

Introduction  
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Definitions  
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Contraction  
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Syntactic dream analysis  
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Semantic dream analysis  
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Conclusion  
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# Space of Dream Data through the Lens of Multilevel Graph



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**September 9<sup>th</sup> 2024**

# Existing literature

**Speech Graphs Provide a Quantitative Measure of Thought Disorder in Psychosis**

Natasja R. Molz<sup>1,\*</sup>, Rosalinda A. P. Vassouras<sup>1,2,3</sup>, Nathalia Lewer<sup>1</sup>, Ana C. Ferreira<sup>2</sup>, Dione Kiesewetter<sup>2</sup>, Guilherme A. Cechel<sup>2</sup>, Mauro Capelli<sup>2</sup>, Silvana Ribeiro<sup>1</sup>

<sup>1</sup> Federal University of Rio de Janeiro, Brazil; <sup>2</sup> Federal University of Rio de Janeiro at Rio das Ostras, Brazil; <sup>3</sup> Universidade de São Paulo, Brazil

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**ARTICLE OPEN**

Thought disorder measured as random speech structure classifies negative symptoms and schizophrenia diagnosis 6 months in advance

Katalin M. Matz\*, Ana C. Ferreira<sup>2</sup> and Silvana Ribeiro<sup>1</sup>

In chronic psychiatric patients, thought disorder is characterized by speech that does not follow normal conversational rules. Memory, syntax and semantics are often disturbed. Communication may be impaired due to either language or thought content. In contrast to a single symptom, thought disorder is a complex construct. Current group is 6.8 times more likely to experience negative symptoms than the control group. In addition, negative symptoms are associated with the duration of illness and the presence of positive symptoms.

**SCIENTIFIC REPORTS**

**OPEN** **Graph analysis of dream reports is especially informative about psychosis**

Natasja R. Molz<sup>1</sup>, Rosalinda Puntella<sup>1</sup>, Pedro P. C. Molz<sup>1</sup>, Mauro Capelli<sup>2</sup> & Silvana Ribeiro<sup>1\*</sup>

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**DOI:** <https://doi.org/10.1038/srep01448>

**SUBJECT AREAS:** APPLIED PHYSICS; COMPUTATIONAL MATHEMATICS; DYNAMIC/COMPLEX SYSTEMS

**Summary** Schizophrenia is a severe mental disorder characterized by negative and positive symptoms. Dreaming, as well as other cognitive functions, is associated with the visual system. Therefore, we hypothesized that dream reports may be informative about psychosis. A particular phenomenon observed in patients with schizophrenia is the presence of thought disorder, which is characterized by speech that does not follow normal conversational rules. In this study, we analyzed dream reports from 20 healthy volunteers and 20 patients diagnosed with acute phase schizophrenia. We compared the frequency of words in the reports of patients with those of healthy volunteers. We found that the frequency of words in the reports of patients was significantly higher than that of healthy volunteers. This result suggests that dream reports can be used to predict the diagnosis of psychosis based on the analysis of dream graphs, pointing to a low, but not negligible, diagnostic accuracy.

**Introduction** The term “thought disorder” has been used to describe a range of symptoms, such as delusions, hallucinations, and妄想 (paranoid thoughts). These symptoms are often associated with schizophrenia and other psychiatric disorders. However, the concept of thought disorder is not well-defined and its relationship with other symptoms is not fully understood. In this study, we used graph analysis to investigate the nature of thought disorder in patients with schizophrenia. We found that the frequency of words in the reports of patients was significantly higher than that of healthy volunteers. This result suggests that dream reports can be used to predict the diagnosis of psychosis based on the analysis of dream graphs, pointing to a low, but not negligible, diagnostic accuracy.

**Methods** Dream reports were recorded during a night of sleep, unpreceded by objective tests and minimally perturbed by experts. Standard psychiatric diagnosis has been highly criticized, despite its widespread use. In fact, it is a subjective process that lacks objectivity and reliability. In addition, expert agreement is low, and dream reports do not have categorical boundaries and clear-cut definitions between certain models may be controversial. For instance, subjects with schizophrenia or bipolar disorder type I and non-psychotic controls in their reported waking and dream contexts. Schizophrenic patients also report more negative symptoms than non-psychotic controls. In this study, we used a quantitative measure to evaluate psychopathology scales. Bipolar and control subjects were distinguishable by walking and running speeds, respectively. In addition, we used a quantitative measure to evaluate the frequency of experienced phenomena versus of walking relatedness for the proxy writing. Otherwise, the results indicate that the frequency of words in the reports of patients was significantly higher than that of healthy volunteers. This approach reflects on the importance of梦的分析在 the analysis of dream reports across the different types of psychosis.梦的分析在 the analysis of dream graphs, pointing to a low, but not negligible, diagnostic accuracy.

**Results**梦的分析在 the analysis of dream reports across the different types of psychosis.梦的分析在 the analysis of dream graphs, pointing to a low, but not negligible, diagnostic accuracy.

**Discussion**梦的分析在 the analysis of dream reports across the different types of psychosis.梦的分析在 the analysis of dream graphs, pointing to a low, but not negligible, diagnostic accuracy.

**Conclusion**梦的分析在 the analysis of dream reports across the different types of psychosis.梦的分析在 the analysis of dream graphs, pointing to a low, but not negligible, diagnostic accuracy.

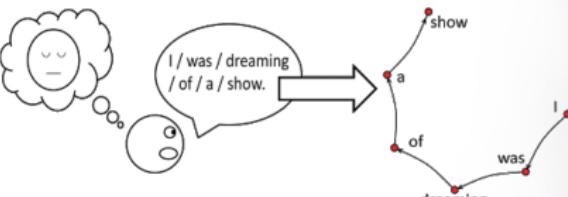


Figure 4 | 448

# Existing literature

**ARTICLE OPEN**  
Thought disorder measured as random speech structure classifies negative symptoms and schizophrenia diagnosis 6 months in advance  
Natasja R. Molin\*, Mauro Capelli\* and Silvana Ribeiro\*

In chronic psychiatric patients, negative symptoms are often present, whether due to the disease or to other causes. In addition, memory reports may be altered in patients with schizophrenia. Consequently, it is important to distinguish between negative symptoms and memory reports in patients with schizophrenia. In this study, we compared negative symptoms and memory reports in patients with schizophrenia and healthy volunteers. We used a graph-theoretical approach to measure the complexity of speech. Delusions, paranoid and non-paranoid, were measured with the visual rating scale (VRS) and the positive and negative symptom rating scale (PSYR). A particularly interesting finding was that negative symptoms and memory reports in patients with schizophrenia were more similar than those in healthy volunteers. This finding suggests that negative symptoms and memory reports in patients with schizophrenia are more similar than those in healthy volunteers.

**ARTICLE OPEN**  
Graph analysis of dream reports is especially informative about psychosis  
Natasja R. Molin\*, Rosminda Puntambé, Pedro P.C. Molin, Mauro Capelli\* & Silvana Ribeiro\*

Psychosis is a core symptom of schizophrenia. In addition, negative symptoms and memory reports are also present in patients with schizophrenia. Consequently, it is important to distinguish between negative symptoms and memory reports in patients with schizophrenia. In this study, we compared negative symptoms and memory reports in patients with schizophrenia and healthy volunteers. We used a graph-theoretical approach to measure the complexity of speech. Delusions, paranoid and non-paranoid, were measured with the visual rating scale (VRS) and the positive and negative symptom rating scale (PSYR). A particularly interesting finding was that negative symptoms and memory reports in patients with schizophrenia were more similar than those in healthy volunteers. This finding suggests that negative symptoms and memory reports in patients with schizophrenia are more similar than those in healthy volunteers.

*"In chronic psychotic patients, word graph analysis shows potential as complementary psychiatric assessment."*

*"The results demonstrate the feasibility of the differential diagnosis of psychosis based on the analysis of dream graphs, pointing to a fast, low-cost and language-invariant tool for psychiatric diagnosis and the objective search for biomarkers."*

*"The results also show that dream reports are substantially more informative about the mental state of psychotic subjects than waking reports."*

# Sources of dreams



## Sogniario

Sogniario è una applicazione mobile sviluppata dall'Università di Camerino per registrare e catalogare i sogni.

Username —

Password —  

 Entra come utente  Entra come ricercatore

 Scarica l'app (Android)

# Sources of dreams

DreamBank  
[www.dreambank.net](http://www.dreambank.net)

**Query:** [ ] Search [ HELP ]

**Dream series:**

**Filters:**  
 All  In story  
 All  In text  
 All  In title  
 All  In URL  
 Dream  Dreamer  
 Date  Date range  
 Description  Description range  
 Event  Event range  
 Location  Location range  
 Person  Person range  
 Thing  Thing range  
 Word  Word range

**Hatching mode:**  
 Words  Sentences

**Share info:**  
 Consistency?  No

**Similar dreams:**  
 None  Date  Contingency

**Consistency chart:**  
 Low  Middle  High

**Consistency chart:**  
 Low [ ] Middle [ ] High [ ]

**Search series: Enna: 48 years of dream**  
 Search 1  
 Search rock. Find all terms (AND)  
 Case-sensitive: no  
 Number of dreams searched: 1221  
 Search (0 seconds.)

**Enna: 48 years of dream**  
 1221 (100%)

**Enna: 48 years of dream (nr 1221)**  
 Show dreams [ ] Hide dreams [ ]  
 Abbreviate dreams  
 Regulate matches  
 Count words

(Click here to jump to the bottom of the list)

**#1949-001**  
 Driving in front of a hotel at a resort and we have to take a boat to another beach where it's calm but there is a big storm with breakers out of sea and there are French boats closing off the exit from the boat house to the sea. I remember holding the doors closed against the onslaught of the breakers. Later everyone has to leave the boat house and then, in a few minutes, a huge wave tears the boat house away and whips it out to sea. Only the boatmen and a few stragglers remain and they are eventually saved. We must stay at a hotel. (111 words) [\[COOKING\]](#)

**#1949-002**  
 Dr. Brooke (thesis advisor) asks me to go to a night club called "Iowa Park" where they usually drink till 4 AM. I don't want to go but he said that he would not look at my paper otherwise. He even buys me a t-shirt. Mother is still alive (she died 4/13/47). She prevents me from going. She is jealous and she wants me to help her clean the house. (71 words) [\[COOKING\]](#)

**#1949-003**  
 I am a queen much admired. M. (lover) is at my side and service. Feeling of ultimate achievement. Shft. Mrs. Jones (professor and supervisor) has died. Mr. Jones is very bereft. I offer him help and services. Much ado about it all. The newspapers carry headlines and are tucked up all along the corridor of the psychology department. Bouquets of flowers sent. General feeling of sorrow. I am consulted by Mr. Jones about the funeral arrangements and then offer to go to live with him in his house as I am divorcing Edward (first husband). (36 words) [\[COOKING\]](#)

**#1950-001**  
 Driving to mountains with Edward; we go ahead while mother-in-law and my father follow. Father is in a horse, dragged along the ground by a truck. He said he liked it that way. W. and I have a regal meal but W. forgets to give some to father. I miss even though I realize that he really is dead already (Reality: he died 1949). Shft. I meet K. (old lover), we drive together and then walk down the mountain. We find a spot that was "only walking to be passed by Cesecine" (very vivid impression). It is a Dutch-like palace in yellow and greens in Cesecine's style. A house by the sea. K. and I seem to be staying there. There is a large garden with trees and flowers. I see myself in the foreground and father is behind Cesecine in the background of the house. Shft. I invite K. to stay at our place in L. City telling him that no one will be there, but when we arrive Mrs. L. (our renter) is asleep and father is in my brother's bedroom. Therefore K. is forced to stay with me in my bed. Remember only a few kisses. In the morning father worrying about Mrs. L.'s political views. (207 words) [\[COOKING\]](#)

**#1950-002**  
 Parents come to life' out of the grave, despite having been cremated. Father looks the same and mother tries to run my life again. They don't seem astonished. I understand that Forest Lawn is being sued for burying them alive! Shft. I walk along a ramp with A.S. (University instructor) and think of him as my therapist. He says, "In two years mother's cancer could have been cured," but he can't explain it. He is very understanding. At home mother sees a daughter born after mother's death and she says, "So that is what you have been up to." Much commotion and people. Feeling of irreducible, how could it have happened? But no explanation. [\[COOKING\]](#)

## An Arlie's dream

*"I am at a lake in my hometown. Something is going on there and we are in a hurry to get away. We get in a station wagon and have a hard time getting two pet deer, with the same names as my son and daughter, corralled. Finally we get them into the vehicle and we are almost all the way out when the wheel goes off one side of the road and the vehicle is stuck and the deer is about halfway out. At this point I notice my mother-in-law is cutting off a Christmas tree which is growing in the water at the end of the dock."*

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STOPWORDS  
REMOVAL

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STOPWORDS

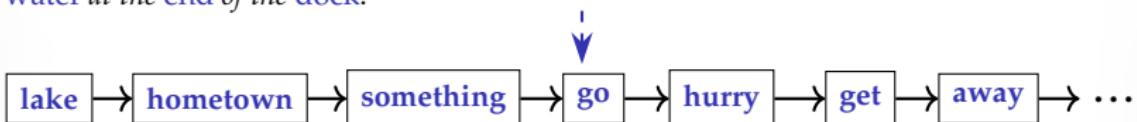
REMOVAL

LEMMATI-  
ZATION

# An Arlie's dream

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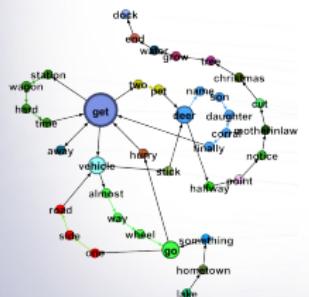
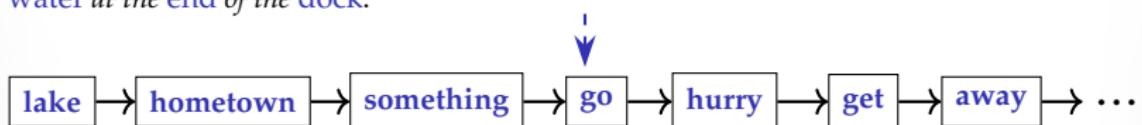
STOPWORDS  
REMOVAL  
LEMMATI-  
ZATION



# An Arlie's dream

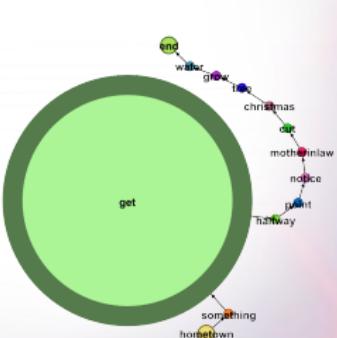
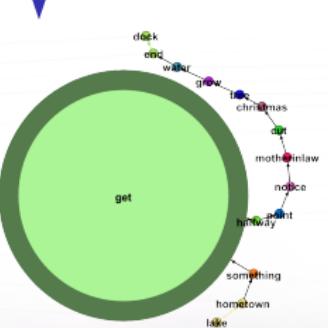
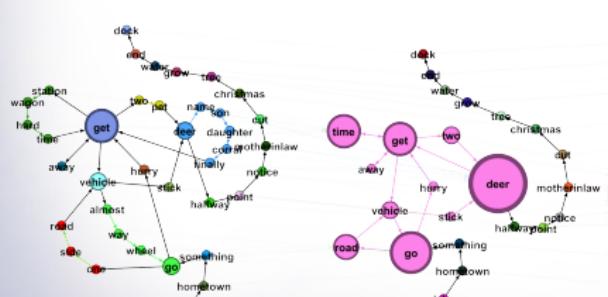
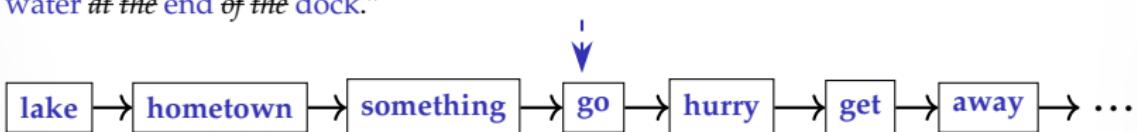
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STOPWORDS  
REMOVAL  
LEMMATI-  
ZATION



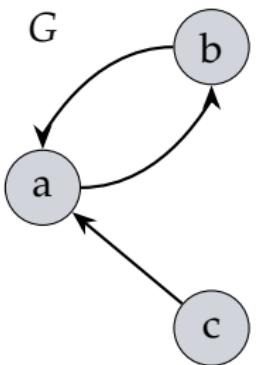
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STOPWORDS  
REMOVAL  
  
LEMMAТИ-  
ZATION

# Graphs



$$G = (V, E)$$

$$\begin{aligned}V &= \{a, b, c\} \\E &= \{(a, b), (b, a), (c, a)\}\end{aligned}$$

Introduction  
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Definitions  
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Contraction  
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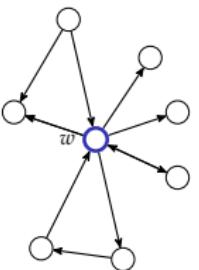
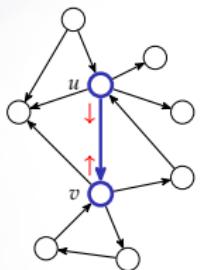
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Semantic dream analysis  
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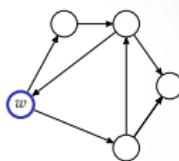
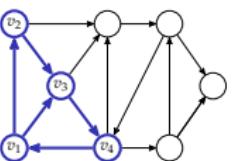
Conclusion  
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# Graph contraction

## Edge contraction



## Subgraph contraction



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Contraction  
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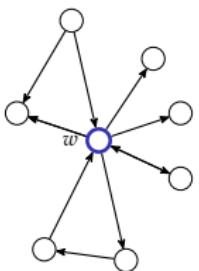
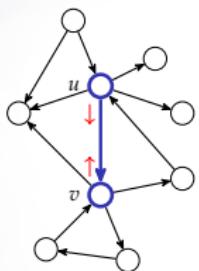
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Semantic dream analysis  
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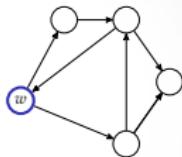
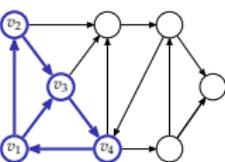
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# Graph contraction

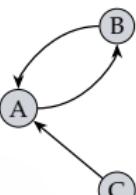
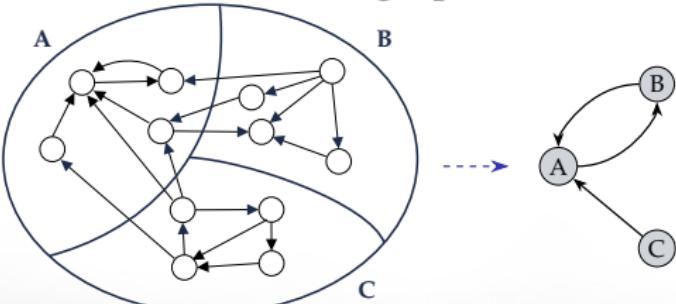
## Edge contraction



## Subgraph contraction



## Quotient graph



# Multilevel graph

## Definition (Multilevel graph)

A **multilevel graph**  $M$  is a couple  $(G, \Gamma)$  where:

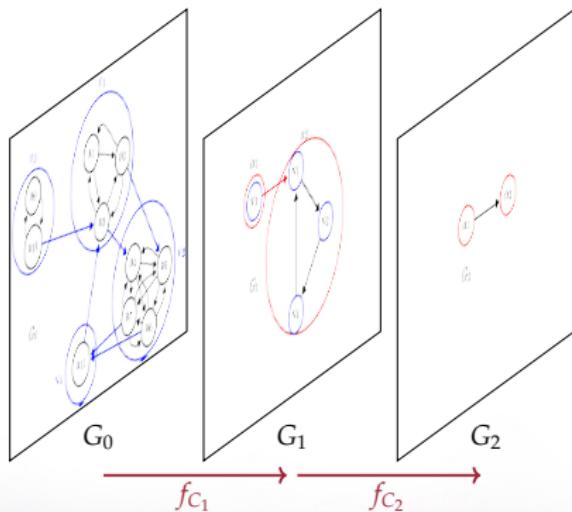
- $G = (V, E)$  is a graph;
- $\Gamma = \langle f_{C_1}, f_{C_2}, \dots, f_{C_k} \rangle$  is a sequence of contraction functions.

# Multilevel graph

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A **multilevel graph**  $M$  is a couple  $(G, \Gamma)$  where:

- $G = (V, E)$  is a graph;
- $\Gamma = \langle f_{C_1}, f_{C_2}, \dots, f_{C_k} \rangle$  is a sequence of contraction functions.



Introduction  
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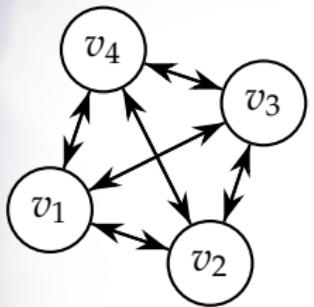
Syntactic dream analysis  
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# Contraction schemes

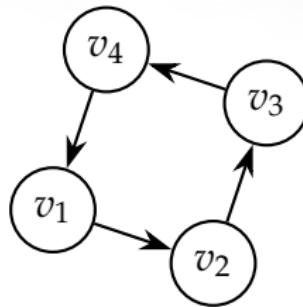
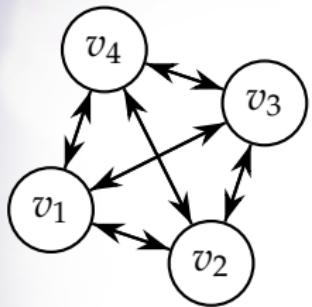
# Contraction schemes



Cliques

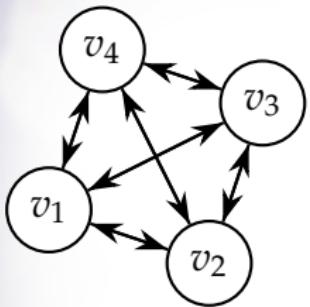
# Contraction schemes

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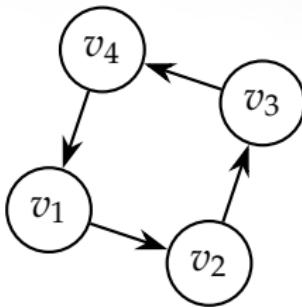


Simple cycles

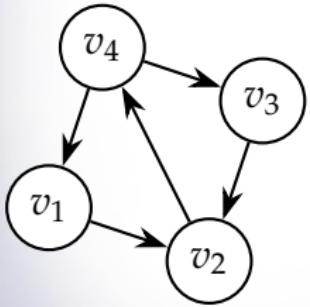
# Contraction schemes



Cliques



Simple cycles

Strongly  
connected  
components

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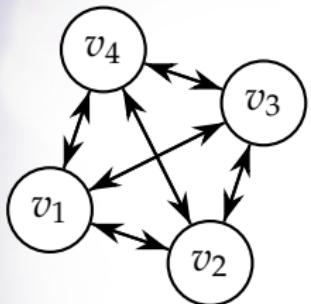
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Syntactic dream analysis  
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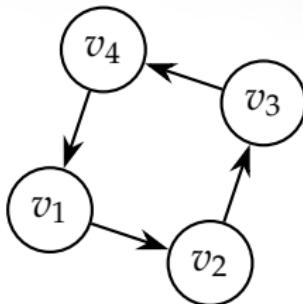
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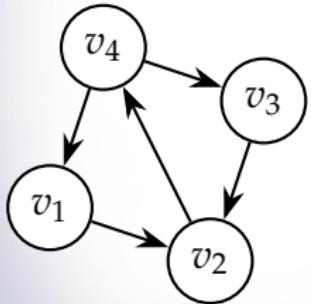
# Contraction schemes



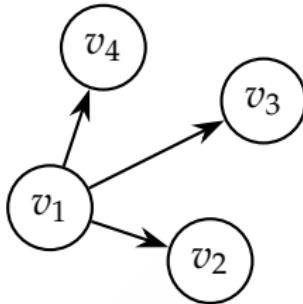
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Simple cycles



Strongly connected components



Stars

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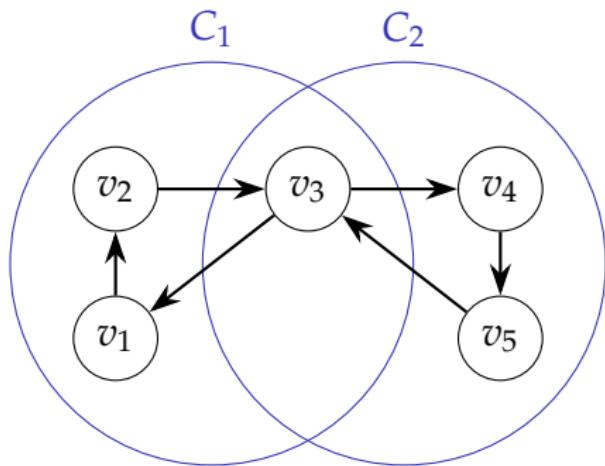
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## Subsets contraction



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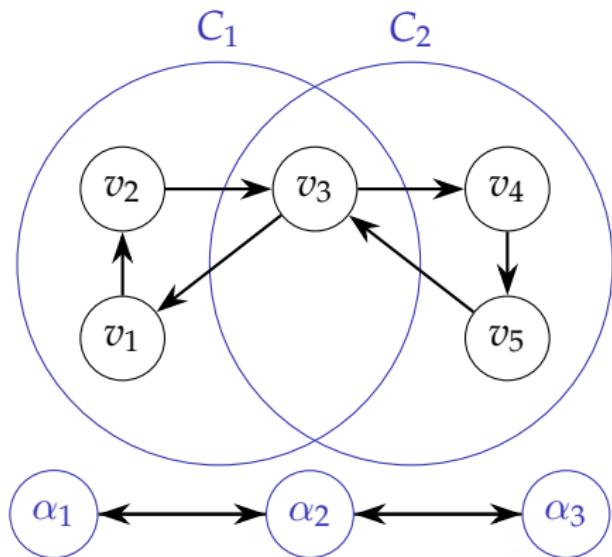
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## Subsets contraction



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Semantic dream analysis  
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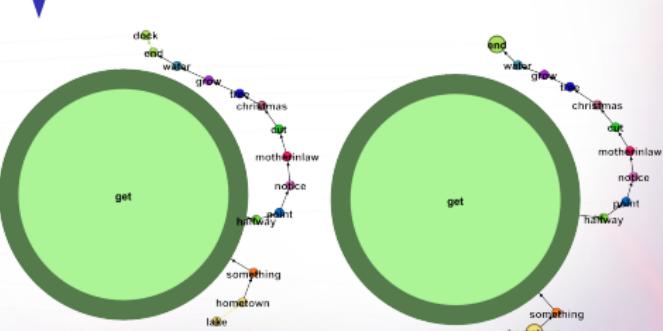
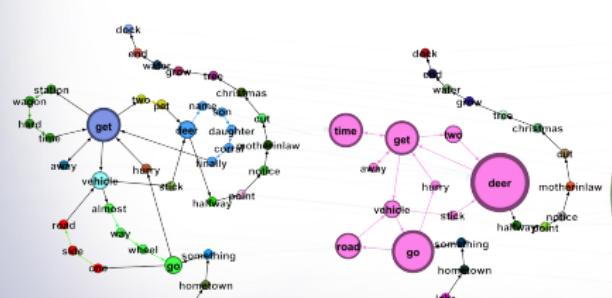
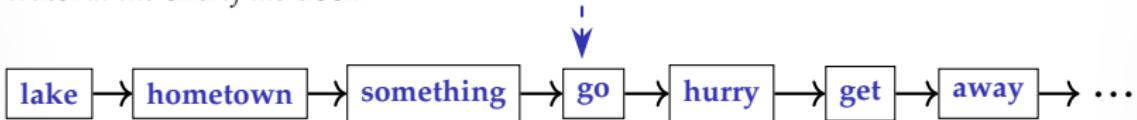
Conclusion  
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## Syntactic analysis of dreams

The aim is to examine the typical syntactic structure of individual dreams of a particular dreamer, with possible implications related to mental health.

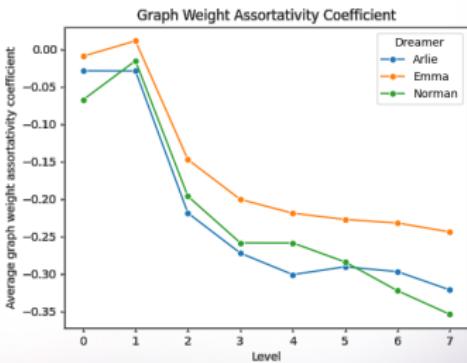
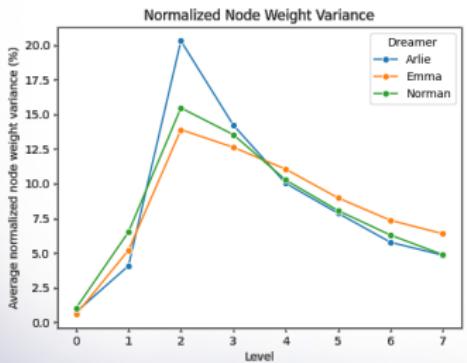
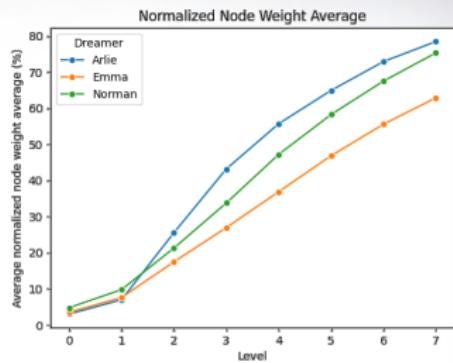
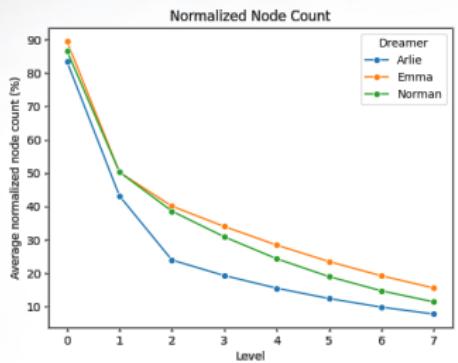
# An Arlie's dream

*"I am at a lake in my hometown. something is go on there and we are in a hurry to get away. We get in a station wagon and have a hard time get two pet deer, with the same name as my son and daughter, corral. finally we get them into the vehicle and we are almost all the way out when the wheel go off one side of the road and the vehicle is stick and the deer is about halfway out. At this point I notice my mother-in-law is cut off a christmas tree which is grow in the water at the end of the dock."*



STOPWORDS  
REMOVAL  
LEMMAТИ-  
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# Arlie, Emma and Norman results



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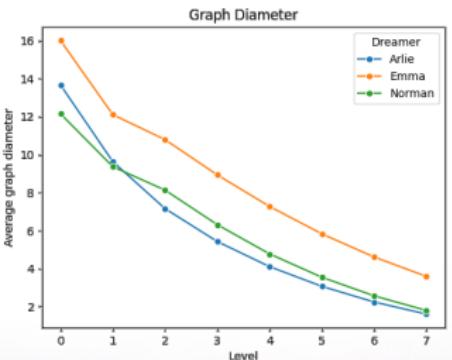
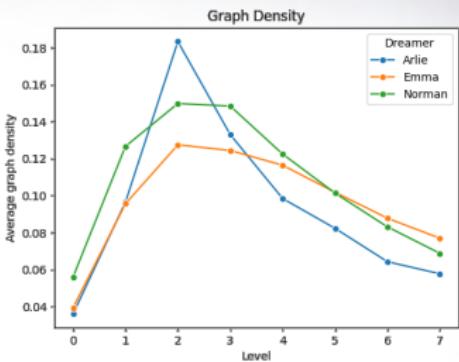
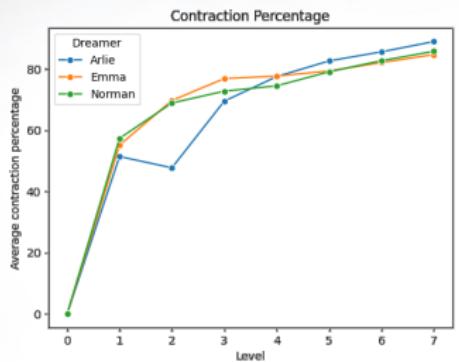
Contraction  
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Syntactic dream analysis  
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Semantic dream analysis  
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# Arlie, Emma and Norman results



## Semantic analysis of dreams

The aim is to build a multilevel semantic space of words that depicts the content themes in a collection of dreams of a particular dreamer.

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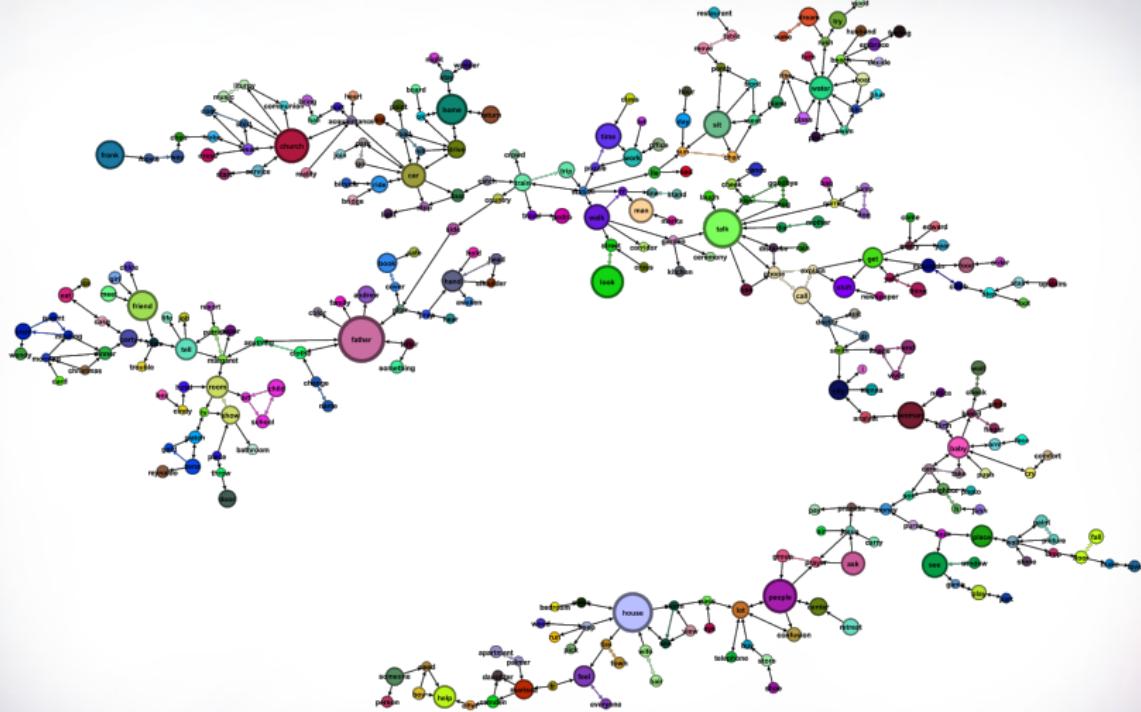
Contraction  
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Syntactic dream analysis  
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Semantic dream analysis  
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# Emma's graph



Introduction  
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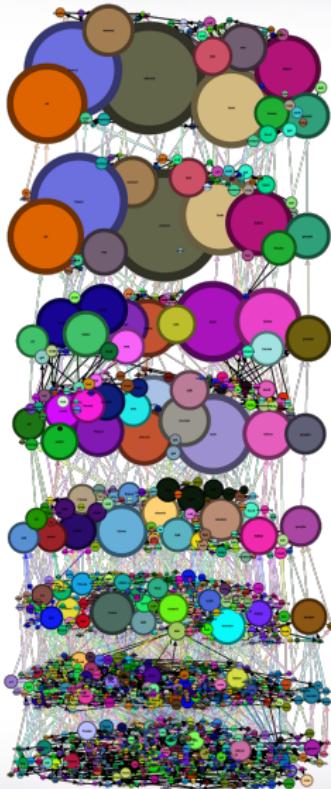
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# Emma's multilevel graph



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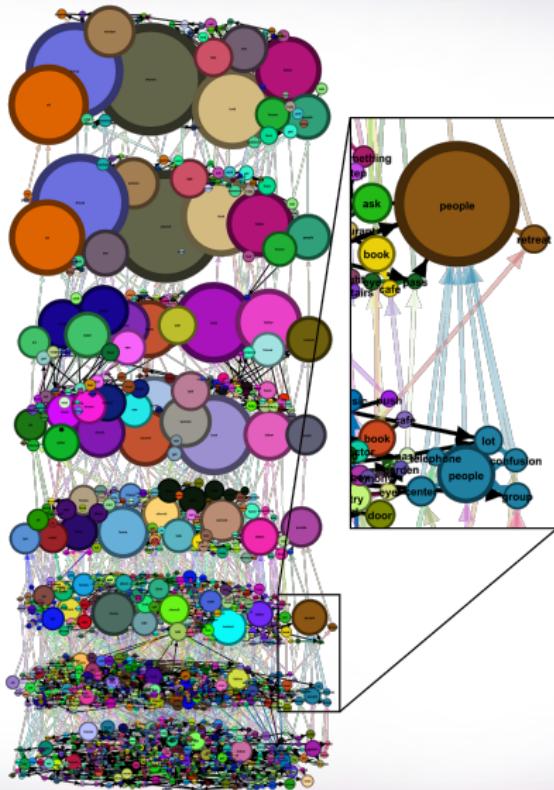
Contraction  
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# Emma's multilevel graph



Introduction  
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Syntactic dream analysis  
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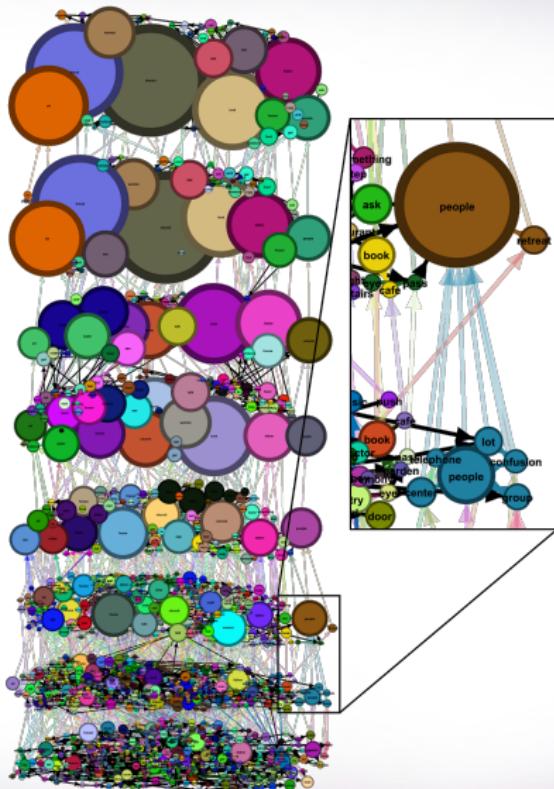
Semantic dream analysis  
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Conclusion  
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# Emma's multilevel graph

## EXAMPLES OF CYCLES

- “cake”-“party”
- “boat”-“lake”-“water”
- “trip”-“train”-“station”
- “road”-“car”-“drive”-“hill”
- “liturgy”-“church”-“music”



Introduction  
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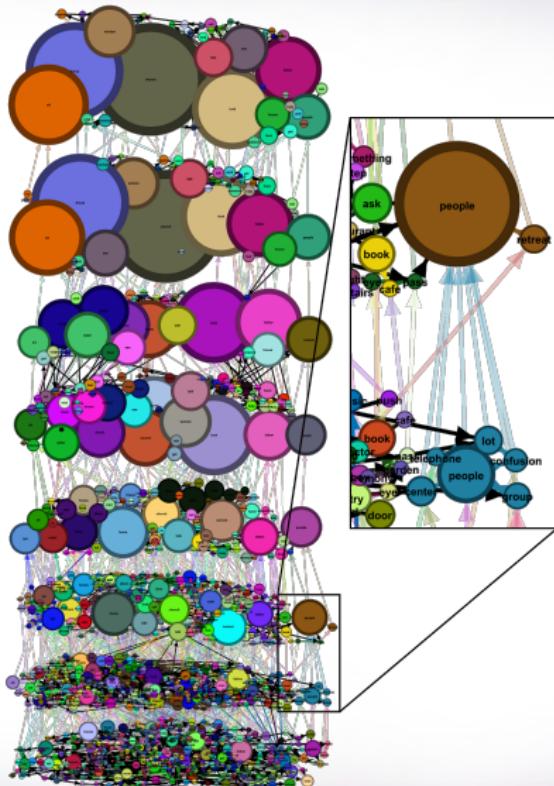
# Emma's multilevel graph

## EXAMPLES OF CYCLES

- “cake”-“party”
- “boat”-“lake”-“water”
- “trip”-“train”-“station”
- “road”-“car”-“drive”-“hill”
- “liturgy”-“church”-“music”

## EXAMPLES OF SCCs

- “sit”-“chair”-“front”-  
“porch”-“seat”-“plane”
- “lake”-“boat”-“water”-“rise”-  
“pool”-“swim”-“rush”



# Conclusions and future work

- Global and dynamic perspective, beyond single-level analysis



# Conclusions and future work

- Global and dynamic perspective, beyond single-level analysis
- Application of multi-level analysis techniques to categorized data





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**Thank you  
for your attention!**