

Discourse Structure and Sentiment

Livia Polanyi, Martin van den Berg

Bing

Microsoft Corp.

Mountain View

e-mail:livia.polanyi@gmail.com, martvdb@microsoft.com

Abstract — In this paper we discuss the application of the Linguistic Discourse Model (LDM) to sentiment analysis at the discourse level. Based on the observations that naturally occurring discourse is interpretable though often not coherent, the LDM provides a unified and explanatory approach to discourse sentiment assignment. Special attention is paid here to the well known problem of computing sentiment in movie reviews which are characterized by shifting contexts of sentiment source and target.

discourse; sentiment; text structure

I. INTRODUCTION

In this paper we discuss the application of the Linguistic Discourse Model (LDM) [1,2,3,4,5;6,7,8,9] to sentiment analysis at the discourse level. Our goal in this work is to provide an explanatory and computationally straightforward account of the relationship between the core properties of interactive discourse and human understanding of sentiment assignment.

II. THE NATURE OF DISCOURSE

The goal of discourse parsing in the LDM is to account for discourse continuation despite discontinuity and lack of apparent coherence by specifying which contexts in the discourse history are accessible for continuation and which are not. Information at accessible contexts can provide referent anchoring for pro-nouns, pro-verbs, anaphors of all kinds and indexical expressions such as here and now which are always set relative to an Interaction taking place in some real or modeled context. The semantic and structural infrastructure needed to account for these cases has also proven necessary to account for formal, written “coherent” text in which the focus of attention and even the persona of the writer shifts from sentence to sentence or, often even within a single sentence, from one interpretational context to another.

For discourse level sentiment analysis even in a coherent apparently monologic written text such as the review of *Midnight in Paris* [10], the identity of the communicating persona can shift even within a single sentence. For instance, the first sentence contains propositional information interpreted relative to four different contexts in which the author is speaking through four different personae: Critic is evaluating the film, Critic quotes what might have been said, Reporter stating objective facts or opinion about a fact in the world:

1. A magical-realist gem, "Midnight" is a bit thin and glib to call a *masterpiece* – now, at 75, Allen is unlikely to have another one of those in him – but it's still a delicious trifle.

In order to account for the sentiment expressed in this sentence, readers segment the sentence into the relevant interactional contexts in which each persona is a participant and assign sentiment to the “speaking” persona. The interactional context sets other indexicals including “Now” relative to a temporal frame, sets the participants and defines the objects and spatial coordinates. Personae of participants is set at a Speech Event indexical which unfolds in the Now of the Interaction and assigns interactants roles in a socially defined genre or activity such as a Review in which personae of the modeled writer may speak as Critic, Objective Reporter, “myself” etc. In addition, readers keep track of whether the context being described is a factual one and the propositions purport to describe what happened or is happening or whether the context is hypothetical, positive or negative, generic or specific. Such a complex specification is needed to account for discourse continuity and accessibility, which requires modeling how linguistic units within a discourse are “continuing the same interactive activity” or not.

In addition to keeping track of the nature of the context, the reader also keeps track of structural dimensions of the sequences of utterances: is a new unit continuing the development of a previous unit, interrupting an ongoing unit to interpolate other information, returning to a previously interrupted unit? To return to our example displayed to show the embedding structure:

A magical-realist gem, "Midnight" is a bit thin and glib to call a masterpiece

– now,

at 75,

Allen is unlikely to have another one of those in him – but it's still a delicious trifle

We can see that the main clause of the sentence is “interrupted” by an embedded phrase which is, in turn, interrupted by an entire sentence. Each of these “Basic Discourse Units” (BDUs) participates both in the construction of the sentence and the construction of the discourse from which this sentence was extracted. In order to

understand how the interplay of interpretive context and the embedding and return structure of discourse interact in determining sentiment understanding at the discourse level, we will first describe the how the Linguistic Discourse Model (LDM) framework assigns contexts to discourse segments and return to consider the full set of personae and contexts needed to simply count the relevant sentiment expressions in the review of *Paris at Midnight*. We will then explain how the LDM represents parses text to create a representation of the continuation and embedding structure and then apply this model to some sentiment bearing textual examples. We conclude by comparing work presented here with related work on sentiment analysis at the sentential and discourse level.

III. OVERVIEW OF THE LDM

The LDM takes inputs sequences propositional signals and outputs a structural and semantic representation of its input. The data structure that is created through the parsing process is called a Discourse Parse Tree (DPT). It is an Open Right Tree that only allows attachment of input along the right edge and is designed to captures the discourse history of an Interaction. The DPT is not structure preserving but allows for insertion of new nodes between two existing nodes on the Right Edge of the Tree.

The LDM consists of four elements: a set of discourse units, a set of relations that hold among units, a data structure in the form of an Open Right Tree that represents the history of the emergent discourse and a set of semantic interpretations created through discourse processing.

A. Content and Function Units

In the LDM, the distinction from linguistics has been adopted between function terms that encode relations among elementary or constructed units that encode propositional information and proposition encoding units themselves characterize linguistic units at the discourse level.

Function Units encode information about how previously occurring (or possibly subsequent) linguistic gestures relate structurally, semantically, interactionally or rhetorically to other units in the discourse or to information in or out of the context in which the discourse takes place. They include terms such as for example, *however*, *but*, *so*, *anyway*, *good bye*, *yes*, as well as vocatives, interjections, hesitation and back channel markers, connectives as well as coordinating and subordinating conjunctions. Preposed adjectival and adverbial clauses with wide discourse scope are also classified as functional units.

Discourse Units are content encoding units. The elementary unit of discourse that encodes content is the **Basic Discourse Unit (BDU)**. *The BDU is semantic construct that projects onto the discourse level the interpretation of a verb based structure that is able to carry both content and indexical information.* Not all verbal structures are capable of anchoring a BDU, however. Some verbal structures such as gerunds or nominalizations that do not carry contextual information because they derive their temporal and modal interpretation from other sentential units are not BDUs.

The **feature structure** of a BDU contains both all surface structure information that the BDU expresses as well as a representation of how that information is expressed. This includes the words used, the order of the terms and placement of constituents in the string, the full syntactic parse and a rich representation of semantic information including a specification of all pertinent context indices including temporality, modality, polarity, genericity, as well as sentiment source and target, stylistic information and various dimensions of Point of View in addition to Interaction, Speech Event and text or genre unit information. The propositional meaning of the BDU is also represented. Performance information that typographical details such as script, font size, bolding etc. for written text is also available at the node. Because BDUs have information about their context of interpretation, they are able to act as an anchor for subsequent units that either will be interpreted relative to the same context or to another context depending on the information in that new unit.

IV. INDEXING SENTIMENT IN MEDIA REVIEWS

Media reviews are notoriously difficult for sentiment analysis systems to deal with success-fully due to the intermingling of sentiment sources, targets and embedding contexts. The task is made even more complex when one realizes that it is not enough to assign an Opinion to an Opinion Holder as is the case in newspaper articles, one must also take into account that the persona of the Reviewer as animated by the author is essentially several different personae each an entity in a separate context. The author may write in one sentence as Critic evaluating the merits of the piece, in another as Narrator explaining the narrative and the characters and events in the story world while in a third may assume the perspective of Reporter explaining factual information about the real world.

It is entirely reasonable to have a “wonderful” film about “vile, despicable” characters. For example: “*Sweeney Todd is a wonderful film in which horrible people viciously carry out despicable horrible deeds.*” And, in fact, these texts are characterized by intermingling, shifting perspectives reflecting the “footing” of the author as:

- (1) Critic making evaluative comments about the quality of the filmmaking
 - a. *It's a fabulous film.*
- (2) Narrator describing the characters and events in the story world in which the action of the film takes place
 - a. *The young boy finds a house in the forest. .*
- (3) Reporter providing background information about the film genre, locales, actors etc. or views of other persons (including the Reviewer in another context) acting as Critic, Narrator etc.)
 - a. *Filmed on location in Southern China.*
- (4) Conversational Partner with the reader, directly addressing or referring to the reader in some way
 - a. *You have to see this film with your kids!*
 - b. *You might think you know what Brad Pitt looks like.*
- (5) Intermingling of sentiment sources, targets and embedding contexts

- (6) The Critic as source evaluating as target
 - a. the film as a creative production
 - i. *It's a fabulous film (Target)*
 - b. political, financial, artistic dimensions of the film's creation, distribution, or screening
 - i. *The projector (Target) kept breaking down.*
 - c. The Narrator as source evaluating as target characters or events in the story world
 - i. *The father (Target) (beautifully played by Brad Pitt) is violent and does terrible things to his devoted family (Target).*
- (7) (3) The Reporter as source providing background information and context as target
 - a. The Reporter presenting the views of other persons (as sources) acting as Critic, Narrator or Reporter towards the film as target
 - 1. *The reviewer in the New Yorker (Source) disliked this scene.(Target).*
- (8) Conversational Partner (as Source) evaluating some aspect of the reader's (past, present or future) behavior. *You (Target) are an idiot if you miss this flick.*

The trick is to have a principled way of disentangling the perspectives. Unlike Rhetorical Structure Theory [11], the LDM requires assignment of semantic features including interaction, Speech Event, text unit and other perspective and semantic operators to each BDU. When combined with sentential syntax and semantic operators which annotate the string with information about sentence subject, object etc. as well as discourse structural rules which allow accessibility of relevant contexts, these BDU assignment operators provide much of the heavy lifting necessary to do a full sentiment analysis of even these difficult texts. Although doing a full analysis of a complex text is too detailed for presentation here, we can get a feeling for the contextual complexity by considering the considerably abridged text of the following film review of *Midnight in Paris*. We have segmented this text according to the LDM BDU segmentation criteria, **bolded each positive sentiment bearing term and italicized each negative term**. Each BDU is typographically coded as follows:

CRITIC – EVALUATIVE STATEMENT ABOUT FILM QUALITY
Reporter – Objective Information related to filmmaking
Narrator – Story world description
REPORTER – EVALUATIVE STATEMENT RELATED TO CONTEXT EXTERNAL TO FILM
<u>Reported Speech or Thought</u>
{Ironic Authorial Meta-Commentator}
Conversational Partner
[Function Unit]

A MAGICAL-REALIST GEM," "MIDNIGHT" IS A BIT *THIN* AND *GLIB* TO CALL A MASTERPIECE - AT 75, Allen is unlikely to have another one of those in him - BUT IT'S STILL A DELICIOUS TRIFLE.

Owen Wilson, best known for playing the *rakish* pretty boy in such *lowbrow* comedies as "Wedding Crashers," stars as Gil Pender, a **successful** screenwriter who refers to himself as a "Hollywood hack." He's in Paris with his *blandly attractive* fiancée, Inez (Rachel McAdams)

Gil endures her *disdain* with the **chipper loyalty** of a dog, though his *hackles* are raised [by] her *cloying* ex, Paul (Michael Sheen). He is the *most tedious* man in the world. But he does have Gil's number.

Hearing the SoCal *dilettante* wax poetic about *la vie bohème* in the Paris of yesteryear, Paul quips, "All that's missing is the tuberculosis."

[Then], *drunk* and *lost* at midnight, Gil is **rescued** by a **dashing** couple in a "vintage" auto who turn out to be Scott and Zelda Fitzgerald and drag him along to a Jazz Age soiree.

The parade of **luminaries** is **ridiculous** and **delightful**. Gil is **wowed** by Mrs., but it's Picasso's mistress, Adriana (Cotillard), who becomes the symbol of all his naive dreams. Yet she is too much like Gil: Her own present is a *burden* and a *bewilderment*, and she longs for the *elegance* of La Belle Époque.

WHILE THE DENOUEMENT IS *PREDICTABLE*, THE LITTLE SURPRISES ALONG THE WAY MAKE "MIDNIGHT IN PARIS" A **SATISFYING LOVE LETTER** NOT ONLY TO THE CITY OF LIGHT BUT TO {"CULTCHAH"} ITSELF. **See it!**

In this review, while the Critic's evaluative remarks are clustered at the beginning and the end of the text, even those sections of the text are nonetheless polyphonic.. These must be disentangled in order identify just the explicitly marked relevant terms needed to categorize the Reviewer's assessment.

If we now extract just the sentiment terms of the Critic towards film as a whole or towards elements of the film, and leaving aside question of the intensity of the terms simply compare the number of positive and negative terms:

– GEM (+), <i>THIN</i> (-), <i>GLIB</i> (-), DELICIOUS (+), TRIFLE (+/-?), <i>PREDICTABLE</i> (-), SATISFYING (+) LOVE LETTER (+)

We can get a reasonably good idea of the very on the fence judgment the Critic is putting on record of his assessment of *Midnight in Paris*. On the positive side: (a **delicious, satisfying, gem, of a love letter**) on the negative side (a "love letter" that is *thin, glib* and *predictable*) for a trifle, an ambiguous term meaning either *confection* or *harmless bit of fluff* that, in both meanings, can carry either positive or negative sentiment. However, eventually, even though the Critic will not call it a masterpiece, in his role of Conversational Partner in a modeled here and now as the modeled Reader is exhorted to **See it!** the ambiguity is resolved and the overall evaluation of the film is positive.

'Midnight in Paris,'

V. DISCOURSE PARSING WITH THE LDM

The first step in discourse parsing under the LDM involves an analysis of the incoming string. If the string is a simple sentence, sub-sentential unit or fragment, the string will be assigned the status of BDU and attached to the attached as a single unit to an **emerging Discourse Parse Tree (DPT)**. The DPT is an Open Right Tree data structure of **Discourse Constituent Units (DCUs)** that provide a record of the history of a discourse up to that attachment. If an incoming sentence is composed of more than 1 BDUs, the BDU tree will be attached as a whole by calculating a match between the features of that BDU against the features available at nodes along the right edge of the Tree using Rules of Discourse Attachment.

The nodes in the LDM DPT are all “first class citizens”. This means that all content nodes, terminals and constructed nodes alike, have computable content and can combine freely with each other. There is no theoretic distinction between a discourse node created through re-analyzing the sentential structure of a sentence as a DPT consisting of BDUs, a terminal node, and a constructed node in the DPT. Features that constitute the representation of BDUs and resulting DCUs provide information that guides attachment. Once attached to the DPT, all BDUs are accorded the status of Discourse Constituent Units (DCUs) that carry all of the content and indexical and encoding information that constitutes the BDU.

A. Discourse Relations (DPT)

There are three types of **discourse attachment relations**:

- Subordination (elaborations, interruptions)
 - At attachment, a new Subordination node is created with an extension that inherits all information present at the left daughter. Subordination Node.
- Coordination (lists)
 - The node label of a coordination node consists of a label of Coordination followed by an extension consisting of a of all information common to all child nodes.
- N-Ary (If/Then, Question/Answer sequences, etc.)
 - The node label specifies the nature of the N-ary node. The extension of an n-ary consists of all information present at all child nodes.

Once a node is no longer on the Right Edge, it is no longer accessible for attachment.

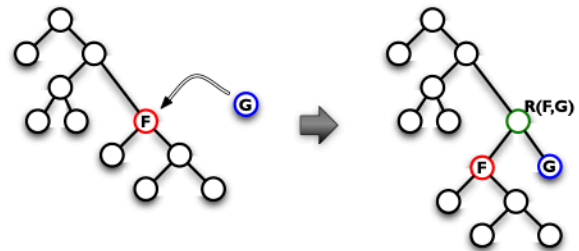
B. Rules of Discourse Attachment

Rules use lexical, semantic, syntactic, and performance information. For example, the use of the same lexical item or a synonym, antonym, hyponym or hypernym of that word indicates a potential relationship between the BDU and a DCU. If the word in the BDU is a hyponym of the word in the DCU, that is an indication that the BDU is discussing a more specific aspect of content in the DCU and this suggests a Subordination relation. Similarly, synonyms, antonyms or

hyponyms at the same level of specificity of the same hyponym indicates Coordination. Shared tense, aspect or syntactic structure likewise indicates Coordination while a shift in tense, a change of aspect or the promotion of a syntactically oblique constituent in the DCU to a more syntactically prominent position in the BDU indicate subordination. N-ary relations are often signaled by an explicit marker such as an *if* or *then*, the use of a term such as *hello* that expects a greeting in return to form a Greeting adjacency pair, or the use of specific structures in a Speech Event such as a Doctor/Patient encounter, a Lecture, a story, argument or other genre unit.^{1,2}

Each rule takes the feature set of the DCU in the chosen attachment point and the feature set of the BDU, and tries to construct a new DCU. Attachment decisions are evidence based weighted decisions with some rules given more weight than others.

The following diagram illustrates this. Given a chosen construction rule R, an attachment point with feature set F, and a BDU with feature set G, the result is a tree with a DCU with constructed DCU with feature set R(F,G).



All rules are specified by defining the value of R(F,G) combined with a set of constraints on the form F and G can take. For example all Subordination rules essentially have the form $R(F,G) = F$, the distinction lies in different sets of constraints.

C. Application of the Rules

It is important to stress that all construction rules work on all indices of the feature set. If the feature set of the DCU chosen for attachment is F, and the feature set of the BDU to attach is G, the application of the rule R(F,G) will result in a complete feature set for the constructed DCU. For the higher indices, like interaction, speech event, speaker etc., rules only apply if they are the same for both F and G, and their values in the constructed feature set will then be the same.³

¹ A Machine Learning algorithm for automatically determining attachment location and relation could easily be implemented from information on DPTs of corpora of documents annotated with reference to syntactic, semantic, and lexical rule.

² Discourse, like all other linguistic phenomena, can be ambiguous with more than one interpretation of the input possible. In these cases, either one makes an early decision to “choose best” and goes on or one allows multiple parses.

³ There are some rules that can change these, for example quotations explicitly change the speaker at the Interaction context.

If both units specify specific aspects of an entity, the general concept that subsumes both specific cases will be part of the feature structure of the Coordination node. (“most specific common denominator” defined by Polanyi [18] and van den Berg and Prüst [8] This notion of specificity is often defined in the context of a lexical ontology but may involve any other feature type.

VI. DISCOURSE STRUCTURE AND SENTIMENT

The LDM sentiment analysis algorithm calls for inheritance up of sentiment valence to a Coordination node, the contrast between positive and negative sentiment in an N-ary node of Type “Contrast” or the scope of sentiment valence in Subordination. For the Coordination case, let’s consider the example:

2. *My sister got married last month and I needed a place to stay for the wedding. Anyway, I found this great little hotel. Clean, comfortable bed and the greatest view of the city.*

The construction of the Coordinated list of Positive characteristics of the hotel located on the right edge of the DPT involved the inheritance up to that Coordination node of the positive sentiment in the semantics of “clean” “comfortable” and “greatest view”. This constructed List DCU is subordinated to “great little hotel” with the positive valence of the sentiment carrying term in each subordinated DCU along with the hotel related term licensing the assignment of the Subordination relation. In these cases, the presence of the same valence reinforces the valence of the dominating node. THIS REALLY WAS A GREAT LITTLE HOTEL!

A. Discourse Level Sentiment Phenomena

One could argue that discourse level analysis in this case adds only marginal value, but there are cases in which understanding sentiment from structural relations obtaining only at the dis-course level can be important:

- When sentiment bearing DCUs dominate or evaluate non-sentiment bearing DCUs and thereby express the author’s or speaker’s opinion towards information with no overt marking in the dominated sentences.
- When an entity or event in a DCU unmarked for valence dominates a sentiment bearing DCU, the structurally dominating DCU is enriched by the sentiment in the dominated unit.

B. Downward Sentiment Inheritance

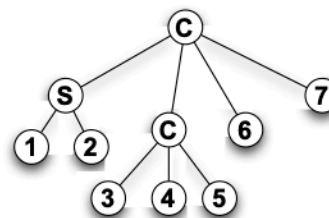
Consider the following text. The first two sentences contain either a **negative** or **POSITIVE** sentiment terms:

3. *I had a **horrible**/WONDERFUL day at work yesterday. Super **ghastly**/FANTASTIC. My boss was in and out of my office all day. He kept asking for last month’s sales figures. He kept saying over and over that he couldn’t believe them. You should have seen the expression on*

his face. Now, I know what’s going to happen with my raise.

Below is the DPT for the two texts collapsed into one above..

- a. I had a **horrible** day at work yesterday. / I had a **wonderful** day at work yesterday.
- b. Super **ghastly**. / Super **fantastic**.
- c. My boss was in and out of my office all day.
- d. He kept asking for last month’s sales figures.
- e. He kept saying over and over that he couldn’t believe them.
- f. You should have seen the expression on his face.
- g. Now, I know what’s going to happen with my raise.



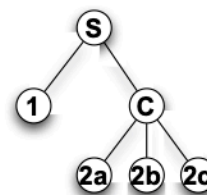
Yet, although the text never indicates explicitly at the sentence level what those sales figures were like, we have no trouble understanding that THE FIGURES THE BOSS EXAMINED in (4) were pretty terrible, while THE FIGURES THE BOSS in (5) examined were pretty wonderful. The speaker is confident of her RAISE in (4) and probably fearful for her job in (4).

The negative interpretation of the first and the positive interpretation of the second text can be understood only with reference to the discourse as a whole. The sentiment in the description of the day is, in each text, inherited from the sentiment expressed explicitly in the DCUs dominating the identically phrased elaborations of what went on at the office.

C. Upward Sentiment Inheritance

Elaborations provide more detail about an entity. In the following example, a hotel is mentioned, followed by a subordination that gives more detail about some aspects of that hotel (the rooms, the view).

4. (1) *In Granada, I found a hotel.* (2a) *The room was very clean,* (2b) *the service was excellent and* (2c) *the breakfast room had a great view of Alhambra.*
5. (1) *In Granada, I found a hotel.* (2a) *The room was not clean,* (2b) *the service was poor and* (2c) *the breakfast room had a lousy view of a neighboring gas station.*



Because the hotel is the sum of its parts, and we can assume all relevant parts are mentioned, we can conclude that the opinion about the hotel will be the same as the one expressed about those parts. Note that the assumption that we gave all relevant parts is crucial. We easily can cancel the implicatures of the subordinate clauses by adding more information, for example, by following (a) with *Still, I hated staying there* or (b) with *I did love the stay there, though, because I met my future wife in the entry hall*. This mirrors the difference between *John is a mediocre mathematician* and *John is a mediocre mathematician but as a human being he is first rate*.

VII. PREVIOUS WORK

Somasundaran [19] and in her Machine Learning based work with colleagues [20] have developed a framework of opinion frames consisting of two opinions with united or contrasting targets which they use to improve classification using a Machine Learning approach that combines a number of indications based on a number of discourse level features in addition to the RST relations including continuity in the spirit of Grosz and Sidner [12] coreference relations, dialog moves and information culled from the Penn Discourse Tree Bank [21]. Unfortunately, it is difficult to isolate the significant generalization about the phenomena at hand.

This is in contrast with the work on opinion of Asher et al. [15,22] and with the work on sentiment to the efforts of Choi and Cardie [23] and Moilanen et al. [24] who have developed methods that rely on sentential syntactic relations among constituents to compositionally compute the scope of sentence level sentiment expressions. Thus, an adjective, a predicate, determines the sentiment of the noun which it modifies. Because these researchers use sentential syntactic information to determine sentential sentiment, they are unable to extend their analysis to the discourse level.

Both sentiment work in the S-DRT framework [21] and the approach to discourse taken in the Linguistic Discourse Model (LDM) framework aim to model the structure of discourse to provide an explanatory account of the phenomena at hand. There are great similarities in these two approaches which is not surprising since S-DRT originated in combining the LDM with Discourse Representation Theory [12,13]

In the case we discuss here, the discourse parse tree emerges from simple syntactic operations without the overhead of S-DRT. The implementation presented here thus is able to account for sentiment at the discourse level using an approach that is both conceptually powerful and computationally simple.

VIII. REFERENCES

- [1] L. Polanyi. 1983. On the Recursive Structure of Discourse. In K. Ehlich and Henk van Riemsdijk, eds. *Connectedness in Sentence, Discourse and Text*. Tilburg: Tilburg University,. Pp. 141-178.
- [2] L. Polanyi. 2003. The Linguistic Structure of Discourse. in D. Schiffrin, D. Tannen, H. Hamiltons eds. *Handbook of Discourse Analysis*. London. Wiley-Blackwell.
- [3] L. Polanyi and R. Scha 1984. A Syntactic Approach to Discourse Semantics. *Proceedings of the 10th International Conference on Computational Linguistics*. Stanford University, Stanford, CA, July 2-6, 1984.
- [4] R. Scha, L. Polanyi (1988). An Augmented Context Free Grammar for Discourse. *Proceeding of the 12th International Conference on Computational Linguistics*. Budapest, August. Pp. 573-577.
- [5] L. Polanyi and M. H. van den Berg. 1999. Logical structure and Discourse Anaphora Resolution. in *Proceedings of the ACL99 Workshop on the Relationship Between Discourse/Dialogue Structure and Reference*.
- [6] L. Polanyi, M. H. van den Berg, C. Culy, G.L. Thione, D. Ahn (2004a). Sentential Structure and Discourse Parsing ACL2004 - Workshop on Discourse Annotation
- [7] L. Polanyi, C, Culy, M. H. van den Berg, G.L. Thione, D. Ahn. 2004b. A Rule Based Approach to Discourse Parsing. *Proceedings SigDial 04*.
- [8] H. Prüst, R. Scha, M. H. van den Berg (1994). Discourse Grammar and Verb Phrase Anaphora. *Linguistics & Philosophy* (17).
- [9] M. H. van den Berg. 1996. *Discourse Grammar and Dynamic Logic*. in P. Dekker, and M. Stokhof, (eds.): Proceedings of the Tenth Amsterdam Colloquium, ILLC/Department of Philosophy, University of Amsterdam.
- [10] K. Lengel. 2011. Review of 'Midnight in Paris. *The Arizona Republic* - May. 26, 2011
<http://www.azcentral.com/thingstodo/movies/articles/2011/05/25/20110525midnight-paris-movie-review.html>
- [11] D. Marcu. 2000. *The Theory and Practice of Discourse Parsing and Summarization*. Cambridge, MA: MIT Press.
- [12] N. Asher. 1993. *Reference to Abstract Objects in Discourse*. Kluwer Academic Publishers,.
- [13] N. Asher, and A. Lascarides. 2003. *Logics of Conversation*. Cambridge University Press, Cambridge.
- [14] B. Grosz, and C. Sidner. (1986) Attention, intentions and the structure of discourse. *Computational Linguistics*, 12:175-204.
- S. D. Afantenos, Nicholas Asher. 2010. *Testing SDRT's Right Frontier*, COLING 2010.
- [15] J. Maxwell and R. Kaplan. 1993. The interface between phrasal and functional constraints. *Computational Linguistics*, 19:571-589.
- [16] L. Polanyi. 1985. A theory of discourse structure and discourse coherence. in P. D. Kroeber W. H. Eilfort and K. L. Peterson, eds, *Papers from the General Session at the 21st Regional Meeting of the Chicago Linguistics Society*.
- [17] Somasundaran S. (2010). *Discourse-Level Relations for Opinion Analysis*. PhD Dissertation, Department of Computer Science, University of Pittsburgh.
- [18] S. Somasundaran, J. Wiebe, and J. Ruppenhofer. 2008. Discourse Level Opinion Interpretation. *The 22nd International Conference on Computational Linguistics (COLING-2008)*.
- [19] R. Prasad , N. Dinesh , A. Lee , E. Miltsakaki , L. Robaldo , A. Joshi , B. Webber (2008) The Penn Discourse TreeBank 2.0 In *Proceedings of LREC 2008*.
- [20] N. Asher, F. Benamara, Y. Yannick Mathieu. 2008. *Distilling Opinion in Discourse: A Preliminary Study*. COLING (Posters) : 7-10
- [21] N. Asher, F. Benamara, Y. Y. Mathieu. (2008b). *Categorizing Opinion in Discourse*. ECAI 2008. 835-836
- [22] Y. Choi and C. Caride.2008. Learning with Compositional Semantics as Structural Inference for Subsentential Sentiment Analysis.. (*EMNLP*), 2008
- [23] K. Moilanen, S. Pulman, and Y. Zhang. (2010). Packed Feelings and Ordered Sentiments: Sentiment Parsing with Quasi-compositional Polarity Sequencing and Compression. In *Proceedings of the 1st Workshop on Computational Approaches to Subjectivity and Sentiment Analysis (WASSA 2010)* at the 19th European Conference on Artificial Intelligence (ECAI 2010, Lisbon, Portugal. pp. 36-43