SOCIAL SCIENCES, EMOTIONS AND ALGORITHMS

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Abstract

This paper aims to provide a framework for questioning and rethinking the relationship between theories and techniques which, in social sciences, allow us to study emotional phenomena through computational text analysis. While commenting on the drawbacks of a culture that takes for granted both the theories of emotions and the techniques for data analysis, a sort of reflective approach will be proposed which refers to linguistic and hermeneutic methods. Section (1) poses some questions concerning a specific technique, namely the sentiment analysis, and argues that, in this case, the phenomena under examination are related with the metaphorical way of thinking and communicating through which we humans construct both our social relationships and our cultural models. Section (2) focuses on theories concerning emotional phenomena and proposes a model for interpreting their reciprocal relationships; as a result, emotions expressed through texts are defined as cultural phenomena inherently context dependent. Section (3) discusses the use of certain tools – namely word embedding and lexicons for emotional text analysis – within the framework of a theory of technique which refers to a sort of hermeneutical paradigm which strictly connects the interpretation work with the specific social contexts where the emotional phenomena originate.

Introduction

This paper is about the use of techniques and theories which – in social sciences – allow us to study *emotional phenomena* through computational text analysis. However here my aim is not that of navigating and mapping the variegated 'galaxy' of scientific contributions in this field as has been attempted by others (e.g. Meiselman, 2016). Rather, by using a few examples, I will focus on some key issues concerning the very relationship between theories and techniques. In doing so I also wish to highlight that nowadays a sort of *primacy of technique* - which focuses on the power of software tools and which transforms emotions into sets of various features which appear to be easily measurable - seems to blur the fact that for many social scientists the 'reality' of emotions is still like that of the *platypus* which Eco (1997)[1] referred to, i.e. a strange entity which challenges both our classification systems and our theories.

In my opinion such a contrast between the *weakness* of theories and *strength* of techniques for data analysis gives rise to phenomena like the following:

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[1] In this book Eco comments on the problems faced by scientists - at the end of the eighteenth century - when attempting to classify a 'strange' animal, which was semi-aquatic, egg-laying and mammal.

- when speaking of theories, some keywords (e.g. 'feeling', 'sentiment', 'affect', 'emotion', 'mood' etc.) whose meaning should be legitimately questioned may risk being used to mark the boundaries between different research communities (Kuhn, 1962) and being used according to some sort of paradigm which establishes that emotional 'things' are 'real' only within the theory we refer to;

- when speaking of techniques, while focusing on the 'correct' procedure and on the 'best' algorithm, we may lose sight of the importance of the cultural and social context where we are using such techniques, where the outcomes of our research will be delivered, and were the very cultural nature of emotions originated.

In other words, I argue that sometimes – within research traditions which are somehow monolingual and hyperspecialized – theories may work according to the logic of *myths* and techniques may work according to the logic of *rituals.* And, as myths and rituals tend to reinforce each other, it may be useful – in order to counteract this risk - to share a sort of reflective and multi-perspective approach which helps us to cross the borders between scientific disciplines and research communities. And, when crossing such borders, we have to rely on hermeneutical skills and a sort of *linguistic hospitality* (Ricoeur, 2004) which help us to interpret and translate a semiotic system into another and vice versa (Eco, 2001).

Having said that, here is how this paper is organized:

- Section 1 poses some questions concerning a specific *technique*, namely the sentiment analysis*,* and – by using some linguistic models – argues that, in this case, the phenomena under examination are related with the metaphorical way of thinking;
- Section 2 focuses on *theories* concerning emotional phenomena and proposes a contextual model for interpreting their reciprocal relationships. Also in this case the metaphorical way of thinking is a key issue;
- Section 3 discusses the use of some tools – namely word embedding and lexicons for emotional text analysis – within the framework of a *theory of technique* which refers to a sort of hermeneutical paradigm.

1 Sentiment Analysis and Emotional Paradigms

Automated sentiment analysis is a technique increasingly popular in market research and social sciences. Typically it involves the following steps:

a) collect a dataset which includes thousands of short documents like tweets, Facebook comments, movie reviews, product evaluations etc.;
b) use algorithms for NLP (i.e. Natural Language Processing), precompiled sentiment lexicons and/or algorithms for machine learning and automated classification;
c) determine the valence or polarity (i.e. 'positive', 'negative' or 'neutral') of every piece of text.

Here I am not interested in commenting on the various challenges and on the best practices of such a technique[2]. Neither am I interested in commenting on what it really measures and how. Thus I will not go deeper into the technical details of sentiment analysis procedures. Moreover, regarding the meanings and the definitions of keywords like 'sentiment', 'valence', 'polarity', 'affect', 'emotion' and so on – at least for the moment – I will rely on the reader's so-called common sense.

In this section my principal aim is to use the typical results provided by the sentiment analysis (i.e. its classification results) as an elementary example which illustrates how emotions are translated into texts. More specifically I will argue that some results of the sentiment analysis may be used to better understand how emotions shape language and cultural models. In technical language, I will argue that some results of the sentiment analysis may be used to better understand how emotional paradigms determine verbal syntagms.

To this purpose I will use a few pieces of text and a simple model.

The pieces of text, which have been previously classified as 'positive' or 'negative', are the following[3]:

|	'POSITIVE' TEXTS	'NEGATIVE' TEXTS
Line 1	@XY I love the service and cheap upgrades XY provides! One of the best airlines ever! good food, good seats, amazing thanks!	@XY this is got to be the worst service I've ever seen with an airline. 3 Cancelled Flightled flights. Rude employees. Currently flight delayed
Line 2	hahaha integrated data usage manager... in sucha brilliant way, sleek design, superb and I'm only watching videos LOL #XY	@XY the upgrade just slows down my phone so much, it's stuck half the time. uch. thankfully no other damage. sucks for you :(
Line 3	Perfect weather + best friend + donuts XY and ice cream = perfection	Is never going to eat XY again! They have ruined the humble junior burger with pepper and now it tastes like crap

Table 1

The simple model is the following:
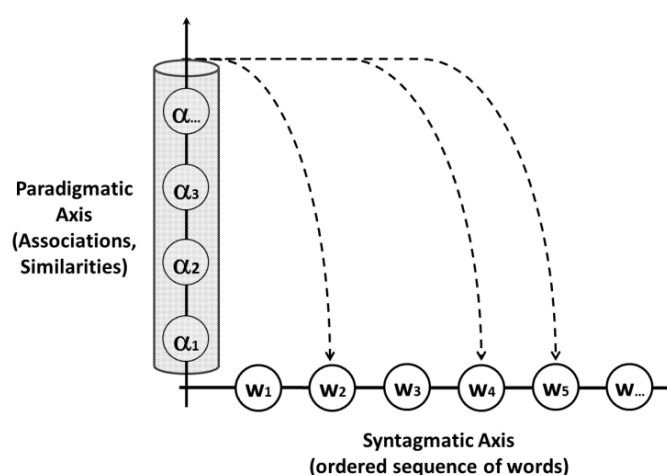
Fig. 1

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[2] See Mohammad, S.M. (2016)
[3] The pair of texts in each line comes from the same pre-classified dataset. For privacy reasons, company names have been replaced with 'XY'.

The reading keys are as follows:
-for each piece of text, the greyed cylinder refers to the feelings experienced by the writer;
-for each piece of text, the various 'w$_i$' refer to the words numbered according to their sequence (i.e. syntagm);
-the cylinder which 'contains' the associated 'α_j' feelings is greyed because, unlike the words, it is assumed to be like a nebulous whole which cannot be easily segmented;
-the arrows which connect the two axes do not refer to one-to-one correspondences, rather they refer to the dynamic of a generative process.

Some decades ago structural linguists were suggesting that both the paradigm and the syntagm may be well segmented and that 'at each point of the sentence' it would be possible to replace a specific word with another word belonging to the same paradigm. Accordingly some of them (Dubois et al., 1973) analysed a sentence like 'The small cat is died' ('Le petit chat est mort') as follows:
'The', which may be replaced with 'This' or 'My' or 'Your' etc.
'small', which may be replaced with 'big' or 'old' or 'fat' etc.
Etc. etc.

To summarize the above structuralist (and 'orthodox') view, which refers to language as a *closed system* of distinct and interconnected units, I have arranged the following diagram, where arrows refer to the sequential choices made by the supposed writer (or reader):
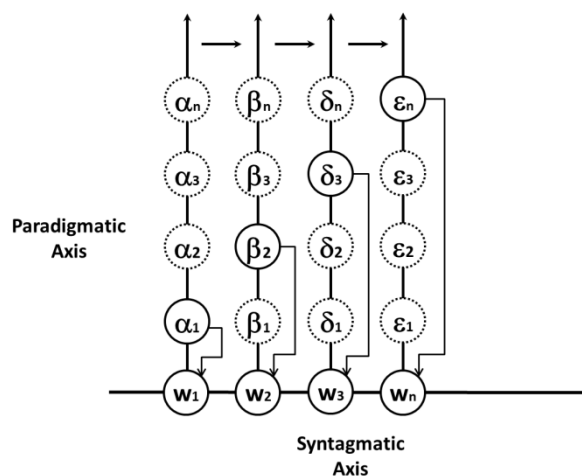

Fig. 2

Actually R. Jakobson, i.e. the linguist who - more than any other – contributed to the theory of 'the twofold character of language', argued that it can refer to two distinct *processes* (or devices), namely to the 'selection' (i.e. paradigm) and to the 'combination' (i.e. syntagm). He also argued that, while the syntagm is the dimension of contiguity (i.e. one word "near to" the other) and of *metonymy*, the paradigm is the dimension of the similarity and of *metaphor*[4] (i.e. one word "in place of" the other). Moreover he argued that 'A competition between both devices, metonymic and metaphoric, is manifest in *any symbolic process, either intrapersonal or social*' (Jakobson R., Halle M., 1956, p. 80; emphasis added). And, I would add, as any 'intrapersonal' symbolic process is mediated through culture it is also 'social'.

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[4] "Similarity connects a metaphorical term with the term for which it is substituted" (Jakobson,1956, p. 81).

It is worth noting that, when using the word *metaphor*, we may refer to two different (and also similar) phenomena:
a) a figure of language (i.e. a *trope*) like 'Busy old fool, unruly sun' (by the poet John Donne);
b) a *way of thinking* through similarities which is also common in science (e.g. think of the mind like a computer) and which – in science - can give birth to new models (Black, 1962; Hesse, 1980).

Accordingly the main difference between the two models depicted above concerns the fact that in Fig 1 the paradigm – which is the 'place' of metaphor as a way of thinking – is assumed to have a *generative function*; moreover in Fig 1 it is assumed that changes on the paradigmatic axis are not synchronic with changes on the syntagmatic axis. To be more specific, in Fig 1 it is assumed that the 'synchronic' experience of feelings cannot be segmented according to the 'diachronic' logic of the syntagmatic axis. In other word, in Fig 1 it is assumed that the same set of feelings can generate two or more different sequences of words, as well as two or more different utterances.

Coming back to the above table 1 where some pieces of text are classified either as 'positive' or as 'negative', we may argue that the two tweets in line '1' refer to two very different 'feelings' experienced by two customers of the airline services:
-in the 'positive' case, syntagms like 'I love the service', 'good food, good seats' refer to a paradigmatic experience which could be also illustrated with a *happy emoticon* or with a 'thumb up';
-in the 'negative' case, syntagms like 'the worst service I've ever seen' and 'Rude employees' refer to a paradigmatic experience which could be also illustrated with a *very angry emoticon* or with a 'thumb down'.
The same exercise could be repeated by commenting on each record of the above Table 1.

The fact that, in terms of its *emotional meaning*, a piece of text can be *replaced* with an emoticon indicates that – within such a piece of text – the various syntagms which refer to the same valenced feelings (e.g. 'worse service' and 'rude employees') are treated as very similar to each other and that they may also be *replaced* with each other. Accordingly we may argue that through this resemblance/replacement logic there is a metaphorical way of thinking at play. Moreover we may add that the classification of emotional expressions either as 'positive' or as 'negative' refers to the '*Like/Dislike*' culture which nowadays shapes our ways of communicating and which – in some ways – determine various types of socio-political polarizations. In other words, it seems to me that -within such a culture - the bipolar structure of the sentiment analysis actually reinforces the bipolar way through which people express their feelings.

Regarding the term *polarity* it is interesting to observe that its use is quite similar in sentiment analysis (i.e. 'negative' vs 'positive') and in some techniques of data analysis which perform linear dimensionality reduction[5]. However, when performing any dimensionality reduction 'negative' and 'positive' poles do not refer to valenced feelings, but rather to the geometrical orientation of axes (e.g. 'negative' on the left and 'positive' on the right).

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[5] For example: Principal Component Analysis (PCA), Singular Value Decomposition (SVD), Correspondence Analysis (CA).

To illustrate the above point I will propose a simplified report of a short experiment.

After importing a dataset including thousands of movie reviews pre-classified either as 'positive' or as 'negative' (i.e. two corpus subsets), I built a co-occurrence matrix including 100 key-terms[6] which - according to the Chi-square test – were the most representative of both corpus subsets (i.e. 50 + 50). Then I performed a PCA (i.e. Principal Component Analysis) of such a matrix and - as a result - I obtained a datable with as many rows as the analysed key-terms and as many columns as the dimensions automatically extracted by the software I used. In other words I obtained a sort of 'word embedding', i.e. a set of dense vectors[7].

Interestingly, but only by chance, in this case the geometrical directions of the first axis (i.e. the first principal component) matches with the intuitive meaning of the sentiment analysis categories (i.e. '-' = 'negative' feelings and '+' = 'positive' feelings). The below picture illustrates the positions - on the first axis - of the top ten key-terms for each polarity.
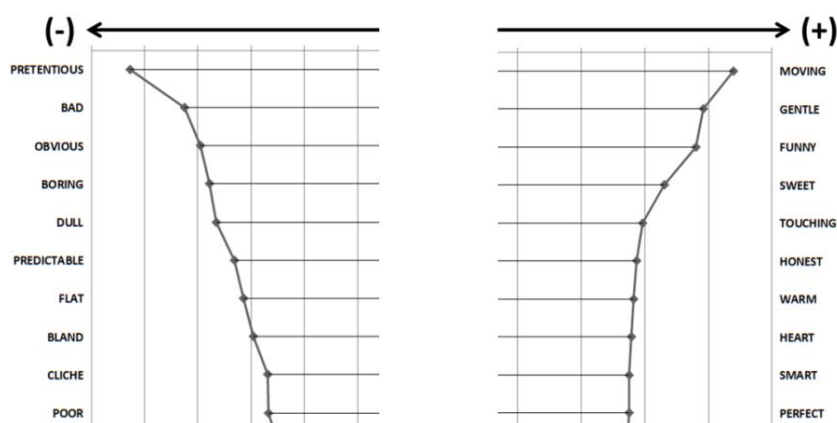

Fig. 2

Without entering into details[8], by using PCA and other similar methods, the co-occurrence matrix depicted in Fig 3 (see picture below) is 'transformed' into the matrix in Fig 4. That means that, while in Fig 3 the word vectors (i.e. rows and columns) are arranged in alphabetical order, in Fig 4 they are ordered according to their first component. As a result the two word vectors referring to 'pretentious' and 'moving' - either as columns or as rows – are on the opposite sides (i.e. 'polarities') of the matrix in Fig 4.

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[6] Because of the lemmatization, each key-term included two or more words (e.g. the key-term 'movie' included both 'movie' and 'movies').

[7] For a detailed description, see section 3 below.

[8] The bi-polarization obtained by using the PCA method results from the following steps: (a) build a normalized square matrix where each 'i' word is represented by a vector (i.e. a set of 'features') consisting of numbers which refer to its co-occurrences with all the 'n' words; (b) build a covariance (or correlation) matrix of the above word vectors; (c) perform a diagonalization of the covariance matrix through eigen-decomposition.
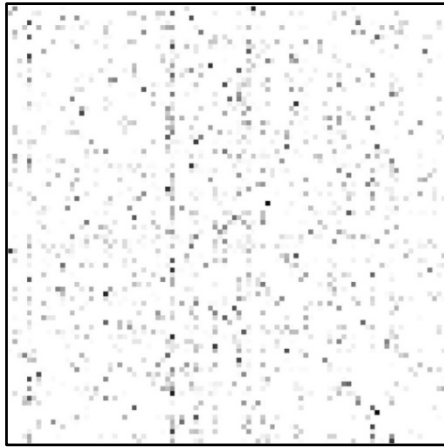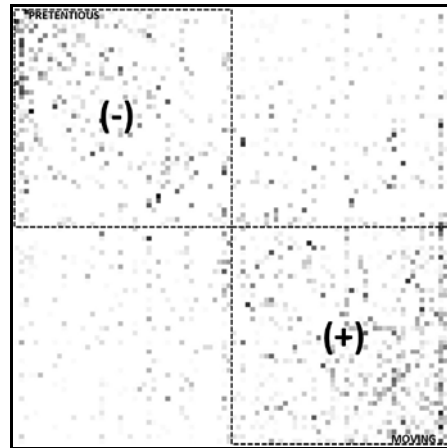
| Fig. 3 | Fig. 4 |

The reason why, in this case, we have only two quadrants which – in Fig 4 – are in the opposite sides of the diagonal is that in the co-occurrence matrix only two groups of words were presents: those marked as 'negative' (-) and those marked as 'positive' (+). However the fact that *within* each one of these two distinct quadrants the word vectors are very similar to each other and that *between* them (i.e. '-' vs '+') the differences are very marked is a phenomenon which cannot be interpreted as just a sort of *algorithm effect* (e.g. a correlation effect). In fact the algorithm used has simply highlighted 'something' which was already present in the data structure, and this 'something' may be interpreted as a sort of *generalization effect* which originates from the high valenced 'emotional' paradigms which we name 'positive' and 'negative'. In other words, when the subjects are confronted with something which – according to their experience and their culture - is symbolized as very 'bad' (or very 'good') they tend to produce comments (i.e. syntagmatic units) which include words belonging to the lexicon which their culture provides for this eventuality. As a consequence, the features of the 'word vectors' end up being very similar *within* each one of the two categories and very different *between* them (i.e. 'positive' vs 'negative').

There are various reasons why sentiment analysis is quite a 'rudimentary' way of analysing human emotions through automated text analysis. Among these, I will quote the following:
1-the dataset (i.e. the corpus to be analysed) usually consists of short pieces of texts put together by the researcher and which do not relate to each other like sentences in a discourse or a dialog;
2-usually the analysis units (i.e. the records collected in the dataset) are assumed to be 'objects' or sets of 'features' which will just be classified and counted like the voting papers in a general election;
3-without considering the so-called metadata - e.g. information concerning 'who', 'when' and 'where' which can all be included in the dataset – the only reference to the context which is taken into consideration is the *aboutness* of the various evaluations, e.g. the 'features' of products and/or services which trigger negative/positive comments.

Undoubtedly, in market research as well as in political science and other disciplines, a sentiment-based segmentation which produces a dichotomous categorical variable like that of gender (i.e. 'male' and 'female') may also be used for exploring 'why' and 'about what' people make negative/positive comments. For example, by selecting one value of this variable, it is possible to perform a topic (or thematic) analysis of the a sub-corpus which includes only 'negative' comments and to explore the various 'negative' topics (or themes) one after the

other. And usually, when doing this type of in-depth analysis, we deal with outputs (i.e. tables and charts) which are multi-semiotic objects and which can be interpreted through abductive inferences and isotopy[9] assumptions (Lancia, 2007; pp. 26-39).

Interpretation issues may arise also when questioning the basic structure of the sentimental analysis dichotomy (i.e. 'negative' vs 'positive'). For example the sentences in Table 2 (see below) which refer to different semantic oppositions concerning 'food', 'family' and 'country', may be also interpreted as all referring to something concerning 'borders' and the in-side/out-side dichotomy. In fact, starting from our childhood, we in-gest food that we consider 'good' (i.e. 'positive') and we protect our body – which has borders – from 'enemies' like viruses and other pathogens. The same applies to family ('Does my daughter have bad friends?') and to countries, including the Brexit effect on the latest UK general elections (December 2019), the results of which show how – for example – people from England and from Scotland have re-consolidated their differences on either side of their 'border'.

The question is: are my comments above just metaphors or rather is it the very dynamic of emotions which works like a metaphor?

	'POSITIVE' TEXTS	'NEGATIVE' TEXTS
Line 1	XY is a very good restaurant. The food is delicious	XY is the worse restaurant I entered. They serve only junk food
Line 2	We love each other, we are friends and we are family	You bastards are no longer members of this family
Line 3	In my country I have lots of friends who are immigrants and they are good people	Immigrant youth are more delinquent than native-born adolescents

Table 2

2 Emotions and the Contexts of their Definition

From an epistemological point of view, it is quite interesting to observe that the job of defining and classifying the various theories of emotions is easier than the job of defining and classifying the emotions themselves. However this is not surprising; in fact, while both theories and classifying systems are structured like semiotic objects which can be managed through analytical language, emotions are dynamic phenomena which cannot be easily modelled.

Regarding the various theories of emotions, in the last few years the psychologist and neuroscientist L.F. Barrett (2016,2017a,2017b) has proposed the hypothesis that they can be grouped into two approaches - namely the *essentialist* and the *constructionist* - and she has also argued that the former (i.e. essentialist) 'does not fit the majority of data' (Barrett, 2016, p. 39).

According to the this author, the essentialist approach – which she also names 'the classical view' – is characterized by the believe that the various emotions have a specific fingerprint and they are 'built-in' in some places (or connections) of our brain/mind and that, when their 'mechanism' is triggered, each one of them use specific expressions (e.g. body language)

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[9] The word 'isotopy' comes from the Greek language: 'iso' = 'equal' or 'similar'; 'topos' = 'place'.

which are similar in different cultures. On the contrary, the constructionist approach – also named 'the new narrative framework' – is characterized by the belief that the various emotions are 'built' and created as 'interpretations' of affective changes in our body and our brain. Moreover, according to the constructionist approach the ways emotions are expressed vary through cultures and, because there is not a one-to-one correspondence between 'dedicated' mechanisms and expressions, the interpretation of these expressions can be often misleading.

This is not the place to summarize and discuss the various findings and arguments proposed by L.F. Barrett. Thus I will limit myself on making a couple of comments:

a) when confronted with a dichotomic category for analysing socio-cultural phenomena, which actually splits things in opposite groups, for one reason or another – and probably for emotional motives – we tend to take sides with one of the opposite views. To be more specific, when reading Barrett's writings, even if I do not agree with some of her statements, I tend to classify my view as *constructionist'*.

b) I have been intrigued by the way the above psychologist and neuroscientist transforms her scientific findings concerning the theory of emotions into tools for 'mastering' the emotions themselves. In fact, repeatedly, she argues that we are (or we can be) the 'architects' of our experiences and that we – as *individuals* – can master our emotions. Actually a chapter of her recent book is entitled 'Mastering Your Emotions' (Barrett, 2017a, pp. 175-198) and there also a couple of TED talks available on the Internet in which she try to 'teach' wisdom of some kind. No problem about that. However it is important to observe that this kind of transformation of a scientific theory into a social practise reveals that the *constructionist* view of the author focuses on the constructionist skills of our *individual* brains/minds and that the way how emotions are built through social and contextual relationships – as well as the way that they 'frame' such relationships - is not taken into consideration.

Actually, when using the essentialist/constructionist dichotomy for understanding how automated textual analysis is used for classifying and/or for exploring 'things' like feelings, sentiments, affects, emotions etc., we can find out that nowadays such a constructed dichotomy (i.e. essentialism vs constructionism) is not as much about scientific knowledge as it is about marketing. More specifically I would like to suggest that the reasons why nowadays 'emotion analytics' and big companies (e.g. Google, Facebook, Amazon, Netflix etc.) are on the 'essentialist' side are quite straightforward: they need to deliver 'simple' answers by analysing 'big data' and by using 'fast' algorithms. The point is that this way they are also spreading a culture of *technique without a theory* which is affecting the culture of social scientists too. I will try to elaborate on the relationship between theory and technique in the next section of this paper. For now I would like to came back to some definition issues and – in particular – I am interested in connecting *emotions* both with *texts* and their *contexts*.

As it is well known, the main function of cultural tools which we name 'definitions' is to help us in making clear distinctions in scientific discourse; thus, in order to make a few distinctions that are necessary for the purpose of my argument, firstly I have decided to refer to a well-known model proposed by the psychologist and linguist Karl Ludwig Bühler in 1934 (see image below).
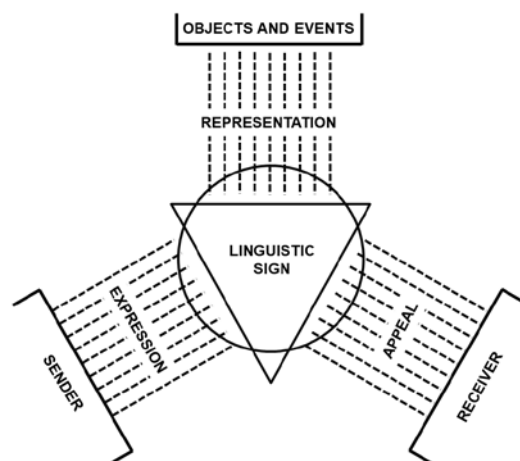
Fig. 5 Bühler's Organon-Model (Bühler, 1934)[10]

In the author's words, here is how the above model should be interpreted:

"The circle in the middle symbolizes the concrete acoustic phenomenon. Three variable factors in it go to give it the rank of a sign in three different manners... It is a **symbol** by virtue of its coordination to objects and states of affairs, a **symptom** by virtue of its dependence on the sender, whose inner states it expresses, and a **signal** by virtue of its appeal to the hearer, whose inner or outer behaviour it directs as do other communicative signs. This organon model, with its three largely independently variable semantic relations, was first expounded completely in my paper on the sentence (Bühler, 1918), which begins with the words: "What human language does is threefold: profession, triggering and representation." Today I prefer the terms **expression** (Ausdruck), **appeal** (Appell) and **representation**, because among language theorists 'expression' is increasingly taking on the precise meaning demanded here, and because the Latin word 'appellare' (English: appeal, German: more or less 'ansprechen') is apt for the second; as everyone knows today there is sex appeal, and in addition to that speech appeal seems to me to be just as palpable a fact. At any rate, whoever has realized that language has a significative nature must take care that his concepts are homogeneous; all three basic concepts must be semantic concepts." (Bühler, 1934, p.35; author's emphasis).

Thus, according to this model, we may say that emotions are 'something' which can be expressed by the 'sender' and triggered in the 'receiver' (see the 'appeal' function). Interestingly, just three pages before proposing the above model, Bühler comments on another of his diagrams in which the 'sender' is named as '*psychophysical system α'* and the 'receiver' is named as '*psychophysical system β'* (Bühler, 1934, p.32). Accordingly, by using an expression which nowadays is quite popular, we may say that – for the author – both the 'receiver' and the 'sender' are *embodied minds* (i.e. embodied individuals).

If this is the case, without considering the semiotic nature of 'sign' and differences in contexts, we may argue that – as both sender and receiver are psychophysical systems - there is no difference in meaning between the following statements:
1-Mary (sender) expresses some 'emotions' which trigger some 'emotions' in Anthony (receiver);
2-Mary (sender) expresses some 'feelings' which trigger some 'feelings' in Anthony (receiver).

In other words, when thinking/talking about emotions as 'embodied' experiences, we may argue that such emotions are 'feelings' to which the following definition proposed by the neuroscientist Antonio Damasio (2018) may apply:

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[10] The original diagram is slightly different because it was created without using any software tool and because the writing was in German.

"Feelings are the subjective experiences of the state of life – that is homeostasis – in all creatures endowed with a mind and a conscious point of view. We can think of feelings as mental deputies of homeostasis (p. 25)… Feelings are, through and through, *simultaneously and interactingly*, phenomena of *both* bodies and nervous systems (p. 125)"

According to Damasio, the main reason why feelings can be considered 'mental deputies of homeostasis' is that they 'are necessarily *valenced*; that is, they are good or bad, positive or negative, appetitive or aversive, pleasurable or painful, agreeable or disagreeable' (p. 158).

To take a step forward I will refer to a book published by the semiologist Roland Barthes in 1977. In this book ('*A Lover's Discourse: Fragments'*) about eighty 'figures' (i.e. 'scenes of language') are reported and commented where *'it is a lover who speaks and who says'* something about his/her different emotions related to love, and where –according to the author – 'Everything follows from this principle: that the lover is not to be reduced to a simple symptomal subject' (p.3).

Even though in recent times the distinction between biology (i.e. a 'natural' science) and semiotics (i.e. a 'social' science) has be questioned in many ways, I argue that *emotions expressed through texts* are like the 'figures' which Barthes refers to and that they are different from the 'feelings' analysed by Damasio. To this purpose I will use my revised version of the Bühler's Organon-Model (see image below).
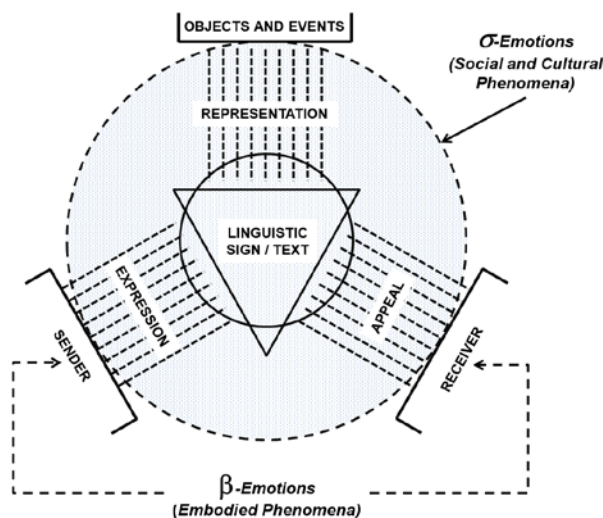

Fig. 6

In the above picture the big circle which encompasses all 'semantic relations' [11] theorized by Bühler, and which includes signs and texts, refers to the *semiotic mediations*[12] which characterize all social and cultural phenomena.

While focusing on emotions, Fig 6 allows us to make a clear distinction between two kinds of phenomena which can however be related:

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[11] For the purpose of my argument it is not relevant to argue that the relations which Bühler refers to are not just 'semantic'.

[12] To my knowledge, the construct of 'semiotic mediation' was firstly proposed by the psychologist L.S. Vygotsky (1930a, 1930b, 1934).

σ-*Emotions*, i.e. social and cultural phenomena like the stock-market 'panic' which followed the 2007-2008 financial crisis and - also - made such a crisis more severe;

β-*Emotions*, i.e. embodied phenomena like 'anxiety' and 'fear' experienced by lots of individuals during the above financial crisis.

To this purpose it is worth remembering a famous phrase of the Gestalt psychologist Kurt Koffka: 'The whole is other than the sum of the parts' (1935, p. 176). In fact, just by summing up lots of β-*Emotions* we cannot obtain a σ-*Emotion*; however, by sharing β-*Emotions* and by *transforming* them into 'signs' we can obtain something like the 'social representation' theorized by Durkheim (1898) or the 'mimetic crisis' theorized by Girard (1972, 1978), i.e. constructs that some economists have used for proposing a new paradigm within their discipline and for interpreting phenomena like the economic bubbles (Aglietta & Orléan, 1982, 1998, 2002; Orléan 2011).

Regarding the *dynamic* processes which transform β-*Emotions* into σ-*Emotions* and vice versa, it seems to me that it may be useful to refer to the research paradigm set up by Sigmund Freud, i.e. the psychoanalysis. To this purpose I will quote a key passage of the philosopher Paul Ricoeur.

"Freud's writings present themselves as a mixed or even ambiguous discourse, which at times states conflicts of force subject to an **energetics**, at times relations of meaning subject to a **hermeneutics** … Freud's originality consists in shifting the **point of coincidence** of meaning and force back to the unconscious itself. He presupposes this coincidence as making possible all the 'transformations' and 'translations' of the unconscious into the conscious. In spite of the barrier that separates the systems, they must be assumed to have a common structure whereby the conscious and the unconscious are equally psychical. That common structure is precisely the function of *Reprasentanz*. This function is what lets us 'interpolate' unconscious acts into the text of conscious acts" (Ricoeur, 1965, pp. 65, 135; emphasis added). [13]

Interestingly, while commenting on 'the most creative and fundamental of Freud's discoveries' – that is the discovery of the characteristics of the Unconscious system – the psychoanalyst Ignacio Matte Blanco (1975) ended up by stating that to psychoanalysis 'emotion and the unconscious are basically the same thing' (p. 274), in the sense that the two words refer to the same (i.e. identical) 'reality'.

Accordingly, we may assume that - within the framework of the psychoanalytic discourse and by considering the 'point of coincidence' which Ricoeur referred to – emotions are neither just biological phenomena (see the above β-*Emotions*) nor just socio-cultural phenomena (see the above σ-*Emotions*), but they are also psychological phenomena which we may name ψ-*Emotions*[14].

While summarizing the main distinctions made so far, the below diagram (Fig 7) is intended to suggest that the relationships between β-*Emotions* and σ-*Emotions* are always mediated

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[13] Something similar has been argued by Derrida (1967) when he wrote "The unconscious text is already a weave of pure traces, differences in which meaning and force are united… Here energy cannot be reduced; it does not limit meaning, but rather produces it."(211,213).

[14] In my opinion, one of the main differences between β-Emotions and ψ-Emotions is that, while the former (e.g. the feelings defined by Damasio) refer to homeostasis mechanisms which are triggered by signals which are already 'present' in the body-brain system, the latter (i.e. ψ-Emotions) can also be triggered by the 'absence' of something which is transformed into a 'presence' of something else. For example, when travelling by train, if at some point we don't find our smartphone where it is expected to be (e.g. on the table), we can transform such an 'absence' into the 'bad' presence of someone who probably has stolen our device. But, after a few seconds, we can also find out that the precious smartphone is actually in the pocket of our jacket.

through *ψ-Emotions*, i.e. through unconscious emotions which are of semiotic nature and which – according to Ricoeur (1965, p. 135) – can be thought as the primal 'standing for' relationships[15].

If we accept the above hypothesis, we may also argue that the first transformation of physical events concerning the brain-body relationships into mental 'signs' (i.e. either images or words) is the work of unconscious emotions which, according to the psychanalysts, are about a *few things* like the body and its parts, family relationships, life and death (Fornari, 1983, p. 137).
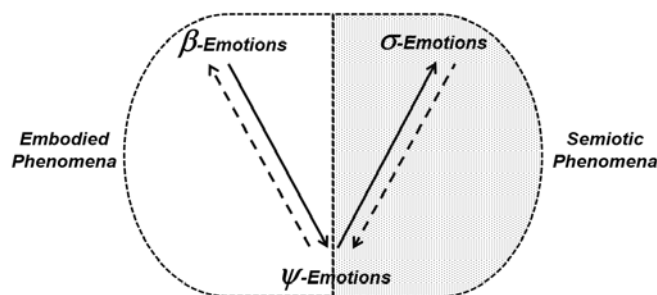

Fig. 7

Actually, if we assume that the relationships between 'embodied' and 'semiotic' phenomena is mediated through the *few things* which the unconscious is talking about, we can reach the conclusion that *ψ-Emotions* mainly work according to the logic of *metaphor*. In fact, they always symbolize and 'replace' both the bodily experiences and the socio-cultural experiences with the *few things* which are experienced to be 'similar' to them. And, by *feeling* new similarities and new differences, either within the 'internal' or the 'external' changing world, they – like the 'living metaphor' theorized by P. Ricoeur (1975) - can also increase the polysemy of language. Moreover we can assume that **–** when expressed through texts and verbal language - *ψ-Emotions* become *σ-Emotions* which not only refer to the individual 'sender' in Fig 6, but rather they affect and organize all 'semantic relations' which Bühler referred to (i.e. 'expression', 'representation' and 'appeal'). In other words, we can assume that emotions expressed through texts are cultural and relational phenomena which are inherently *context dependent* and that – for this very reason – they challenge any attempt to organize them into the finite 'cells' of any classification scheme.

Undoubtedly, both in Fig 6 and in Fig 7 there are *borders* which can be legitimately questioned. In fact the categories I used for distinguishing the various types of emotional phenomena do not refer to differences between Kantian *things-in-themselves*; but rather they refer to the way how definitions - and so similarities and differences between various phenomena - are managed within various social sciences. To this purpose it may be useful to remind us that, as P. Bourdieu (1991) pointed out, the etymology of 'category' comes from the Greek language, where the meaning refers also to 'accuse' or to 'speak against' someone (*káta* = 'against'; *agoréuein* = 'speak'). In fact, according the French sociologist, there are always *struggles over classifications*, and the analysis of such struggles 'brings to light the political ambition which haunts the gnoseological ambition to produce the correct

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[15] "To designate this point, Freud coined the excellent expression *Repräsentanz*. Instincts, which are energy, are 'represented' by something psychical." (Ricoeur, 1965, p. 135). N.B.:   *Repräsentanz* also refers to situations in which someone speaks or acts 'in the place of' someone else.

classification: an ambition which properly defines the *rex* [i.e. the king], the one who has the task, according to Benveniste[16], of *regere fines* and *regere sacra*, of tracing in speech the frontiers between groups, and also between the sacred and the profane, good and evil, the vulgar and the distinguished' (p.243). For this very reason, the French sociologist argued that the 'game' concerning classifications is also 'a game in which the social scientist is himself involved', and – accordingly – he theorized a reflexive (or critical) sociology which is a sort of 'sociology of sociology'.

Accordingly the *border* which, both in Fig 6 and in Fig 7, divides 'embodied' and 'semiotic' phenomena from each other shouldn't be interpreted as referring to some sort of essentialist paradigm. In fact, by marking the above border, I did not intend to endorse Eco's argument for defining the 'lower threshold of semiotics' (Eco, 1975: pp. 19-21) and for arguing that biosemiotics originated from some sort of epistemological *trompe-d'oeil* (Eco, 1988). Rather – by adopting a sort of pragmatist point of view - here I am referring to the simple fact that I need to stress that phenomena like the following are very different from each other:

a) what one specific person (e.g. the President of USA) is feeling and/or thinking;
b) the tweet that the same person (i.e. the President of USA) has published right now.

In fact, according to my model (see the above Fig 6), only the second type of phenomenon may activate σ-*Emotions* which are relevant for *textual* analysis.

3 Social Sciences, Algorithms and the Theory of Technique

While commenting on 'Adapting computational text analysis to social science (and vice versa)', the sociologist Paul DiMaggio (2015) argued that social scientists have to do 'some extra work' to adapt and that the use of certain unsupervised techniques 'requires many of us to *move outside our comfort zone in accepting interpretive uncertainty*' (p. 2, emphasis added).

Probably not so many social scientists have had – like the author above quoted - the experience of collaborating with computer scientists; however, beyond the collaborative experiences we can have, the difficult job of connecting and integrating – within computational text analysis practices – the use of techniques (i.e. software tools) and the reference to social science theories cannot be overlooked or underestimated. In fact what is at stake is the very quality of research.

Personally I agree with DiMaggio's claim that 'invest in corpus curation' is the most efficient way to boost the quality of our results (2015, p. 2). Moreover I would add that – within computational text analysis practices - the hermeneutical work of the researcher should not be limited to the interpretation of the results (i.e. tables and charts). This is because the hermeneutical work is also about choosing and customizing the various software procedures, including those which determine the corpus segmentation and the keyword lists, which both – when using algorithms for co-occurrence analysis – have a relevant impact on the results.

In other words I am suggesting that, when doing computational text analysis, hermeneutics is not just about interpreting texts and other semiotic objects; rather it is also about interpreting

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[16] Here Bourdieu refers to Benveniste (1969, vol I, I.1).

how we are using the various tools in different contexts and how – through such a use – we are modelling our texts for the purpose of our research. For example, if we are interested in exploring how emotions are translated into texts and how they shape both cultural models and social relationships, we cannot achieve this purpose just by analysing a generic text collection and by using the *default* options provided by the software programs.

Actually, sometimes it can also happen that we transform the use of software procedures into some sort of ritual which may be also symbolized as 'sacred' because it performs some sort of 'miracle'. In fact, not by chance, sometimes we may refer to an algorithm as the 'Algorithm' with a capital 'A'. To this purpose it may be interesting to remind ourselves that – when studying the archaeology of duty – the philosopher Giorgio Agamben (2011) discovered a sort of religious paradigm according to which the effectiveness of a human activity does not depend on the subject who puts it into practice, but rather on the entity (either God, the King or the Law) which acts through the human who is assumed to be an 'animated tool'. In other words, according to this paradigm the action is supposed to reach its effectiveness *ex opere operato*, which is a Latin expression referring to the fact that the effectiveness of some human activities does not depend on the human but rather on the activity itself.

Accordingly I would say that - when we rely on the *power* of the automatic procedures and we think that our analysis can work *ex opere operato* - we are no longer relying on our theory of technique, which is not just a theory concerning the phenomena we are studying, but rather a theory of the practise (Bourdieu, 1980) which connects what we are doing with the social context and with the conceptual and technical tools we are using.

Moreover I argue that, when referring to a theory of technique, our findings are not about general laws, but rather about *local* structures of meaning and about the processes which generate them. For this reason I argue that – when doing computational text analysis - there are no *general* rules to be followed or *universalistic* models to be applied, but rather each single researcher and/or each community of researchers have to elaborate the theory of technique which they refer to.

Regarding the *universalistic* ways of performing text analysis, I will comment on two cases: the first one which refers to the use of some types of *word embeddings* and the second one which refers to the use of some types of *lexicons* for emotion analysis.

The *'word embeddings'* expression manly refers to a way of representing each word of a corpus as a dense vector of real numbers (e.g. 'immigration'= [0.32, -0.15, 0.32, -0.22,…]). Usually such dense vectors are obtained by analysing co-occurrence matrices were the various words are represented as sparse vectors, i.e. vectors in which most values are '0' (e.g. 'immigration'= [0, 0, 0, 1, 0, 0, 0…]). There are advantages and disadvantages in using word embeddings, and people who are interested in learning more about this topic may consult Wikipedia and do some research on the Internet.

Here I will limit myself to commenting on some types of pre-trained word embeddings, which are datasets provided through free download by big companies like Google and Facebook, i.e. by the same companies which have developed machine learning algorithms for creating these very types of word embeddings.

Ideally, a dataset which includes millions of word embeddings obtained by analysing gigabytes of texts (e.g. the entire Wikipedia English corpus) can be thought of as a new type of electronic dictionary where word definitions are replaced by numeric vectors which can be used for computations concerning word similarities, word analogies and – also – some types of sentiment analysis.

Regarding the use of the above quoted tools for analysing a typical corpus gathered and 'curated' by some social scientist - e.g. a dataset including text materials like journal articles, transcripts of political debates, transcripts of focus groups etc. – the cases are two:

    a) use pre-trained word embeddings downloaded from the Internet, in which case we can find out that their *universalistic* logic captures word similarities according to the logic of standard dictionaries and ontologies;

    b) use algorithms like *word2vec (*Google) and *fastText* (Facebook) for obtaining customized word embeddings trained by analysing word co-occurrences within our target corpus, in which case we can find out that - on semantically related tasks - 'classical' algorithms like SVD (i.e. Singular Value Decomposition) and PCA (Principal Component Analysis) perform better than the popular algorithms above mentioned.

Without entering into technical details, I would like to stress that the semantic information provided by the *universalistic* way of training word embedding is not appropriate for revealing 'emotional effects' present in *local* contexts. To illustrate this point I will propose the results of two queries concerning words associated with 'health': the first one (see Fig 8) has been performed on a *universalistic* dataset including millions of word vectors, the second one (see Fig 9) has been performed on a small dataset concerning a political debate and including a few hundred word vectors.
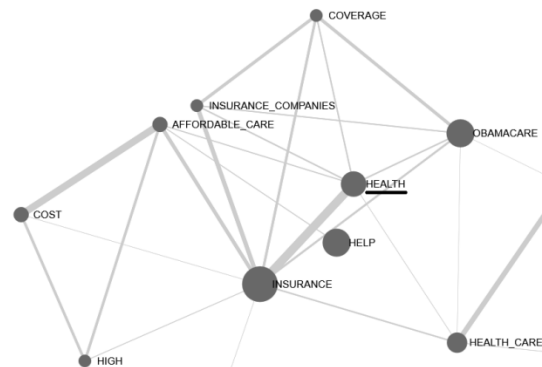

Fig. 8   Fig. 9

We may say that - while Fig 8 refers to a sort of 'general' meaning - Fig 9 captures a 'local' meaning that for some people (e.g. people in the USA) may also be emotionally dense. And, by considering that in such a 'local' context no specific word refers to the *lexicons* for emotion analysis, this fact is at least intriguing.

By using a category proposed by L.F. Barrett (see section 2 above), I would say that the majority of *lexicons* for emotion analysis refer to the *essentialist* approach. However, in order to refer to them, I will use the '*decontextualized lexicons*' expression, where '*decontextualized*' also refers to the lexicons which are supposed to be culture dependent (e.g. different words

for indicating emotions in different countries) but which do not take into consideration the specific 'contextual' language of the corpus under analysis.

To be more specific, I argue that researches who rely on *decontextualized* lexicons usually share the following assumptions:
a) human emotions are a finite set of elements which differ from each other (e.g. Basic Emotions[17] = { anger, anticipation, disgust, fear, joy, sadness, surprise, trust});
b) according to specific *rules*, analysis units like words or sentences can be matched with the specific emotions enumerated in the above finite set;
c) the 'features' used for describing any particular emotion experienced by an individual (e.g. 'anger') can be used for defining a socio-cultural phenomenon.

In detail:
-assumption (a) enumerates and distinguishes emotions according to same logic we use for classifying *natural kinds* (Barrett, 2006);
-assumption (b) refers to semantic relationships between linguistic expressions and emotional meanings as relationships which follow the binary logic of a *code* (Eco, 1984);
-assumption (c) is a typical example of a *category mistake* (Ryle, 1949); in fact "It represents the facts of mental life as if they belonged to one logical type or category (or range of types or categories), when they actually belong to another' (p. 6).

As a result, researchers who use decontextualized lexicons typically assume that emotions are known in advance and that the analysis process is about computing statistics and summarizing the way how emotions are distributed within the analysed corpus. In other words, we may argue that this way researches work according to the *ex opere operato* paradigm outlined above.

To my knowledge there are also social scientists – mainly psychologists – which build and use *contextualized lexicons*. Actually some years ago I was collaborating with some of them (Carli & Paniccia, 2002) and, as at that time I was intrigued by a couple of constructs proposed by the anthropologist C.J. Geertz (1973, 1983) – namely that of 'local knowledge' and that of 'thick description' - I suggested to them to build contextualized lexicons in which 'dense' (i.e. 'thick') words were tagged as different from the other words. However such dense words were not pre-classified into groups, neither was there a specific set of emotions which were supposed to match with them; rather we made the assumption that they could work like *markers* for distinguishing the various emotional contents of semantic clusters obtained through the analysis of co-occurrence matrices.

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[17] Starting from P. Ekman (1972) several authors – mainly psychologists – have proposed various sets of 'basic' or 'primary' emotions. The set of eight emotions reported here refers to the theory of R. Plutchik (1980) and it is also used in computational text analysis (e.g. Mohammad, 2016; Öhman E., Honkela T. & Tiedemann J., 2016; Abbasi & Beltiukov, 2019).
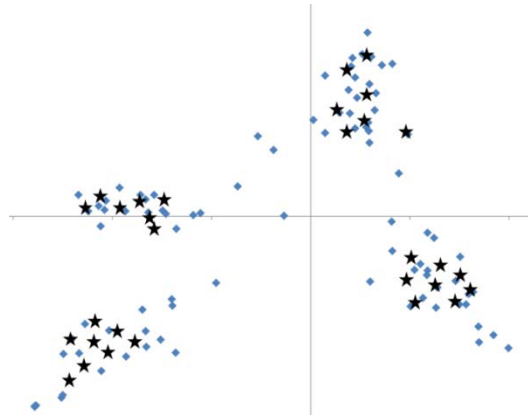
Fig. 10

According to the above assumption, in charts like that depicted in Fig 10, the 'stars' were dense words which were able to guide the *interpretation* of the emotional/cultural 'constellations' present in the analysed corpus. Undoubtedly, such an assumption is an interesting example of how social scientists can move outside their 'comfort zone' in accepting interpretive uncertainty (DiMaggio, 2015, p. 2). And I would add that, even if lots of papers focus on the performances of competing algorithms and – accordingly - lots of researches tend to overestimate the differences between such algorithms, here – i.e. outside the 'comfort zone' – it is the *theory of technique* which makes the difference. For example, for interpreting emotional meanings – and therefore metaphors - mapped in a chart like that depicted in Fig 10 we have to make the assumption that in this case syntagms are not ordered sequences of words which follow each other within a text, but rather they are clusters (or patterns) characterized by the fact that similar words are 'near to' each other in a multidimensional space. And we have also to assume that such proximity relationships are determined by emotional factors which work through linguistic paradigms.

Actually, regarding the ways that emotions shape our language and our culture, we can also make some new and interesting assumptions. For example, looking at the clusters depicted in Fig 10, we can argue that they are not 'fixed stars', but rather we may argue that they are clouds moving within some sort of *dynamic field* which generates the same clouds. In fact a psychologist with whom I sometimes collaborate (Salvatore, 2015) has theorized that, when mapped on a self-organizing space, the dynamic of the emotions and the dynamic of sense-making are basically the same 'thing'. Interestingly in computational text analysis there are also algorithms – such as Markov Chains and Recurrence Quantification Analysis – which allow researchers to develop such a theory further.

In the two cases quoted above psychologists share the assumption that emotions are not properties of individuals, but rather they are relational and cultural phenomena. Moreover such psychologists are using computational text analysis within a framework where both theories and techniques are 'at the service' of a practise oriented to analyse social demands and to deliver new understandings of cultural changes concerning issues like immigration, public health services, public transport etc.. In other words, their research framework is inspired by a specific theory of technique.

Conclusions

In this work, while commenting on the use of some techniques and theories which – in social sciences – allow us to study emotional phenomena through computational text analysis, I have been led to make two main assumptions:

-the ways that the phenomena we name 'emotions' are translated into texts can be thought of as mainly referring to the metaphorical way of thinking and communicating (see the above sections 1 and 2) through which we humans *construct* both our social relationships and our cultural models;
-in order to analyse and interpret such phenomena we have to rely on a hermeneutic theory of technique of some sort (see the above section 3) which – while allowing us to rethink the problematic relationship between the theories concerning emotions and the techniques for data analysis - strictly connects the interpretation work with the specific social context where the emotional phenomena originate.

Actually, if we think of emotions translated into verbal language (and so into texts) as phenomena which are inherently context dependent (see the above section 2), we can reach the conclusion that any theory which tries to define such emotions through *concepts* which relate to each other according to some sort of Aristotelian logic is doomed to failure. In fact context dependent phenomena of this sort do not refer to entities which 'exist' and which can be classified on the genus or species level[18]; rather they always manifest themselves as specific patterns which result from the interplay of specific similarities and specific differences in our perceptions and our interpretations.

Interestingly this sort of interplay logic is present both in the scientific and the emotional ways of thinking, both in the metaphorical structure of language and in lots of algorithms used for computational text analysis[19].

Moreover I may argue that we are entitled to use interpretative strategies because, at least in textual analysis, we can assume that the generative process which produces texts – but also multi-semiotic objects like tables and charts – is 'similar' to the process through which we interpret them. That also means that for discovering and interpreting emotional structures (or emotional processes) translated into texts we also have to rely on our emotions themselves.

To conclude, both the above statements as well as all arguments developed in this paper can be interpreted as a way to remind us that all social sciences – and not just cultural anthropology (Geertz, 1973) - are about the 'interpretation of interpretations'. And if we assume that emotions conveyed by texts are metaphorical expressions through which we *interpret* our social and cultural world, we may also argue that the interpretations of such

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[18] See, for example, the theories which classify emotions as 'primary' (or 'basic') and 'secondary'.
[19] While algorithms look for similarities and differences between numerical vectors which encode only the 'expression forms' theorized by Hjelmslev (1943), the metaphorical way of thinking looks for similarities and differences which mainly refer to the 'content forms'.

interpretations reveal something concerning the very logic through which the *encyclopedia* of social sciences actually works[20].

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[20] Here I refer to the following argument made by Umberto Eco: "At any rate, for too long it has been thought that in order to understand metaphors it is necessary to know the code (or the encyclopedia): the truth is that the metaphor is the tool that permits us to understand the encyclopedia better. This is the type of knowledge that the metaphor stakes out for us." (1984:129)

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