

The Semantic Macrostructure and Mental Models in Political Speech: Mathematical Approaches and Text Mining

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Abstract:- This research is a contribution to the discourse analysis, how the author uses the discourse tools to create the macrostructure, interrelationship between knowledge and communication based on discourse macrostructure theory, guided by the Fairclough's critical discourse analysis (CDA) and mental models for the global structure which explains knowledge and psychological factors of participants by Teun A. van Dijk and (Garnham 1987; Johnson-Laird 1983; van Dijk & Kintsch 1983; Van Oostendorp & Zwaan 1994).

Through the analysis, aimed to identify the author's attitude, has been reviewed the creation of discourse mental model is a direct representation of attitude from the author within mental space described by knowledge, presupposition from the situation, then understanding of the issues is people take information directed by the author's attitude and belief, also tried to find out how interviewer uses discourse tools to approach and discover the guest's attitude at all. Moreover, it examines how to create knowledge which is a base of the macrostructure and global meaning of discourse. The meaning of keywords and concepts that express the global meaning of the discourse, were weighed mathematically to determine the significant value. These top ranks of weighted words are considered as a cognitive mapping and mental model within knowledge theory and information structure theory, thus here, aimed to identify and analyze authors' opinions and attitudes in political speech.

Keywords:- Macrostructure, Cognitive mapping, Semantic Knowledge, Mental Model, Topic modeling, text mining, mathematical statistic.

I. INTRODUCTION

Language is a key dimension of human thought and in its mental space. Philosophers believe that language is a system of signs that is a popular means of embodying the content of both consciousness and intellectual culture. They are knowledge models for creating ideas, expressing ideas, and analyzing ideas. The space for the creation of knowledge and the mind are the concepts and cognition that ideas "catching" information from everyday life, social experiences, episodic and information flows, and then organize them in their neural networks in the brain.

The factors that assess knowledge depend on the socio-cultural environment, and each field of knowledge is a gestalt created by its own value.

"The power of the mind is the complex act of making a natural thing a social thing, and then the owner of the action can change the social thing according to certain conditions and describe it in his own way. Even ancient thinkers considered language and thought to be one and the same. For example, the ancient thinkers understood the term "logos" to include both words, concepts, ideas, and knowledge "(B. Dagiimaa, EC, 2020).

In the social sciences, knowledge is a key factor in determining variables and their relationships. Therefore, in this research article, we have tried to define the semantic macro structure of discursive meanings through linguistic and mathematical models, considering that mental models, discursive attitudes, and cognitive semantics are the main factors determining knowledge and the role of knowledge in discursive attitudes.

II. RESEARCH OBJECTIVES

Objective: Within theory of discourse macrostructure aims to analyze the semantic structure of meaning using a 'language-mathematical' model for creating, expressing, analyzing, modeling and optimizing knowledge'.

The "topic modelling" of the discourse is scaled by mathematical models to determine the author's ideas, positions, implications, and conclusions in terms of factors, as well as to determine whether decisions could be made at the decision-making level based on mathematical models alone.

Research hypothesis: The "key word" that forms the macro structure of the discourse is the cognitive and intellectual "result" and is the author's deliberately chosen mental model. These mental models have a "significant mathematical value: significant value" that defines the structure of discourse meaning.

III. RESEARCH MATERIALS

[<https://www.americanrhetoric.com/> the research case is Barack Obama's 'Speech Proposing Financial Crisis Responsibility Fee', which is one of America's top 100 speeches on overcoming the economic crisis and the country's policy.

IV. LITERATURE REVIEW

A. Philosophy of knowledge

The primary function of language is the function of communication to convey ideas. Therefore, defining the role of language begins with understanding the nature of speech at the level of communication. (Bloomfield, 1998), Finch (1998), (Wisniewski, Word Formation, June 13, 2014) The role of language use is to inform and to communicate (Finch, Function of language, 1998). (Wisniewski, Word formation, 2007). The main tool for expressing ideas is "Knowledge". Knowledge is an important factor in creating discourse and understanding discourse. Knowledge is the general level of "understanding" of a writer, speaker, or interlocutor, how he or she views the issue from many angles, how well it conforms to general principles, how he or she evaluates real-world phenomena, and the current and historical context in which the issue is relevant. It is the most important criterion for determining the direction of an individual's development, maturity, and position concept, such as how time and chronology are used. (B.Dagiimaa, EU, 2020) Knowledge itself is discourse. I believe that understanding is more important than creating discourse. (Nunan, 1993, p. 69). Consideration of all forms of knowledge as a discursive factor in the construction of relationships and attitudes is a key issue in discourse studies.

At all, regarding the concept of discourse: "*Dis • course* \ 'di-, skörs, di- 'skörs \ 1.a.literary a conversation; talk. b. a dissertation or treatise on an academic subject. c. a lecture or sermon. 2. linguistics a connected series of utterances; a text. 1.intr talk; converse 2. intr. (usu. Foll. By of. On, upon) speak or write learnedly or at length (on a subject). (Judy Pearsal, 1995) (Bill Trumble, 1995). *Discourse analysis focuses on the structure of naturally occurring spoken language, as found in such 'discourses' as conversations, interviews, commentaries, and speeches. Text analysis focuses on the structure of written language, as a found in such 'texts' as essays, notices, road signs, and chapters.* (Crystal, The Cambridge Encyclopedia of Language, 2008) "*Discourse is a theory and methodology about the role of language communication, which studies language use, interpersonal relationships, and attitudes based on socio-cultural environmental factors. Therefore, the pragmatic theory of language use, the theory of knowledge, and the theory of meaning are discourse studies. The concept of "power + knowledge" by the French philosopher Michel Foucault, the pioneer of discourse theory, has become a key measure and value of knowledge in discourse studies.* (B.Dagiimaa, theoretical and methodological issues of discourse: on the example of discussion of interview, 2019).

Therefore, the general principles and concepts of discourse are the same as the general theory and concepts of knowledge, and are defined by models of cognitive psychology, philosophy of knowledge, and general theory of mind.

V. THEORITICAL FRAMWORK

Semantic knowledge is a gestalt of knowledge gained by thought and beliefs, such as abstract modeling, understanding and comprehending based on everyday life experience, in general it's the ability to abstract the concretes. It is measured by episodic-based personal experiences, memories, general knowledge, and specific knowledge. In principle, any knowledge should move from episodic to semantic knowledge. Semantic knowledge is an issue related to the scope of intelligence and knowledge with cognitive psychological factors that interact with procedures and episodes to complement each other. (Tulving, 1972; Hodges, Salmon & Butters, 1992; Garrard et al., 1997; Laatu, 2003).

Semantic knowledge creates space on three levels in a hierarchical structure. (Garrard, Lambon Ralph, Hodges & Patterson, 2001) There is a level of higher or general knowledge, a sub or detailed level of knowledge, and a level of primary or specific expression. Semantic expression is a form of knowledge that summarizes the characteristics of an item and is a type of knowledge that consists of many small units and sub-concepts. There is a general principle to classify things according to their characteristics or to define them by their characteristics. (Garrard et al., 2001; Garrard et al., 2005). These are at three levels of abstraction: common space, source space, and mixed space (Mark Turner), and create a whole spatial network that depends on distant and near values, such as central, peripheral, and integrated space (B.Dagiimaa, Mental space and mental lexicon: on experiments results, 2019). Set of knowledge and chunk of ideas within discourse macrostructure, are a mental model that is a key issue in discourse and semantics.

A mental model is a set of ideas, perceptions, and concepts that refers to something. The connection of the phenomena of the world is considered to be interdependence, logical semantics, and imagination based on the laws of nature and society. The solution to a problem is a whole set of ideas, consisting of related units of ideas that help to find a solution. The mental model is a basic cognitive problem, and because it is a concept of cognitive semantics, it is a level of memory, attention, semantic knowledge, cognitive ability, and ingenuity-based knowledge (Craik, 1943). (Johnson-Laird, 1983) The mental model is the architecture of knowledge and is an analogy of the situation defined by the laws of reason and logic (Wittgenstein, 1922). The mental model is a group of mental functions of the mind based on psychological factors (Johnson-Laird B.). a., 2009). Researcher N.Nansalmaa use the term "concept" as "the basic concept of cognitive linguistics is inevitably a complex concept (concept, lat. Conceptus-concept). A complex concept is a unit of thought and is located in the human consciousness. Such an implicit, abstract concept is the basis for such a variety of models. A complex concept is defined as a set of knowledge of the real world, a reflection in the brain based on the individual's cognitive experience of the phenomenon, and the person's knowledge of the phenomenon. It is possible to regulate the units that represent a complex concept and to classify them in terms of meaning recognition, and as a result, it is possible to model a complex concept. The content structure of a complex concept tends to

change. This is due to the fact that the structure of human knowledge is changing ”(p. 71) (N. Nansalmaa, S. Dolgor, 2014).

However, In modern semantics, 'topic modeling' is the mathematical modeling of keywords that make up the macro structure of discourse. It optimizes knowledge in a way of visualizing distribution of polygon, semantic nodes of neuron networks, binaries of positive and negatives.

VI. TOPIC MODELING AND METHODOLOGY

In modern discourse, a text mining and NLP (Natural language processing) approach are widely used to optimize knowledge modeling and algorithms mathematically the text through the semantic node and neuron network to uncover the implications and ideas. Optimizing knowledge and information structure is evolving into a multidisciplinary, multidisciplinary scientific approach to digitizing large amounts of information, visualizing it, determining correlations, weighted averages, the distribution of topics, and sentimentality. Mathematical approaches such as frequency and approximation value clustering are used to determine the structure of discourse values, and all text analysis methods, such as determining value nodes based on neural network algorithms, are performed by data-driven machine processing. Latent dirichlet allocation (LDA) is an approach used in topic modeling based on probabilistic vectors of words, which indicate their relevance to the text

corpus and how they can be used together to provide more relevant results for the general method. (Papadimitriou, Raghavan, Tamaki and Vempala, 1999), (David Blei, Andrew Ng, Michael I. Jordan, p. Dirichlet prior discourse.

Algorithms and formulas:

- ✓ Basic IR Models – Boolean Model – TF-IDF Weighting – Vector Model – PLSA – Latent Semantic Indexing Model – Neural Network Model – Retrieval Weigh a concept (keyword) in a semantic network by frequency:

- ✓ Tf-idf: (tf) normalizing

$$tf(t, d) = 0.5 + 0.5 \cdot \frac{f_{t,d}}{\max\{f_{t',d} : t' \in d\}}$$

- ✓ Determine the strength of the inverse frequency relationship: (idf)

$$tf-idf(t, d) = tf(t, d) * idf(t)$$

$$idf(t, D) = \log \frac{N}{|\{d \in D : t \in d\}|}$$

- ✓ (PLSA) formulas

$$P(w, d) = \sum_c P(c)P(d|c)P(w|c) = P(d) \sum_c P(c|d)P(w|c)$$

114.591559	degree	frequency	betweenness	topic	conductivity	locality	diversity
sum total	1288	310	2.85556	n/a	1839.8	655	7790.2
sum / 150 node	8.59	2.07	0.019037	n/a	12.27	4.37	51.93

Table 1: Data table of semantic nodes ‘Speech Proposing Financial Crisis Responsibility Fee’

Semantic nodes in the structure of the discourse: **150/8.59**, the power of the inverse of the frequency of concepts, their location: **150/2.07**, distance between topic modeling: **0.019**.

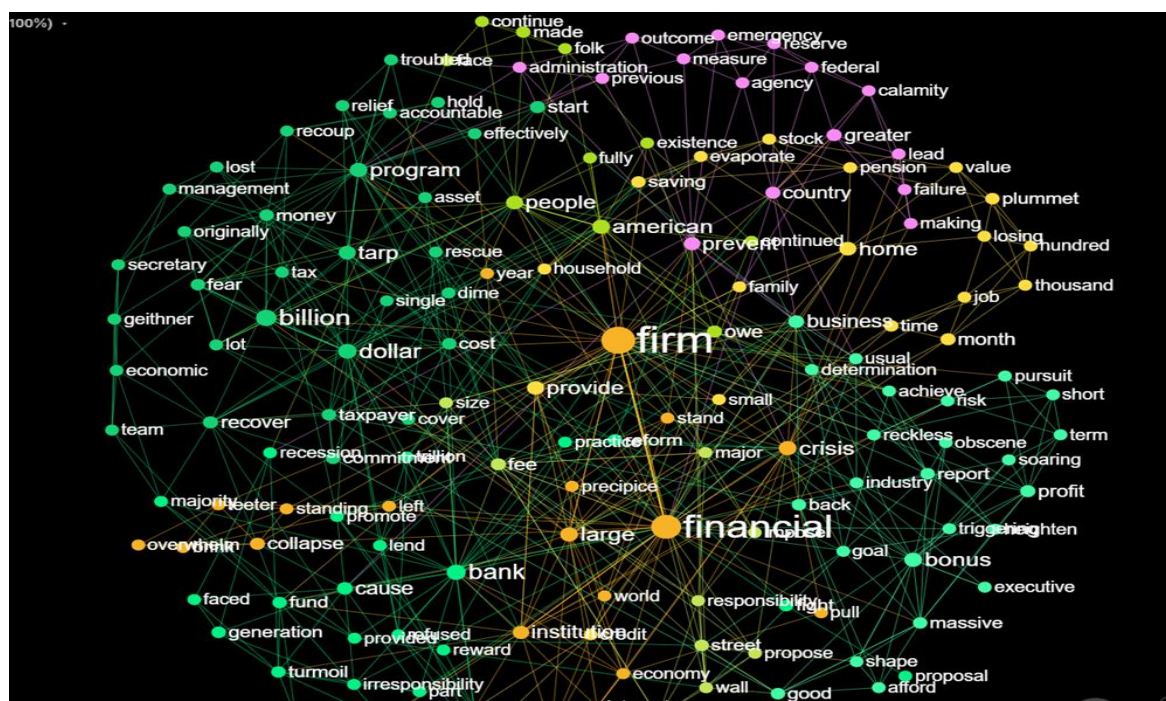


Fig.1: Semantic macrostructure of 'Speech Proposing Financial Crisis Responsibility Fee'

Semantic nodes in the discourse structure, frequency limits, and their relationships: “Yellow / green / pink” network space and probabilistic semantic nodes in semantic macrostructure

Core Topic modeling: 'FIRM' / 44/12 / 0.48

The strongest linear relationship is 'Financial' -46/12/0.36/

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firm	44	12	0.484824	2	110.2	0	404
financial	46	12	0.367038	2	79.8	1	305.9
billion	16	4	0.137183	3	85.7	0	343
dollar	26	5	0.104299	3	40.1	1	208.6
bank	29	7	0.096561	1	33.3	1	137.9
large	19	4	0.09269	2	48.8	0	231.7
program	27	6	0.092678	3	34.3	1	154.5
american	16	5	0.08548	7	53.4	0	171
bonus	18	5	0.080739	2	44.9	0	161.5
provide	14	3	0.080132	3	57.2	0	267.1
people	21	6	0.07788	7	37.1	1	129.8
prevent	15	3	0.067651	0	45.1	0	225.5
institution	18	4	0.063523	2	35.3	1	158.8
home	11	3	0.06324	4	57.5	0	210.8
crisis	21	6	0.052771	2	25.1	1	88
business	15	5	0.044829	6	29.9	1	89.7

Table 2

Data table of Semantic macrostructure in 'Speech Proposing Financial Crisis Responsibility Fee'

Frequency values with semantic significance in the discourse structure: 1288/310, limits of topics: 2.85

The most Significant values: between topics

“FIRM” / 44/12 / 0.48

“FINANCIAL” -46 / 12 / 0.36

“BANK”: 29/7/0.96

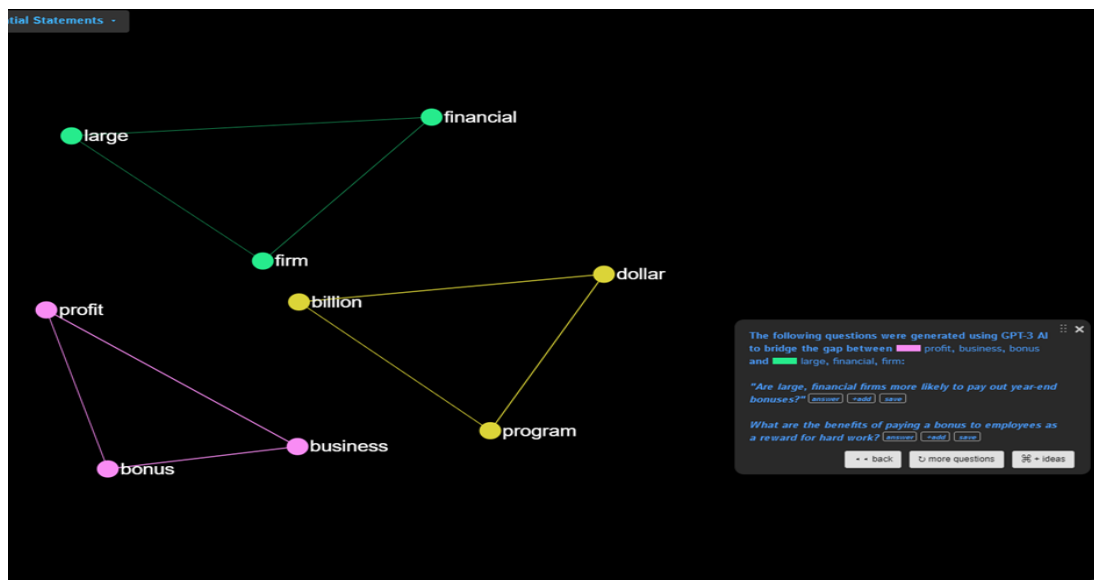


Fig. 2

The most significant topic models in Semantic macrostructure in 'Speech Proposing Financial Crisis Responsibility Fee' basic topic models are:

Yellow: program, dollar, billion

Green: Financial, firm, large

Pink: business, profit, bonus

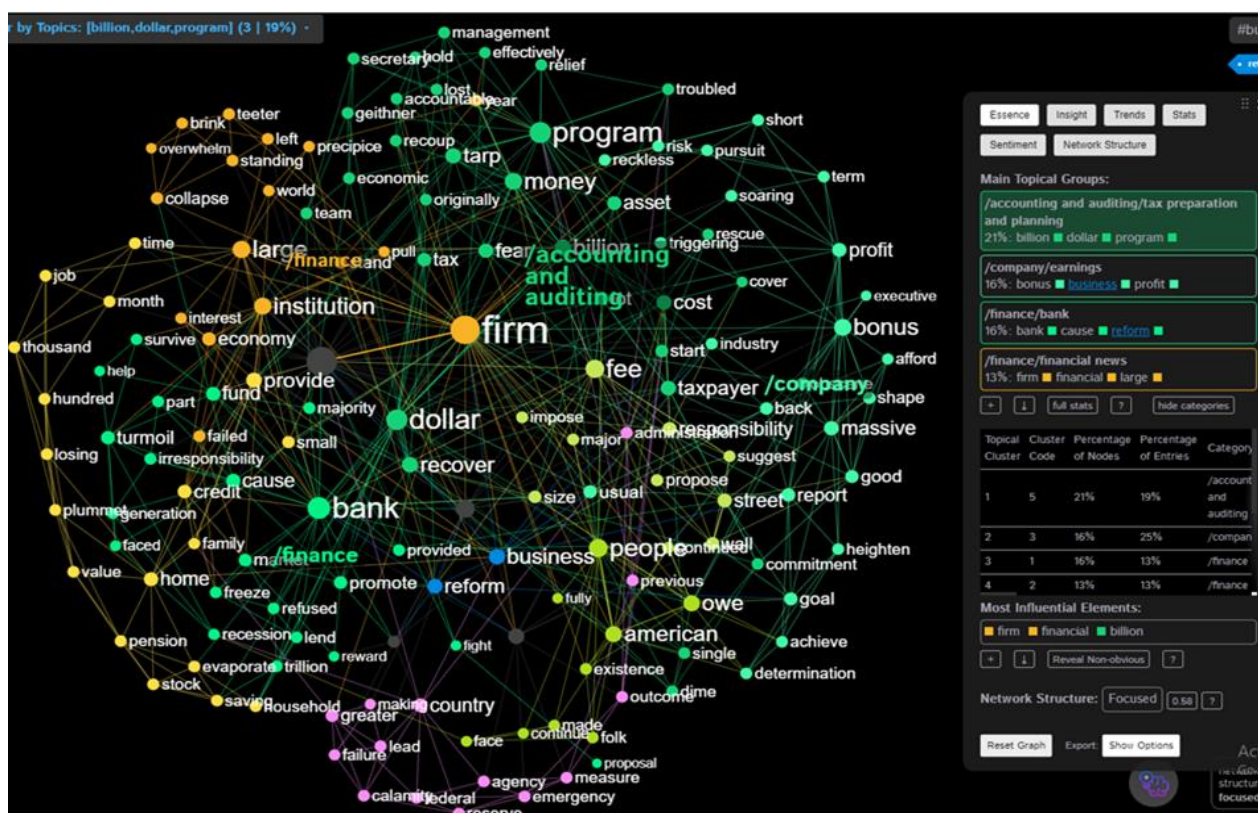


Fig.3

The most significant mental models in Semantic macrostructure in 'Speech Proposing Financial Crisis Responsibility Fee' From "Topical modeling" to 'Mental model':

A.accounting and auditing, b. Finance, c. company

Cluster	%Nodes	Percentage	Category	Keywords	Keywords	Keywords	Keywords	Keywords	Keywords
2	19%	19%	/finance	firm	financial	large	bonus	institution	crisis
1	14%	13%	/finance	bank	cause	reform	fight	market	generation
3	13%	13%	/accounting and auditing	billion	dollar	program	provide	tarp	money
7	11%	13%	/music genres	american	people	owe	made	folk	goal
6	10%	25%	/business and industrial	business	taxpayer	usual	commitme	back	report
4	10%	10%	/investing	home	month	saving	plummet	time	value
0	10%	6%	/law, govt and politics	prevent	country	greater	emergency	measure	previous
5	7%	7%	/finance	recover	fund	survive	provided	geithner	secretary
8	6%	10%	/law, govt and politics	fee	street	wall	responsibil	suggest	propose

Table 3

Data of The most significant mental models in Semantic macrostructure ‘*Speech Proposing Financial Crisis Responsibility Fee*’

Significant values and clusters: Keyword distribution: ‘topic-share’ within the masrostructure.

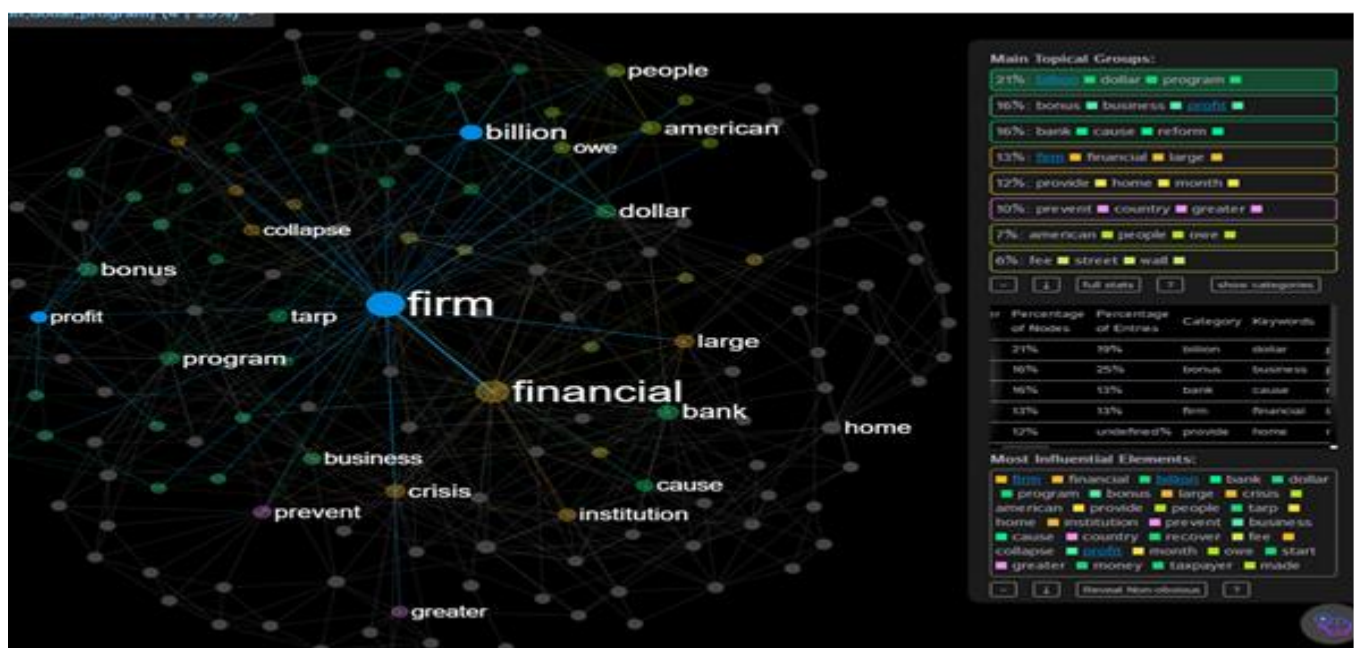


Fig.4

Distribution of The most significant mental models in Semantic macrostructure ‘*Speech Proposing Financial Crisis Responsibility Fee*’

The fig. 4 represents Table.3 in axis, Significant values and clusters: Keyword distribution: ‘topic-share’ within the masrostructure.

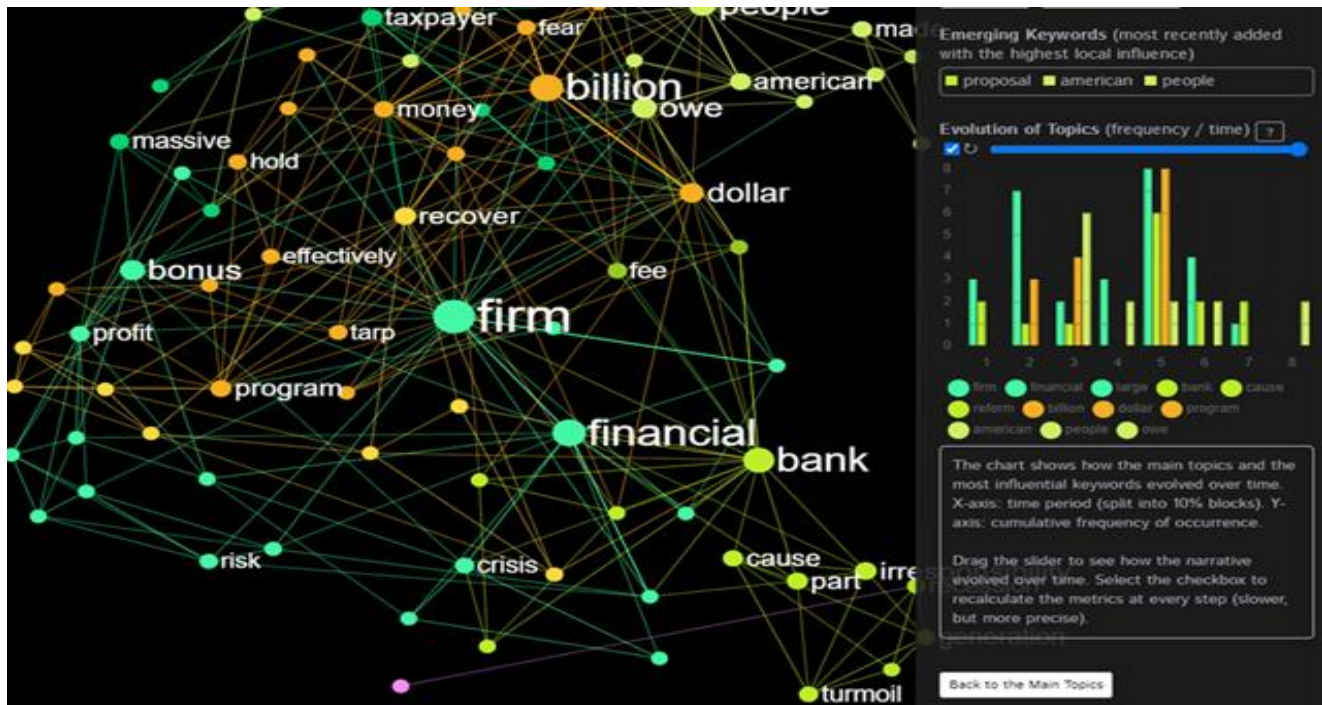


Fig. 5

The evolution of most significant concepts in Semantic macrostructure of ‘Speech Proposing Financial Crisis Responsibility Fee’

Significant values: A graphical representation of the relocation of the macrostructure shows that in the concluding section, there is more “ownership” of banking policies and services, while in segment-6, there is a higher level of corporate capital inflows and programs at the local level.

Significants are: PROPOSAL, AMERICAN, PEOPLE

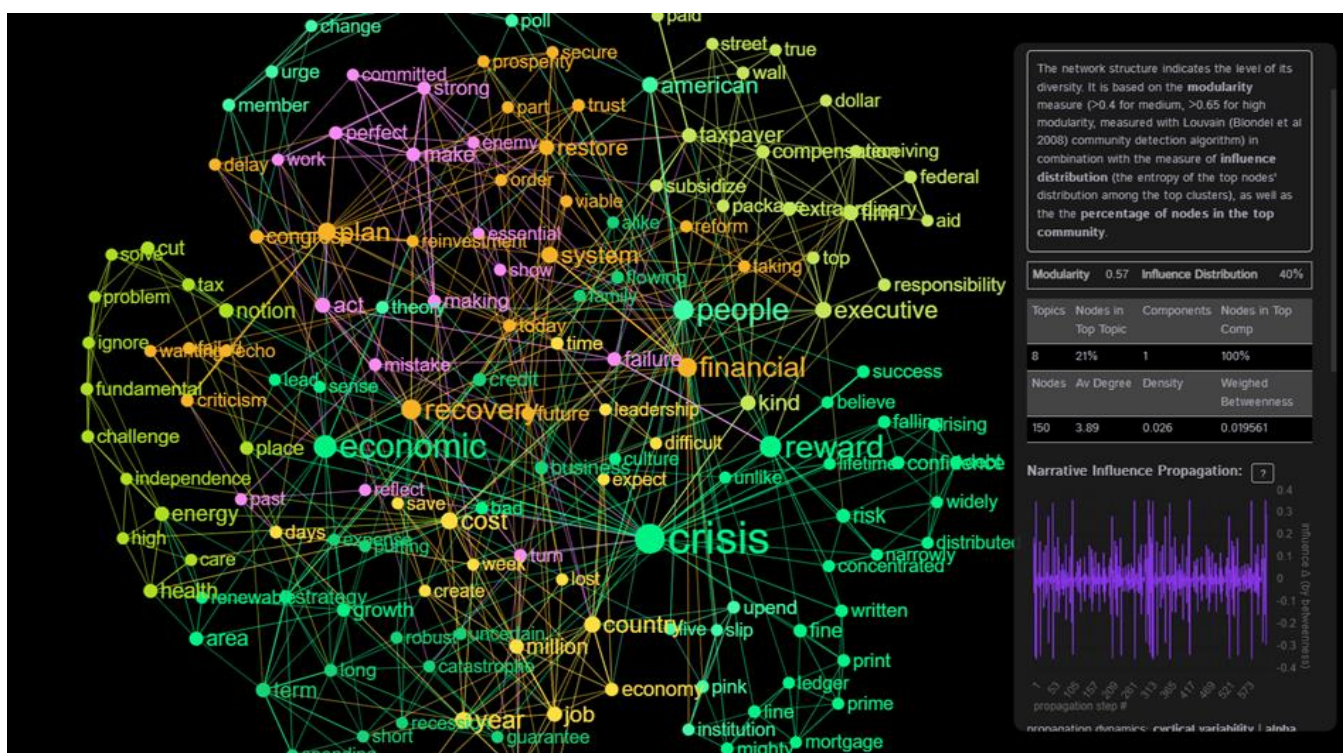


Fig. 6: Discursive “Modularity: 0.58” /narrative influence propagation/ in ‘Speech Proposing Financial Crisis Responsibility Fee’

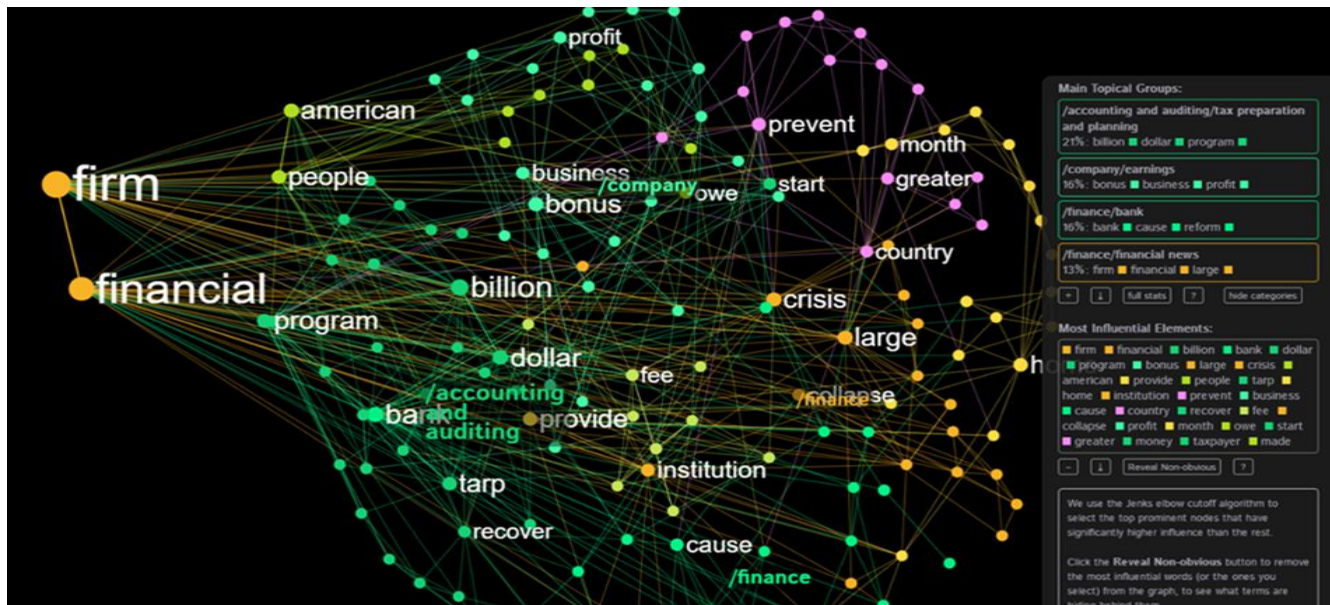


Fig.7

‘Speech Proposing Financial Crisis Responsibility Fee’

Linear and nonlinear Relationships: Optimal Decision Making Model according to graphs the problem Solving Steps from the Content of the discourse states Firm and Financial are the key issues in discourse frame.

VII. SUMMARY

"As Americans and American businesses adopt financial programs to overcome the financial crisis, it will increase cash flow and enable businesses to operate profitably," he said. Note: The case above (Figure -7) is intended to show that it is possible to make a mathematical calculation of the probability that a precautionary measure can be made from the pink grid.

Optimal decision-making models have a marginal and core value structure from the presentation structure. The content structure contains the core of the content that defines the original character.

The core structure is related to the common culture of the people and the world, as well as to common problems and decisive factors. In the mental or discursive approach to modern knowledge, speaking and writing take place in a multi-component phase of "information-information-model-optimization-conclusion".

Each stage, depending on the scope and capacity of the functions of the mind and human cognition, optimally decides whether to achieve the goal.

VIII. CONCLUSION

TOPIC MODELING:

- Discourse structure: The spread of ideas in the form of sub-topics on a single-core 'FOCUSED'/main topic is defined as the core content framework.
- Modularity: 0.58 / influence distribution / Proagation dynamic
- Cyclical variability: 0.45, alpha exponent: 0.45 medium
- Plotting: [Log2 scale] X, Log2 scale [Y] fluctuation LogLog: liner polyfit,
- power: low relation Alpha exponent of the fit: $\alpha < 0.5$
- Variable: (stationary: long term: correlation / $0.65 < \alpha < 1.15$)
- Complex $\alpha > 1.15$
- Maximal diversity: adaptivity and plurality, narrative should be close to fractal
- Type: fiction essays: some form of 'Poetry' uniform
- Informative: will often variable + stationary
- Complex state is an indicator that text is always shifting its state
- Fraction of nodes: ks: 1.03, D: 030 < cr: 0.40
- For mental models: The use of keywords in political discourse is considered to be the main way of expressing ideas, and within a superstructure, those words serve as semantic mentalities that form a semantic structure. The frequency of these keywords or mentalities has a "normal" pattern of distribution at the level of meaning. Barack Obama's Speech Proposing Financial Crisis Responsibility Fee is a fiction essays: some form of 'Poetry' uniform style. The choice of eloquent language tools depends on the speaker's speaking strategy and rhetoric.

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