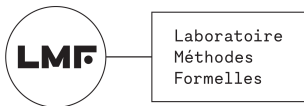


# Natural language processing for subjectivity analysis in personal narratives

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# Introduction

# Context

- ▶ Natural language processing for psychology is underexplored
- ▶ We build on an existing subfield: emotion analysis
- ▶ We study subjectivity (involving first-person perspective, meaning-making processes, and experiential content)
- ▶ We focus on personal narratives (e.g., dreams, emotional narratives)

We first address the *content* by classifying elements of personal narratives (e.g., characters and emotions). Then, we study the *form* through the concept of style

# Introduction

How to model subjective experience in personal narratives?

- ▶ Definition of objectives and scope using cognitive science
- ▶ Construction of an emotion dataset
- ▶ Training of language models for emotion analysis
- ▶ Formalization of style in personal narratives
- ▶ Automatic thematic analysis in mental health narratives

# Definition of objectives using cognitive science

**G. Cortal** and C. Bonard. [Improving Language Models for Emotion Analysis: Insights from Cognitive Science](#). *CMCL, ACL 2024*.

# Psychological theories and emotion annotation schemes

What are current limitations and interesting research directions?

[add refs to each theory and annotation schemes]

Psychological theories	In text, emotion is...	Example
Basic emotions theory	a <b>category</b>	"I love philosophy." → joy
Constructivist theories	a continuous value with an <b>affective</b> meaning	"His voice soothes me." → valence (4/5), arousal (1/5)
Appraisal theory	a continuous value with a <b>cognitive</b> meaning	"I received a surprise gift." → sudden (4/5), control (0/5)
	composed of <b>semantic roles</b>	"Louise (experiencer) was angry (cue) towards Paul (target), because he didn't inform her (cause)."

# Limitations in emotion analysis

- ▶ Different emotion theories lead to divergences in how to annotate them in the text
- ▶ Some linguistic and cognitive science theories are not considered
- ▶ There is no benchmark that evaluates the richness of the emotional phenomenon

## Linguistic and cognitive science theories

# Which verbal signs are used to infer expressed emotions?

Raphaël Micheli categorizes a range of linguistic markers into three *emotion expression modes* (Micheli, 2013). The emotion can be:

- ▶ *labeled* explicitly with an emotional term ("I am sad")
- ▶ *shown* with utterance features such as interjections and punctuations ("Ah! That's great!")
- ▶ *suggested* with the description of a situation which generally, in a given sociocultural context, leads to an emotion ("She gave me a gift")

→ Different emotion expression modes are more or less difficult to interpret [add refs psycholinguistic, psychiatry, refs aline etienne]

# What are the psychological mechanisms used to infer what is communicated?

A *code* is a pre-established pairing between stimuli and sets of information

The Morse code is a pairing between <combination of short and long signals> and [letters]

The formal semantics of a language is made of syntactical and lexical rules that pairs <strings of words> with [sentential meanings]

What are the psychological mechanisms used to infer what is communicated?

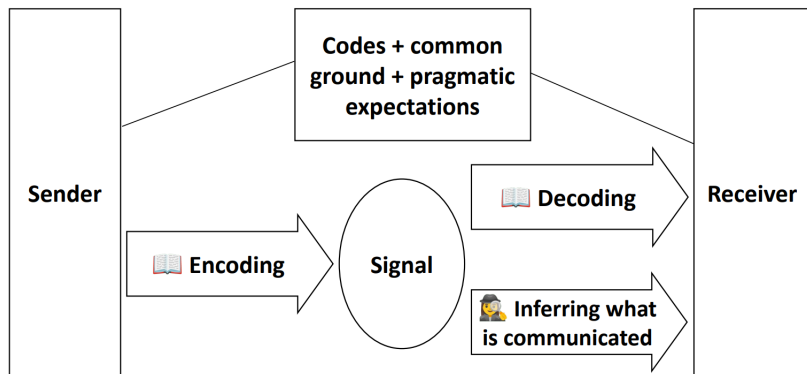


Figure: Dictionary analysis in cognitive pragmatics. [cite]

# Codes underdetermine emotion meaning

Let's take emotion expression modes as an example:

- ▶ *Labeled*: “I am happy now” is explicit about the feeling but does not encode what the emotion is about
- ▶ *Displayed*: interjections (“Wow!”, “Ah!”, “Damn!”) show affect yet leave valence and focus unclear
- ▶ *Suggested*: “The ship has black sails.” can communicate any kind of emotion

→ We rely on other sources of evidence to infer what is communicated

What are the psychological mechanisms used to infer what is communicated?

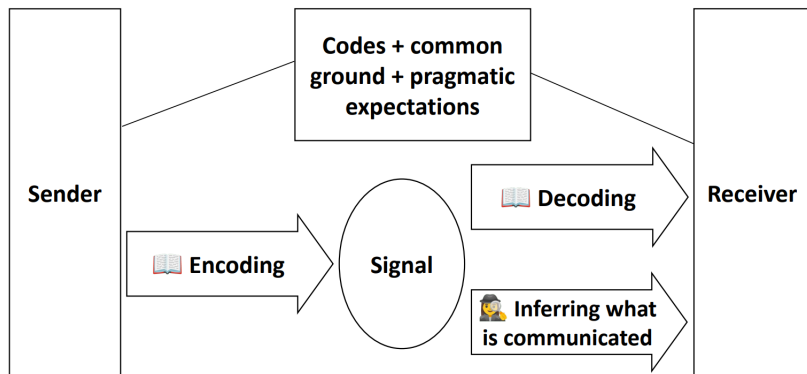


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What are the psychological mechanisms used to infer what is communicated?

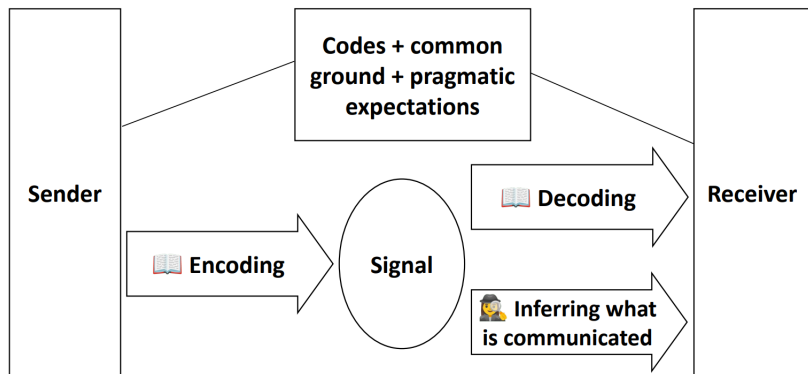
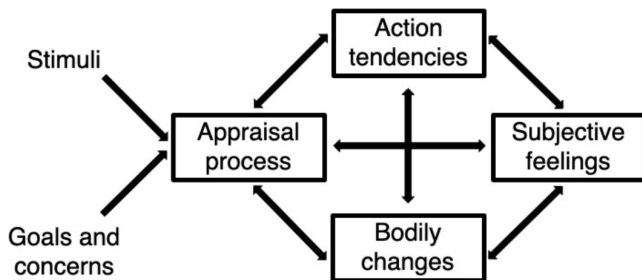


Figure: Detective analysis in cognitive pragmatics. [cite]

# How to integrate psychological theories of emotion?



**Figure:** Integrated framework for emotion theories. Emotional episodes are synchronized changes in four components (Scherer, 2022).

[refs cortical et al.]

# Construction of an emotion dataset

Available at [hf.co/datasets/gustavecortal/FrenchEmotionalNarratives](https://huggingface.co/datasets/gustavecortal/FrenchEmotionalNarratives)

**G. Cortal**, A. Finkel, P. Paroubek, L. Ye. [Emotion Recognition based on Psychological Components in Guided Narratives for Emotion Regulation](#). *SIGHUM, EACL 2023*.

# French emotional narratives based on components

**Goal:** A more comprehensive understanding of emotional events

Component	Answer
Behavior	I'm giving a lecture on a Friday morning at 8:30. A student goes out and comes back a few moments later with a coffee in his hand.
Feeling	My heart is beating fast, and I freeze, waiting to know how to act.
Thinking	I think this student is disrupting my class.
Territory	The student attacks my ability to be respected in class.

Chosen emotion: anger (possible choices: anger, fear, joy, sadness)

More than 1,000 narratives were collected during emotion regulation sessions

# Training language models for emotion analysis

**G. Cortal**, A. Finkel, P. Paroubek, L. Ye. [Emotion Recognition based on Psychological Components in Guided Narratives for Emotion Regulation](#). *SIGHUM, EACL 2023*

**G. Cortal**. [Sequence-to-Sequence Language Models for Character and Emotion Detection in Dream Narratives](#). *LREC-COLING 2024*

# Discrete emotion detection based on components

Component	Logistic Regression			CamemBERT		
	Precision	Recall	$F_1$	Precision	Recall	$F_1$
All	71.2 (2.6)	69.1 (2.2)	67.8 (2.3)	<b>85.1</b>	<b>84.8</b>	<b>84.7</b>
Without behavior	77.4 (2.3)	75.8 (2.4)	74.5 (2.6)	80.3	79.8	79.7
Without feeling	64.3 (1.9)	61.5 (1.2)	61.3 (2.2)	81.6	79.8	79.9
Without thinking	70.9 (1.8)	69.1 (2.0)	68.3 (2.2)	79.6	78.5	78.7
Without territory	64.3 (4.1)	64.5 (2.4)	62.3 (2.8)	78.7	78.5	78.6
Only behavior	52.1 (3.5)	54.6 (2.9)	51.7 (2.9)	68.4	67.1	66.6
Only feeling	69.6 (1.5)	68.9 (2.1)	68.4 (2.0)	67.8	68.4	67.7
Only thinking	50.1 (3.4)	53.8 (2.3)	50.6 (2.7)	70.5	70.1	70.1
Only territory	68.2 (1.8)	66.8 (2.2)	66.6 (2.3)	71.4	68.4	68.9

→ Each component improves prediction performance, the best results are achieved by jointly considering all components

→ Some components benefit from contextual understanding and world knowledge (e.g., behavior and thinking)

# Quantitative analysis of dream narratives

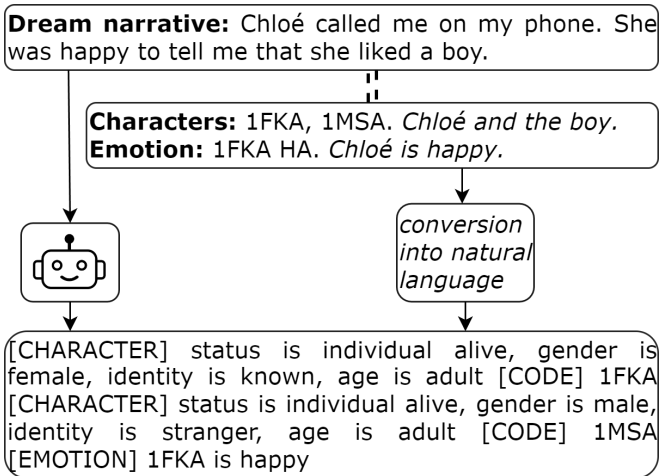
Need other datasets with narrative structure, emotional content, and available for research

Quantitative dream analysis most relies on dream databases (e.g., DreamBank composed of 27,000 dreams) and annotation schemes (e.g., Hall and Van de Castle system)

The annotation process is complex and costly

How to automate the annotation process?

# Character and emotion detection in dream narratives



# Results

Baseline is LaMini-Flan-T5 finetuned on 1823 dream narratives

Model	Status	Gender	Identity	Age	Character	Emotion
Baseline	82.87	78.02	76.17	86.21	64.74	75.13
No <sub>semantics</sub>	71.37	56.54*	61.0	90.51	41.79*	75.79
No <sub>names</sub>	80.66*	74.32**	74.2	83.95*	60.93**	73.04*
Size <sub>small</sub>	78.35**	72.13**	70.25**	81.66**	56.79**	70.15**
Size <sub>large</sub>	84.51*	80.3**	78.63**	87.29	67.63**	74.71
First <sub>group</sub>	82.33	77.71	74.86	85.61	63.71	71.94
First <sub>individual</sub>	80.59**	76.14	74.22*	83.87**	62.67	67.32
First <sub>emotion</sub>	83.92	78.74	77.06	87.63	64.97	72.03
Conversion <sub>comma</sub>	84.02**	79.84**	77.67**	87.08*	66.69**	73.68
Conversion <sub>marker</sub>	82.39	78.45	76.53	86.09	65.44	74.36
Cross-validation	86.28	81.9	79.51	89.52	68.64	76.18

**Table:**  $F_1$ -scores for character and emotion detection. Significant differences from baseline: \*\* ( $p < 0.01$ ), \* ( $p < 0.05$ ).

→ Language models can effectively address character and emotion detection in dream narratives

# Results

StableBeluga<sub>i</sub> is a 7B model with in-context learning using  $i$  examples

Model	Status	Gender	Identity	Age	Character	Emotion
Baseline	82.87	78.02	76.17	86.21	64.74	75.13
StableBeluga <sub>1</sub>	43.95**	39.76**	31.25**	56.16**	15.65**	-
StableBeluga <sub>3</sub>	52.44**	46.49**	38.46**	63.88**	21.06**	-
StableBeluga <sub>5</sub>	55.89**	46.29**	42.61**	63.73**	24.86**	-

**Table:**  $F_1$ -scores for character and emotion detection. Significant differences from baseline: \*\* ( $p < 0.01$ ), \* ( $p < 0.05$ ).

→ Compared to StableBeluga, our supervised models perform better while having 28 times fewer parameters (248M vs 7B)

## Case study on the war veteran

Group	Category	% Vet	% Total	$\Delta$
Identity	known*	24.9	51.6	-26.7
	prominent	1.9	2.5	-0.6
	occupational*	22.4	8.0	14.4
	ethnic*	4.1	0.9	3.1
	unknown*	46.8	37.0	9.8
Gender	male*	56.2	43.0	13.1
	female*	24.1	33.1	-9.0
	joint	10.9	12.2	-1.3
	undefined	7.9	8.7	-0.9

**Table:** Identity and gender proportions for the veteran (n=566 narratives) versus other dreamers.  $\Delta$  shows the difference in percentage points. \* indicates significant difference ( $p < 0.05$ ).

→ The war veteran dreams more about *occupational*, *ethnic*, and *unknown* identities compared to other dreamers.

# Formalization of style in personal narratives

**G. Cortal** and A. Finkel. [Formalizing Style in Personal Narratives](#). *EMNLP 2025*.

# How is subjective experience communicated in narratives?

We use narratives to express our representations of reality and make sense of the world (Bruner, 1990)

In everyday usage, style refers to a distinctive manner of expression

We use style as a proxy to study how subjective experience is linguistically communicated

We narrow the general definition of style: *a distinctive manner of communicating subjective experience in narratives*

## Related work on style analysis

TODO

Stylometry, stylistics, knowledge graph, cognitive linguistics, etc.

# How to give an operational definition of style?

**Hypothesis:** An individual uses some redundant choices of features that characterize its style

1. A sequence-based framework defining style as patterns in sequences of linguistic choices
2. A methodology for identifying patterns using sequence analysis
3. A case study on dream narratives

# What linguistic features encode subjective experience?

According to systemic functional linguistics, language represents experience through *processes*, *participants* and *circumstances* (Halliday et al., 2014)

Processes	Examples
Action: actions and events in the physical world.	[He] <sub>Actor</sub> [ <b>takes</b> ] <sub>Action</sub> [the valuable] <sub>Affected</sub>  [Members of my cult] <sub>Actor</sub> [ <b>have made</b> ] <sub>Action</sub> [1500 euros] <sub>Result</sub>  [I] <sub>Actor</sub> [ <b>give</b> ] <sub>Action</sub> [her] <sub>Recipient</sub> [a chance] <sub>Range</sub>
Mental: internal experiences such as thoughts, perceptions, and feelings.	[We] <sub>Senser</sub> [ <b>believe</b> ] <sub>Mental</sub> [women are the leaders of change] <sub>Phenomenon</sub>  [The moon] <sub>Senser</sub> [ <b>sees</b> ] <sub>Mental</sub> [the earth] <sub>Phenomenon</sub>  [He] <sub>Senser</sub> [ <b>disliked</b> ] <sub>Mental</sub> [Gilbert's writing] <sub>Phenomenon</sub>
Verbal: acts of communication.	[David] <sub>Sayer</sub> [ <b>said</b> ] <sub>Verbal</sub> ["the corrupt, criminals and money launderers"] <sub>Verbiage</sub>
State: states of being, having, or existence.	There [ <b>was</b> ] <sub>Existential</sub> [a swimming pool] <sub>Existent</sub>  [John] <sub>Carrier</sub> [ <b>is</b> ] <sub>State</sub> [an interesting teacher] <sub>Attribute</sub>  [Hadrian's Wall] <sub>Possessor</sub> [ <b>has</b> ] <sub>State</sub> [something for everyone] <sub>Possessed</sub>

# Pipeline for our sequence-based framework

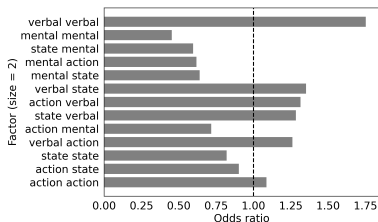
Clause	Process (symbol)	Participants
I wake in a dark room	Action ( <b>a</b> )	Actor
I feel a cold wind	Mental ( <b>m</b> )	Sensor, Phenomenon
I tell myself to move	Verbal ( <b>v</b> )	Sayer, Recipient

**Sequence:** *amv* | **Substrings:** {*am*, *mv*}

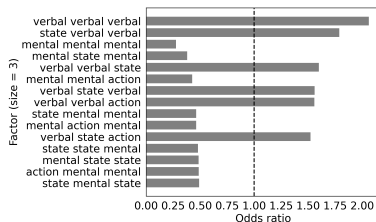
1. We first segment "*I wake in a dark room. I feel a cold wind. I tell myself to move.*" into clauses
2. Identify features (e.g., processes and participants) for each clause using in-context learning with large language models
3. Each narrative is mapped to a symbolic sequence using an alphabet based on identified features
4. We perform sequence analysis to identify patterns such as frequent substrings and representative sequences

# Results on the war veteran

We compare the proportion of sequences containing a given substring



(a) Size 2.

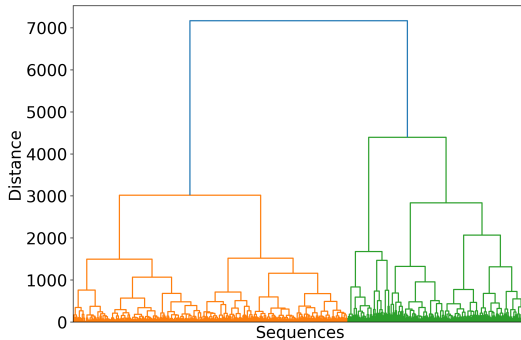


(b) Size 3.

**Figure:** Top substring odds ratio between the veteran and the norm

We show a preference for the war veteran to remain in a verbal process, as indicated by substrings such as *verbal.verbal* and *verbal.verbal.verbal* with high odds ratios (respectively 2.00 and 1.75)

# Results on the war veteran



**Figure:** Dendrogram with Ward linkage and cosine similarity

**Representative sequences:** *savamasasaaamaasavvvaaaaaaavssaaaaa*  
and *sssssavaavssvsavvvvsmasasaasasaamaamvmsss* with  
*a = action, m = mental, s = state, v = verbal*

# Perspectives

- ▶ Authorship profiling
- ▶ Style-conditioned narrative generation
- ▶ Applying methods from complexity science and formal language theory

# Automatic thematic analysis in mental health narratives using language models

**G. Cortal**, S. Guessoum, X. Cao, R. Riad. *Fine-grained mental health topic modeling in different cohorts using large language models* (preprint). 2025.

# Introduction

- ▶ Qualitative analysis of speech content is central to clinical practice
- ▶ Thematic analysis studies how people construct meaning
- ▶ Thematic analysis is time-consuming, and typically constrained to small, monolingual corpora
- ▶ Computational approaches offers time savings over manual annotation, and the power to analyze a larger amount of data

→ We developed a pipeline that (a) clusters narratives from different cohorts, (b) generates descriptions for each cluster, and (c) links clusters to variation in clinical scores and sociodemographic factors

# Data collection

We collected clinical scores and narratives from **four cohorts**. A French general population cohort (n=1809), and three clinical populations: Italian (n=116), Chinese (n=52), and Spanish (n=90) cohorts

**Clinical scores** were assessed using various scales such as: AIS (Athens Insomnia Scale); BDI (Beck Depression Inventory); GAD-7 (Generalized Anxiety Disorder 7-item scale); MFI (Multidimensional Fatigue Inventory); PHQ-9 (Patient Health Questionnaire-9 for depression)

**Open-ended questions:** *Describe your last 24 hours / a negative event that happened to you in the past / a positive event that happened to you in the past / a negative event you think might happen in the future / a positive event you think might happen in the future / Describe how you are feeling at the moment and how your sleep has been lately*

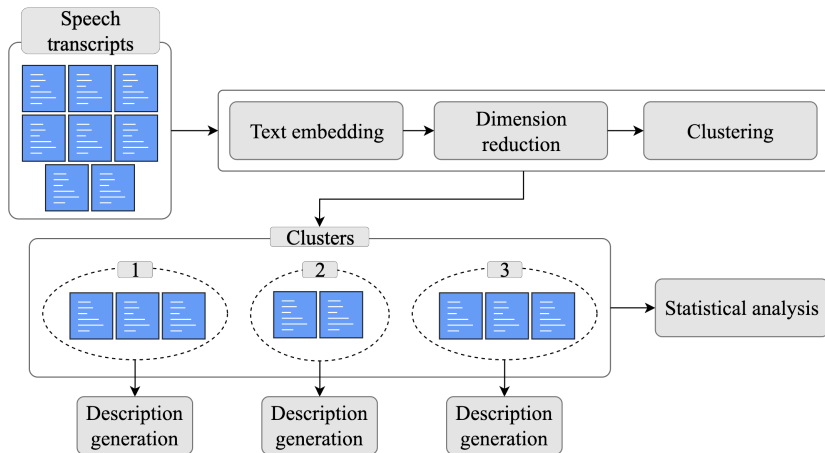
# Demographics

	General Population n=1809	Androids n=116	MODMA n=52	VOCES n=90
<b>Demographics</b>				
<b>Language</b>	French	Italian	Chinese	Spanish
<b>Age</b>	***	<i>n.s.</i>	<i>n.s.</i>	***
Mean (SD)	37.8 (18.2)	37.4 (12.0)	31.3 (9.2)	38.6 (14.9)
Range	18–91	19–71	18–52	21–76
<b>Sex, n (%)</b>	<i>n.s.</i>	<i>n.s.</i>	<i>n.s.</i>	<i>n.s.</i>
Female	1187 (66.2)	84 (72.4)	16 (30.8)	39 (43.3)
Male	595 (33.2)	32 (27.6)	36 (69.2)	48 (53.3)
Other	11 (0.6)	0 (0.0)	0 (0.0)	3 (3.3)
<b>Education, n (%)</b>	<i>n.s.</i>	<i>n.s.</i>	<i>n.s.</i>	<i>n.s.</i>
No diploma	52 (2.9)	11 (9.5)	7 (13.5)	-
Secondary	291 (16.2)	37 (31.9)	8 (15.4)	-
Higher short	213 (11.9)	52 (44.8)	0 (0.0)	-
Higher long	1236 (69.0)	16 (13.8)	37 (71.2)	-

## Clinical evaluation

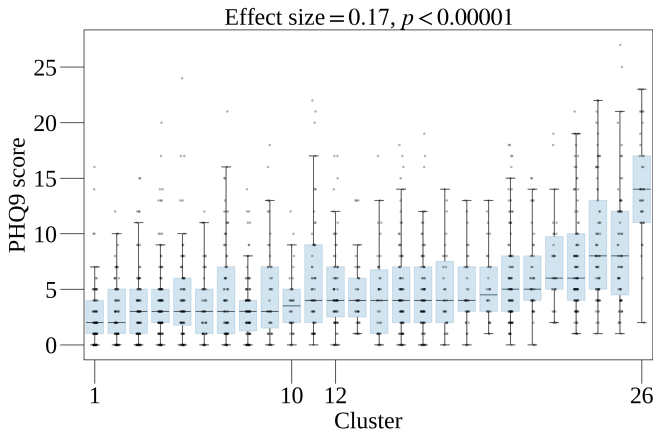
	<b>General Population n=1809</b>	<b>Androids n=116</b>	<b>MODMA n=52</b>	<b>VOCES n=90</b>
<b>C-SSRS</b>	<i>n.s.</i>	<i>n.s.</i>	<i>n.s.</i>	<i>n.s.</i>
Suicidal risk, n (%)	-	-	-	60 (66.7)
No suicidal risk, n (%)	-	-	-	30 (33.3)
<b>MADRS / MDD</b>	<i>n.s.</i>	<i>n.s.</i>	<i>n.s.</i>	<i>n.s.</i>
Depression, n (%)	-	64 (55.2)	23 (44.2)	-
No depression, n (%)	-	52 (44.8)	29 (55.8)	-
<b>PHQ-9</b>	<i>n.s.</i>	<i>n.s.</i>	***	***
Mean (SD)	5.2 (4.6)	-	9.4 (8.5)	10.5 (6.8)
Range	0–27	-	0–25	0.0–26.0

# Pipeline for semantic clustering and description generation



# Distribution of depression scores across clusters

*How you are feeling and how your sleep has been lately*



→ Depression scores vary significantly: cluster 26 highest ( $13.4 \pm 5.4$ ), cluster 1 lowest ( $2.6 \pm 2.2$ )

# Generated cluster descriptions

**Cluster 1 description:** The individuals express consistent satisfaction with their current well-being, emphasizing good sleep quality, restful or pleasant nights, and a general sense of relaxation, even when noting variations in sleep duration or occasional fatigue. (age=39±19, n=92)

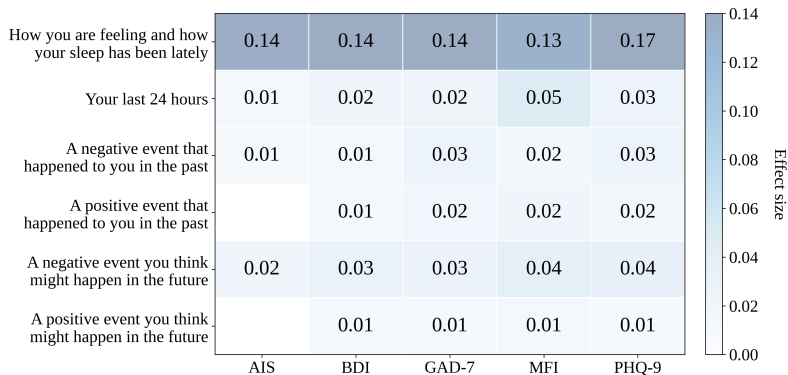
**Cluster 10 description:** The individuals express frequent nighttime urinary interruptions disrupting sleep, often attributed to age-related conditions like prostate issues or overactive bladder, alongside mixed reports of physical well-being, mental resilience, and lifestyle factors such as retirement or exercise influencing their overall health and sleep patterns. (age=69±15, n=34)

**Cluster 12 description:** The individuals express stress related to academic exams, significant life decisions, and workloads, alongside sleep disturbances caused by lifestyle changes, increased responsibilities, or environmental adjustments, while some also highlight temporary relief from pressures through personal achievements or upcoming positive events. (age=24±9, n=67)

**Cluster 26 description:** The individuals express sleep disturbances characterized by insomnia, frequent awakenings, and restless sleep, alongside pervasive anxiety, emotional instability, and self-esteem issues, which collectively contribute to persistent fatigue, impaired daily functioning, and a diminished sense of well-being. (age=25±9, n=37)

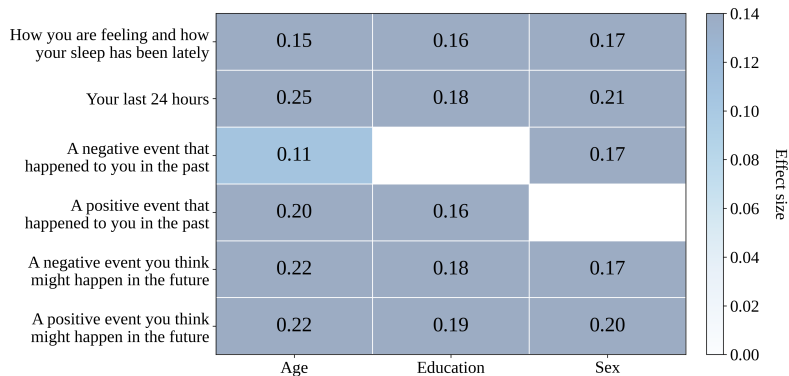
→ Clustering captures symptom severity and age-related circumstances

# Effect size across questions and clinical scores



→ Certain questions better discriminate clinical scores

# Effect size across questions and sociodemographics



→ Nearly all questions discriminate sociodemographics

## Conclusion and perspectives

# Conclusion

How to model subjective experience in personal narratives?

- ▶ Definition of objectives and scope using cognitive science
- ▶ Construction of an emotion dataset
- ▶ Training of language models for emotion analysis
- ▶ Formalization of style in personal narratives

# Perspectives

- ▶ Emotion analysis for mental health (empathic support, cognitive distortions, theory of mind)
- ▶ Post-training for psychology (preferences and reasoning data)
- ▶ Psychology of language models (sycophancy, thought operations)

# Appendix

# Selected open-source projects

*My research models are publicly hosted on Hugging Face and were trained using the Jean Zay supercomputer.*

A repo for [lightweight preference optimization](#) using LoRA and ORPO.

[Piaget](#), a model fine-tuned for psychological reasoning, and [Beck](#), a model aligned with psychotherapeutic preferences.

[PsychologicalReasoning-15k](#), open psychological and philosophical reasoning traces.

[Oneirogen](#), a model for dream generation, and [Dream-T5](#), a model for emotion and character prediction in dream narratives.

# Selected research papers

Constant Bonard and Gustave Cortal (2024). "Improving Language Models for Emotion Analysis: Insights from Cognitive Science". In: *Proceedings of the Workshop on Cognitive Modeling and Computational Linguistics*. Ed. by Tatsuki Kuribayashi et al. Bangkok, Thailand: Association for Computational Linguistics, pp. 264–277. DOI: 10.18653/v1/2024.cmc1-1.23

Gustave Cortal, Alain Finkel, et al. (2023). "Emotion Recognition Based on Psychological Components in Guided Narratives for Emotion Regulation". In: *Proceedings of the 7th Joint SIGHUM Workshop on Computational Linguistics for Cultural Heritage, Social Sciences, Humanities and Literature*. Ed. by Stefania Degaetano-Ortlieb et al. Dubrovnik, Croatia: Association for Computational Linguistics, pp. 72–81. DOI: 10.18653/v1/2023.latechc1f1-1.8

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Gustave Cortal and Alain Finkel (2025). "Formalizing Style in Personal Narratives". In: *Proceedings of the 2025 Conference on Empirical Methods in Natural Language Processing*. Ed. by Christos Christodoulopoulos et al. Suzhou, China: Association for Computational Linguistics, pp. 7322–7337. ISBN: 979-8-89176-332-6

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Bruner, Jerome (1990). *Acts of Meaning*. Acts of Meaning. Cambridge, MA, US: Harvard University Press. ISBN: 978-0-674-00360-6.



Cortal, Gustave (2024). “Sequence-to-Sequence Language Models for Character and Emotion Detection in Dream Narratives”. In: *Proceedings of the 2024 Joint International Conference on Computational Linguistics, Language Resources and Evaluation (LREC-COLING 2024)*. Ed. by Nicoletta Calzolari et al. Torino, Italia: ELRA and ICCL, pp. 14717–14728.

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