9.91), drug (7/9.64), *survivor* (4/9.16), dna (4/9.13), detection (4/9.12), death (3/8.72), detector (3/8.69), cancer (5/8.63), gene (3/8.60), treatment (3/8.56), therapy (3/8.56), diagnosis (2/8.18), prevention (2/8.17),

	surgeon (2/8.16), project (2/8.11), surgery (2/8.10), type (2/8.01), tissue (2/7.94), tumor (2/7.86), disease (2/7.82)
VERB + CANCER	treat (14/11.04), have (28/10.78), detect (9/10.57), *fight* (6/10.04), develop (5/9.65), be (26/9.52), catch (4/9.49), feed (4/9.47), include (4/9.45), understand (4/9.43), cause (4/9.37), go (4/9.36), get (5/9.26), spread (3/9.08), cure (3/9.04), find (3/8.63), see (3/8.60), excise (2/8.52), *defeat* (2/8.52), *starve* (2/8.52), *attack* (2/8.50), *invade* (2/8.49) *beat* (2/8.48), describe (2/8.47), *control* (2/8.46)
CANCER + VERB	be (61/10.96), have (9/9.97), come (5/9.96), grow (4/9.85), call (4/9.77), do (5/9.75), occur (3/9.61), strike (2/9.05), touch (2/9.04), arise (2/9.04), look (2/8.92), get (2/8.76), go (2/8.68)
CANCER AND/OR NOUN	cancer (28/12.49), disease (4/10.32), body (3/10.09), myeloma (2/9.62), woman (2/9.56), diabetes (2/9.52), chemotherapy (2/9.46), tissue (2/9.46) tumor (2/9.38), cell (2/9.19)
PREPOSITION + CANCER / CANCER + PREPOSITION	... of ‘cancer’ (78/10.73), ... with ‘cancer’ (27/3.71), ... for ‘cancer’ (24/3.30), ... in ‘cancer’ (17/2.34), ‘cancer’ in ... (12/1.65), ... to ‘cancer’ (10/1.38), ... on ‘cancer’ (10/1.38), ... *against ‘cancer’* (10/1.38), ... about ‘cancer’ (9/1.24), ... like ‘cancer’ (8/1.10), ... from ‘cancer’ (6/0.83), ‘cancer’ as ... (5/0.69), ‘cancer’ at ... (5/0.69), ... at ‘cancer’ (5/0.69), ‘cancer’ of ... (4/0.55), ‘cancer’ by ... (4/0.55), ... by ‘cancer’ (4/0.55), ‘cancer’ with ... (2/0.28), ... into ‘cancer’ (2/0.28)
CANCER IS A... (1.93) CANCER’S... (0.55)	disease (5/13.07) growth (2/13.41)

Table 6 shows the relevance of corpus-based analysis for the lemma *cancer* in the TED_MED Corpus. Some of the patterns reported in the table are not surprising, in that they form common noun phrases within the scientific community, such as *cancer cells* (75 occ.) or *breast cancer* (28 occ.). For instance, the pattern MODIFIER + CANCER refers to the various types (e.g. *microscopic*, *rare*, *advanced*, *metastatic*, *contagious*, *deadly*), or locations of the disease (e.g. *breast*, *pancreatic*, *lung*, *ovarian*, *prostate*, *brain*), whereas the pattern CANCER + NOUN is frequently represented by the collocations *cancer cell*, *cancer research*(*er*) or *doctor*, and *cancer patient*.

Among verbs collocating with the subject *cancer* (CANCER + VERB), the most frequent one is the verb *to be* (61 occ.). Expectedly, this collocation marks definitions, such as *cancer is a direct result to injury*, *cancer is a genetic disease*, or *cancer is an interaction of a cell that no longer is under growth control with the environment*. With *cancer* as object (VERB + CANCER), the most frequent verbs are *to have* (28 occ.) (e.g. *when you have advanced cancer*, *The patient has cancer*) and *to treat* (14 occ.) (e.g. *a new approach to treating cancer*, *I want to see the day when cancer is treated easily*, *we have revolutionized the way we treat cancer*).

However, the most remarkable results in this table have been highlighted in italics and consist of metaphorical collocations (Lakoff & Johnson 1980). For instance, *cancer survivor* (e.g. *I know there are some of you in the audience who are cancer survivors, or who are fighting cancer at this moment*) activates not only the literal meaning 'a person who continues to live after the illness', but also the figurative meaning 'person who has overcome a difficult experience', miraculously escaping death. Among verbs collocating with *cancer*, those shown in Figure 1 are used metaphorically.

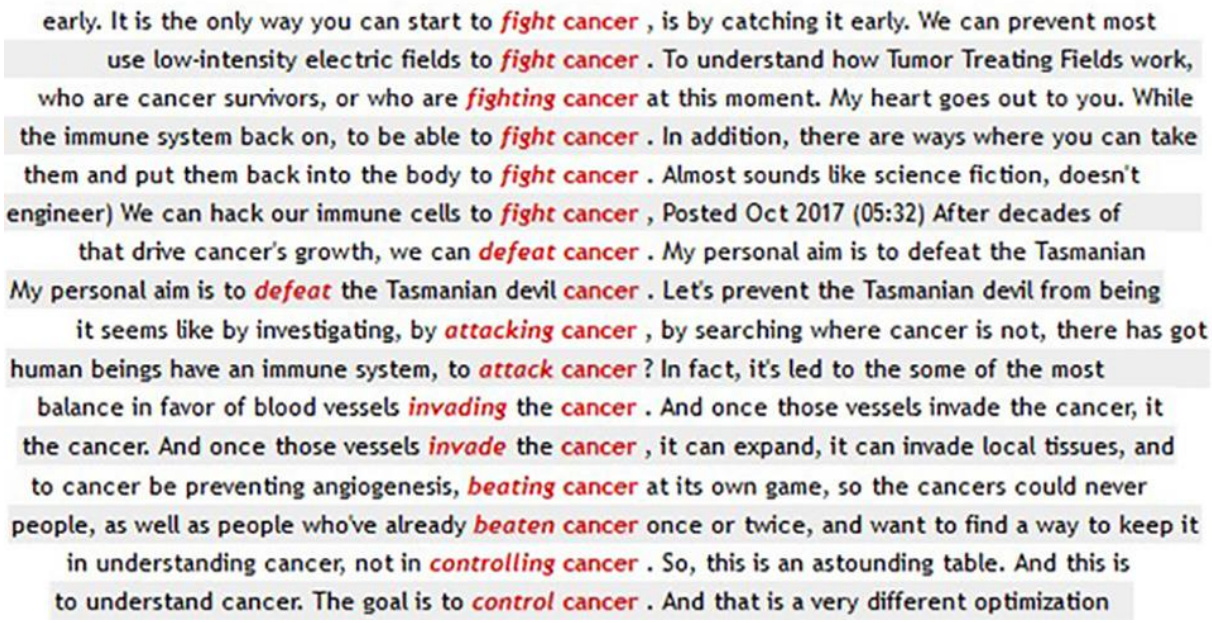

Figure 1. Metaphorical verbs collocating with 'cancer' in the TED_MED Corpus

The verbs in Figure 1 trigger an idea of *cancer* as an enemy to *attack*, *invade*, *fight*, and hopefully *control*, or even *defeat* (CANCER IS ENEMY) (cf. Semino et al. 2016). Like a real *fight*, in which people use their physical force to try to defeat an opponent, an antagonist, or an adversary, the fight against cancer is metaphorically viewed as the central aim of both doctors or researchers, on the one hand, and patients or survivors, on the other.

Another significant collocation activating the same metaphorical associations is NOUN + *against* + CANCER, as reported in Figure 2.

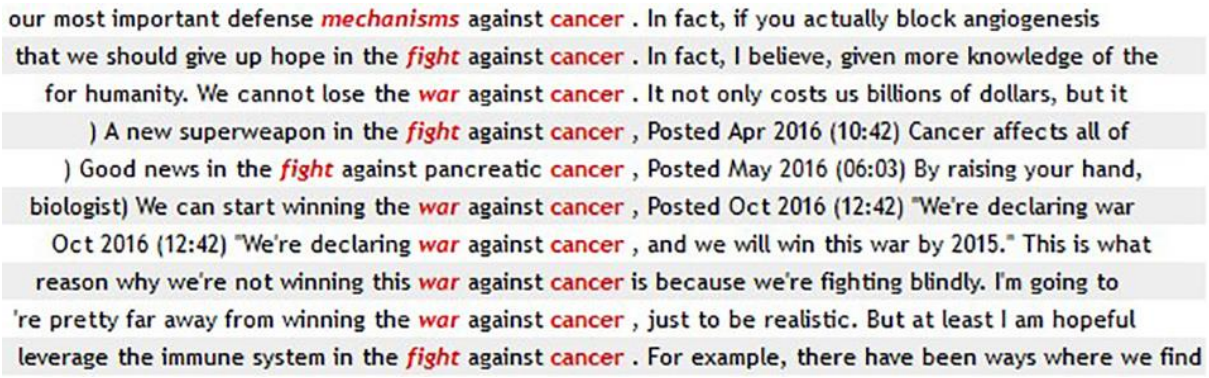

Figure 2. Collocations 'N + against + cancer' in the TED_MED Corpus

Figure 2 proves that TED speakers often depict their efforts to treat or cure *cancer* as a metaphorical *battle*, a *fight*, or even a *war* (CANCER TREATMENT IS WAR/FIGHT) (cf. Semino et al. 2016). The metaphor of a *war*/*fight against cancer* is supported by other suggestive collocations in Figure 2, such as *defense mechanisms* or *a new superweapon*. Other related phrases in the corpus include *going through such a huge struggle* and *weapons … available to fight the disease*, implying that, although the struggle is hard, we can defeat this disease. Still other sentences in the corpus contribute to extend this metaphor: e.g., *that does not mean that we should give up hope*, *we should be able to fight this war*, *we cannot lose the war*, *we're declaring war*, *we can start winning the war*, and *we will win this war* represent progressive stages of the warfare.

Thus, on the one hand, TED speakers depict cancer as an enemy to destroy:

(1) Well, your immune system might be able to see that cancer cell for what it really is: *something that needs to be destroyed*. (Carolyn Bertozzi, 2017, 09:57)

or against whom declare war:

(2) *We're declaring war against cancer*, and we will win this war. (Adam de la Zerda, 2016, 00:01)

On the other hand, they express their confidence, even faith that we are on the right path to defeat cancer:

(3) I bring you good news from the front lines of cancer research. The fact is, *we are starting to win the war on cancer*. (Jimmy Lin, 2017, 00:34)

(4) This is the beginning of the end. *We will win the war on cancer*. And to me, this is amazing news. (Jimmy Lin, 2017, 11:55)

This type of figurative use of language has a different function than the defining or describing functions explored above. While figurative language in TED Talks is often used to enhance the comprehensibility of the speeches among wider non-expert audiences (Scotto di Carlo 2014), comparing complex scientific notions to everyday life experiences, or alluding to them, WAR metaphors activate in the audience's mind the idea, or the hope, to fight cancer. This idea can be viewed as a further attempt by TEDsters to reach a broad heterogeneous audience, including not only expert cancer researcher or semi-expert medicine learners, but also ordinary people, who fight their daily battle against cancer, and who could be encouraged by the thought that we can win the battle, or even the entire war.

4. Conclusions

This study has explored the informative/explanatory functions of scientific TED Talks related to cancer topics in a small corpus consisting of thirty TED_MED talks delivered by experts between 2006 and 2017. From discourse and corpus-based analyses, scientific TED Talks has emerged as a popularization genre with potential didactic application, as well as a professional usefulness.

Results from the discourse-based analysis have demonstrated that the linguistic strategies used to explain science in TED Talks range from periphrasis and juxtaposition to metaphor and hyperbole. In particular, denomination occurs in various forms, both impersonal (*this is called X*) and personal (*we call this X*), and is often parenthetically given in juxtapositions (between long dashes or commas). Definition is usually in the traditional form *X is*, and may be marked either by figuration (from hyperbole to personification) or by emphatic forms displaying demonstratives and negation. Finally, description is introduced by a discourse marker (e.g. *And, So, But*) or by the author's subjective comment (e.g. *An amazing fact is that*). These verbal strategies can contribute to the overall process of disseminating scientific knowledge, in both semi- and non-expert contexts.

In semi-expert contexts, especially for foreign language learning in specialized contexts, TED Talks can have a large impact on semi-experts, such as students of medical or other scientific disciplines, because the language that TEDsters use is widely accessible. First,

terminological denominations of cancer-related terms are clearly discernible and they anaphorically follow their referents. Second, definitions and/or descriptions are generally characterised by simple (non-technical) vocabulary and concrete lexis. TED speakers tend to use familiar terms which are not typical of scientific discourse, but can enhance understanding of semi-experts, or even of non-specialist audiences. Moreover, the lexis they employ is often figurative. Non-literal language, such as simile and metaphor, can help unskilled learners to associate abstract concepts with everyday life experiences or familiar objects. This suggests that TED Talks can be used as educational material in academic contexts where ESP such as medical English is taught.

Moreover, the language that TEDsters use is effective. For instance, hyperbole stresses the seriousness of the disease (e.g. *I'd heard of cancer as the most feared disease of our time*) and personification even attributes human qualities to this disease (e.g. *Cancer is a very clever disease*), assigning more power to it. Simile and metaphor associate abstract domains to concrete – hence more accessible – domains, by direct comparison (BLOOD VESSELS ARE LIKE HIGHWAYS) or allusion (CANCER CELLS ARE CRUMPLED BOTTLES). In metaphor, the substitution of abstract concepts with familiar or concrete ones can ease understanding and contribute to disseminate science among non-experts.

In particular, results from the analysis of frequent collocations in the corpus has shown a prevalence of the metaphor CANCER IS ENEMY (to fight). For instance, the verb phrases *fight cancer*, *defeat cancer*, *beat cancer* or the noun phrases *fight*/*war against cancer* and *cancer survivor* reveal that TEDsters' attitude is supportive and reassuring, and at the same time encouraging and hopeful of a successful defeat of cancer.

In professional contexts where non-experts (i.e. patients) are involved, TED Talks on cancer-related issues can aid psycho-oncology experts to address the two major psychological dimensions of cancer: namely, the psychological responses of patients to cancer at all stages of the disease and that of their families and caretakers (Holland et al. 2010). Cancer sufferers and their caregivers are generally unaware of specialized terminology, but need effective language to be reassured and encouraged.

Our analysis has demonstrated that, to address their heterogeneous audiences, including non-experts such as cancer sufferers, TED speakers frequently adopt WAR metaphors (e.g. *you can start to fight cancer*, *we're declaring war against cancer*, *we will win this war*) as a means to instil hope and confidence, and inspire will to react against the illness. The language that psycho-oncology experts use for emotional support and communication with cancer sufferers should be carefully chosen, in that encouraging language can favour the patient's full recovery

and have a decisive influence in controlling symptoms. Further research in this area is definitely necessary, but our findings hitherto suggest the importance of using effective language that treats patients as 'warriors' (PATIENTS ARE WARRIORS) rather than as ill people.

Acknowledgements

This research has been financed by the Italian Ministry for the University (PRIN 2015 no. 2015TJ8ZAS).

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