Human Language Technology for Text-based Analysis of Psychotherapy Sessions in the Spanish Language

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Abstract

We present work in progress in the application of Natural Language Processing (NLP) technology to the analysis of textual transcriptions of psychotherapy sessions in the Spanish Language. We are developing a set of NLP tools as well as adapting an existing dictionary for the analysis of interviews framed on a psychoanalytic theory. We investigate the application of NLP techniques, including dictionary-based interpretation, and speech act identification and classification for the automatic analysis of spoken transcriptions in Spanish of psychoanalysis sessions between therapists and patients. In Figure 1 we show a fragment of a manually transcribed interview in Spanish (and its translation to English) from our development corpus.

The automatic analysis of the sessions, which is used as a tool for assessment and interpretation of the transcribed psychotherapy sessions is based on a theory developed by Liberman and extended by Maldavsky (Liberman and Maldavsky, 1975) and framed on Freudian theory (Freud, 1925). The automatic tools to be presented here aim at recognizing a subset of Freudian drives manifested in both patient’s and therapist’s discourse.

The objective of the analysis is not to provide a full automated solution to discourse interpretation in this area, but a set of tools and resources to assist therapists during discourse analysis. Although work in text-based interpretation in psychology is not new, researchers in our project have identified limitations in current practices due to the fact that current text-based systems do not tackle ambiguity problems at lexical, syntactic, or semantic levels: for example systems that consider out-of-context superficial forms would are unable to distinguish between different usage of the same lexical item (“para” as a preposition vs. “para” as a form of the verb “parar” (to stop); “rio” as a common noun vs. “rio” as a contextual clue for the identification of a geographical name; etc.). The use of advanced natural language processing techniques could help produce
better analysis of the input material and therefore be used for a better diagnosis and follow-up. It is worth mentioning that full interpretation of therapy sessions is not only based on textual analysis, but also in other elements of the session such as the actual speech (e.g. pitch), para-verbal elements such as patient movement, etc. This work addresses only text interpretation issues.

The rest of the paper is organized as follows: Section 2 describes related work in the area of computational tools for text analysis in psychology. In Section 3, the theoretical framework for our work is briefly introduced. Section 4 describes the implementation of NLP tools for the analysis of the interviews and Section 5 closes the paper describing current and future work.

2 Related Work

There are a number of well-established computational tools for the analysis and extraction of meaning from text in the social sciences (See (Alexa and Zuell, 2000) for an overview of tools and resources). Some tools are bound to particular theoretical principles, for example the LWIC dictionary (Pennebaker et al., 2001) encodes specific categories to be identified in text while others follow a theory-free approach (Iker and Klein, 1974) where the theory emerges from the analysis of the data.

There has been substantial research in the development of methods to analyze linguistic input in the field of psychotherapy in order to measure a number of psychological variables such as emotion, abstraction, referential activity, etc. among them Bucci’s Referential Activity (RA) non-weighted (Bucci, 2002) and weighted dictionaries (Bucci and Maskit, 2006) for the English language, or Hölzer and others’ affective dictionary (Hölzer et al., 1997) for the German language. The LIWC tool has been used to detect different types of personalities in written self-descriptions (Chung and Pennebaker, 2008). This program counts meaningful words that express emotion, abstraction, verbal behavior, demographic variables, traditional personality measures, formal and informal settings, deception and honesty, emotional upheavals, social interaction, use of cognitive and emotion words, word analysis in psychotherapy, references to self and others.

For Spanish (Roussos and O’Connell, 2005) have developed a dictionary in the area of psychotherapy...
to measure referential activity.

Early work on dictionaries in the area of psychology include the General Inquirer psychosociological dictionary (Stone and Hunt, 1963) which can be used in various applications; current work on lexical resources for identifying particular text variables – such as measuring strong/weak opinions, sentiments, subjective/objective language, etc. – include the SentiWordnet resource (Esuli and Sebastiani, 2006) derived from WordNet which has been used in various opinion mining works (Devitt and Ahmad, 2007); other lines of research include the derivation of word-lists (semi) automatically for opinion classification (Turney, 2002). To the best of our knowledge, little research has been carried out on natural language processing for discourse interpretation in psychology.

3 Theoretical Framework Overview

Liberman’s theory identifies 7 drives (i.e., a subset of Freud’s drives) which are introduced in Table 1 we may associate these drives with emotional or affective states such as: strong emotions associated with IL; ecstasy or trance with O1; sadness with O2; anger with A1; concrete language with A2; warnings, suspense, and premonition with UPH; and congratulation, adulation, and promises with GPH. In diagnosis these variables are associated to pathologies such as addiction, schizophrenia, depression, paranoia, obsession, phobia, and hysteria; so their manifestation in text is of paramount importance for diagnosis.

| Abbreviation | Drive Name                      |
|--------------|---------------------------------|
| IL           | Intra-somatic libido            |
| O1           | Primary oral                    |
| O2           | Secondary oral sadistic         |
| A1           | Primary anal sadistic           |
| A2           | Secondary anal sadistic         |
| UPH          | Urethrae phallic                |
| GPH          | Genital phallic                 |

Table 1: Drives in Liberman and Maldavsky theory

The theory also associates lexicalizations to each of the drives (Maldavsky, 2003), thus creating a semantic dictionary with 7 categories, the main work-

| Drive | Lexicalisation                                      |
|------|----------------------------------------------------|
| IL   | verbs: to throw up, to break; nouns: hospital, throat; adjectives: sick, fat; adverbs: fatally, greedily |
| O1   | verbs: to sip, to suck; nouns: enigma, research; adjectives: mystical, enlightening; adverbs: elliptically, enigmatically |
| O2   | verbs: to feel, to feel like; nouns: feeling, victim; adjectives: sensitive, happy, sad; adverbs: fondly, obediently |
| A1   | verbs: to bother, to kick; nouns: violence, transgression; adjectives: angry, locked; adverbs: angrily, boldly, crossly |
| A2   | verbs: must, to know; nouns: vice, doubt; adjectives: good, bad; adverbs: but, although, however |
| UPH  | verbs: to be able, to dare; nouns: scar, precipice, wound; adjectives: coward, scared; adverbs: almost, a bit |
| GPH  | verbs: to promise, to give; nouns: beauty, ugliness; adjectives: wavy, pretty; adverbs: more, even |

Table 2: Sample of drives and associated lexicalisation

hypothesis is that drives manifest through linguistic style, present at word level, phrase, and narrative. Lexicalisations for each drive have been carefully selected following a variety of methods including manual derivation of words from concepts, study of texts where a scene is clearly present (e.g., everyday activities), use of thesaurus, etc. Ambiguity is preserved and a lexicalisation can signal more than one drive. We show some lexicalisations in Table 2.

In addition to word-level analysis, the theory provides methods for analysis at narrative and speech act level.

Speech acts are actions performed when making an utterance (Searle, 1969) and they include (Searle, 1976) illocutionary (e.g. assert, suggest), perlocutionary (e.g. convince, insult), and propositional (e.g. making a reference) types. There has been substantial work on speech act segmentation and classification. Different authors adopt different classifications or theories of speech acts in order to restrict the categories to those relevant for the purpose of analysis. For example, in dialogue systems (Allen et
Drive | Speech Acts
---|---
IL | references to the state of things; reference to body and body processes; etc.
O1 | abstract deduction; negation; reference to physical discomfort; etc.
O2 | lamentation; complain; beg; etc.
A1 | verbally abuse; provoke; confront; etc.
A2 | judge; clarify; confirm; etc.
UPH | forewarning; warning; inquest; counsel; etc.
GPH | congratulate; thank; promise; exaggerate; etc.

Table 3: Drives and Speech Acts

al., 1996; Henry Prakken, 2000), the list of speech acts may vary from 4 to 10 categories and it may include acts such as assertion, WH-question, directives, greeting, direct/indirect request, etc. The psychoanalytic framework we are following has its own inventory of speech acts. The objective is also to link scenes in narratives and speech acts to the 7 drives (in Table 1). There is a variety of speech acts in the adopted framework, in Table 3 we present a sample of speech acts associated to each of the drives. The objective of the semi-automatic analysis is to help their identification to facilitate the work of the psychotherapist.

4 Text Analysis of Interviews

We have implemented a series of programs, lexical resources, and grammars to process interviews and other types of textual data in Spanish. We are using the GATE system (Maynard et al., 2002) as an infrastructure or development framework; most developments are new, not included in the GATE system, and they are packaged in a plug-in which can be accessed through the GATE system or used stand-alone. We have developed various programs to automatically annotate the interviews including segmentation of the transcription, word-based thematic segmentation, tagging, and dictionary-based interpretation and analysis.

4.1 Dictionary

One of the main components of the system is a dictionary which is taken as the basis for text interpretation. This is being implemented as a language resource in GATE. It is based on lists of word forms which have been created for each of the drives. The lists are organized according to their parts of speech. The available dictionary (Maldavsky, 2003) contains all inflected forms of verbs, nouns, adjectives, and adverbs which we are transforming into a dictionary which will contain only roots. An instance of the dictionary is created from the set of lists and kept on-line for processing. The current version of the dictionary (inflected forms) contains over 298 thousand verb forms, over 22 thousand noun forms, over 137 thousand adjectives, and over 9 thousand adverbs. An annotation tool has been implemented based on a schema for our dictionary, we use the graphical user interface functionalities provided by the GATE infrastructure allowing a researcher annotate words she may want to included in the dictionary or segment the text in units for further analysis.

4.2 Programs for Interviews’ Interpretation

The following programs used for the automatic analysis of the interviews.

- A wrapper to the TreeTagger parts of speech package (Schmid, 1995) (See [http://www.clarin.eu/tools/treetagger](http://www.clarin.eu/tools/treetagger)) has been implemented in order to call it from the GATE system and an alignment program has been developed to associate the output of the tagger to the actual text of the interview, therefore creating word annotations containing features from the TreeTagger and additional features computed by our programs. Note that the TreeTagger distributed with GATE was inappropriate for our purposes because it does require tokenisation of the input performed before invoking the tagger, this is the reason why we had to create our own wrapper.

- A segmentation program is used to identify patient and therapist interventions.

- Text chunking and named entity recognition is being developed using Support Vector Machines and training data from the CoNLL
evaluation program. We have created a train-
able system using machine learning resources
provided by the GATE framework. The
CoNLL 2002 Spanish dataset which provides
information on named entities such as Loca-
tion, Organization, Person, and Miscellaneous
was analyzed using parts-of-speech tagging,
morphological analysis, and gazetteer lookup
in order to derive a set of features for learn-
ing. A support vector machine was trained
that uses gazetteer information, word level
information, orthography, parts-of-speech, and
lemmatization. We have collected a number
of lists to assist the identification of names
of organization, persons, locations, time ex-
pressions, etc. The performance of the current
system is at 68% F-score. Note that named
entity recognition is particularly important
to track names in longitudinal analysis of
interviews, but also to disambiguate names
which in Spanish are ambiguous (e.g. “amado”
can be a person name in addition to a form of
the verb “amar”; “quito” can be the name of a
place in addition to a form of the verb “quitar”,
etc.)

- A program uses the dictionary and interprets
each word or complex term according to the
drives in the dictionary taking into account
parts of speech information and named entity
recognition.

- A topic segmentation program has been
implemented to break the interview in frag-
ments which can be selected for fine-grained
interpretation. This module is based on tf*idf
similarity between candidate segments. A
second module we are implementing aims
at the recognition of segments referring to
prototypical scenes a patient may refer to:
family, work, love, health, money, etc. Further
gazetteer list information has been collected
from Spanish sources to create lexicons for
assisting the automatic identification of the
above categories. We are in the process of
manually annotating a set of transcriptions as
the basis for training a classification system for
this task. Conceptual information will be used
for this purpose.

- A processing resource has been implemented to
generate an interpretation of the different lan-
guages or drives’ variables for different seg-
ments chosen by the human analyst (thera-
pist or patient or any other segment of inter-
est) and statistics are computed for each of the
segments; these can be exported for the ther-
apist to carry out additional analysis and in-
terpretation. Note that the current tool con-
siderably improves the previous practices in
dictionary-based interpretation, since the im-
plemented tool takes into account syntactic and
semantic information as a filter for interpreta-
tion.

4.3 Rule-based Speech Acts’ Detection

We are carrying out induction sessions with psy-
chotherapists in order to capture ways in which
speech acts in the adopted framework are expressed.
The induction sessions provided valuable material
to start implementation of a rule-based speech act
detection program (with regular expressions and a
dictionary) based on use use of syntactic and lexical
information. These procedures allow us to collect a
set of expressions and lexical/syntactic patterns for
objective identification of a subset of speech acts.
We are also annotating the development corpus of
interviews (a total of 30 will be annotated with a
minimum of 2 annotators per interview) with speech
acts categories. Each speech segment is annotated
with one main speech act and a number (possibly
zero) subordinate speech acts. We are using the
GATE environment to provide appropriate support
for the annotation process. In Figure 2 we show a
fragment of interview in the annotation tool anno-
tated according to the interpretation of one of our
judges (the annotation window shows a “complaint”
speech act associated to the fragment “no me estaba
tratando de entender como él siempre hace” (“he did
not understand as he always does”)). We expect the
annotated corpus to be a valuable resource for the
development of a trainable speech act recognition
program based on lexical clues and syntactic infor-
nation. This trainable system will extend the rule-based approach or incorporate the rule-based analysis into it.

A sample of expressions we have identified and implemented for a subset of speech acts is presented in Table 4. The analysis of speech acts will provide an additional level for drive’s identification.

5 Perspectives and Current Work

We have described our initial work on a set of tools being developed for the analysis of psychotherapy interviews in the Spanish language. The tools extend work on dictionary-based text interpretation by incorporating NLP tools such as tagging, topic/scene segmentation, speech act detection, and named entity recognition. One main contribution of our research is the implementation of a dictionary for the Spanish language which can be used not only for the identification of Freudian variables but also for work on affective language and sentiment analysis. We are currently working on the development of a full module for speech-act recognition and on the creation of a corpus of annotated interviews which will serve for further training and evaluation purposes. The set of resources developed in the project will be made available to the computational linguistics community for research purposes. We think that although this is work in progress it is worth mentioning evaluation. Where evaluation of the tools is concerned, we are carrying out intrinsic evaluation comparing annotated categories against predicted categories currently for named entity recognition and discourse segmentation and in the future for speech act recognition and classification. Where more extrinsic evaluation is concerned, we will evaluate how the tools presented here can help therapist in better interpretation of clinical data. The implemented tools will also be used to compare word-level based interpretation produced by the dictionary to interpretation produced by the analysis at speech act level.

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| Speech Act          | Pattern or Expression                                                                 |
|---------------------|---------------------------------------------------------------------------------------|
| beg                 | PPX + rogar | implorar | suplicar                                               |
| demand              | PPX + exhortar | exigir | demandar | pedir                                                   |
| demand recognition  | decir que esta bien | correcto | perfecto | bueno; está bien, no?                                  |
| demand forgiveness  | PPX + perdonar                                                                 |
| justify             | por que; por eso; debido a que; por esa razón                                        |
| permission          | con PPO permiso; pedir; PPX + dejar                                                 |
| interrupt           | para... para; espera...; ah me olvide...                                               |
| cite                | como dijo NP | PPX ; según NP | PPX ; de acuerdo con NP | PPX                                                   |
| synthesis           | en resumen; para concluir; en síntesis                                               |
| doubt               | no PPX quedar | ser | estar claro; quien sabe                                |
| trust/distrust      | no confiar | desconfiar; confiar | desconfiar                                           |
| submission          | tener razón; no + PPX + enojar                                                        |
| appeal              | decime que me querés; ...                                                             |
| compassion/self-compassion | me da pena; pobre; pobrecito;...                                                 |
| sacrifice           | yo que hice todo esto; yo que te di todo; si no fuera por mi; ...                   |

Table 4: Speech Acts and Lexical/Syntactic Patterns (PPX = pronouns; NP = proper nouns; PPO = possessive)
Figure 2: Speech Acts Segmentation and Interpretation