UNIVERSITY OF PLYMOUTH

Using experience sampling via smartphones to investigate thought–emotion interactions in daily life

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SWDTP

Experience sampling (also known as Ecological Momentary Assessment)

- Collect data in natural settings
- Real-time reports (or close to real-time)
- On many repeated occasions across time (e.g., days, weeks)

Goals of the talk

- Why and how to use “experience sampling” for research
  - Process of data collection and analysis
  - Challenges and reflections

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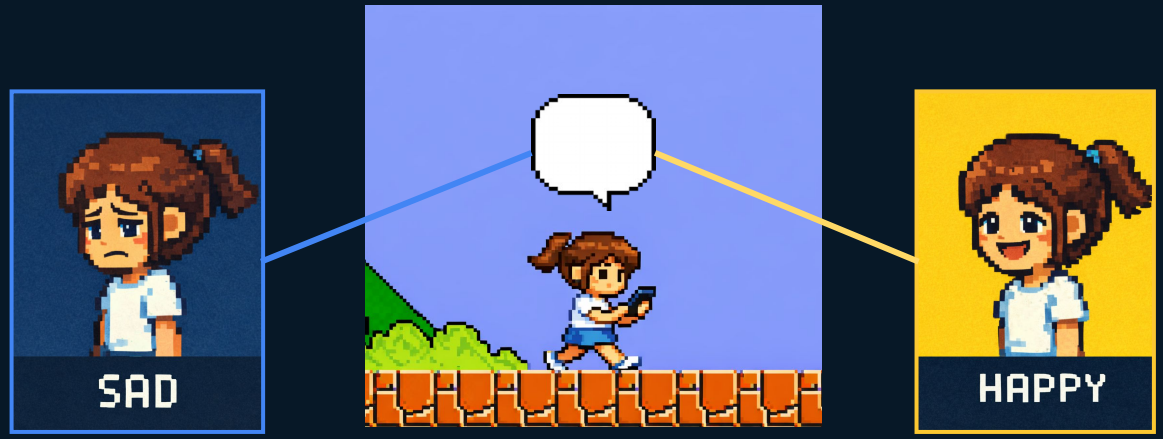
- Why and how to use "experience sampling" for research
  - Process of data collection and analysis
  - Challenges and reflections

- "Validating construct through quantitative sampling"
  - Large-scale experience sampling, when combined with dimension reduction technique, can reveal meaningful structures of thought
  - Thoughts map onto distinct emotional states
  - Thought-emotion interactions vary as a function of personality traits

Background: Thoughts and emotions – how do they connect?



Background: Thoughts and emotions – how do they connect?

Clinical population

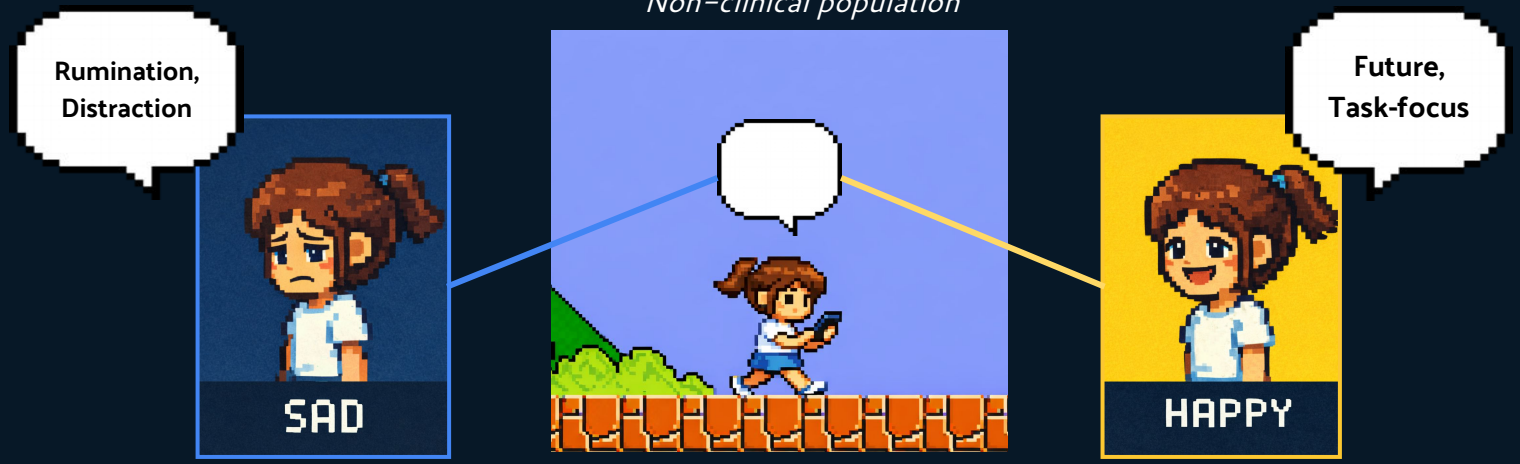
Emotional disorders

depression
anxiety
PTSD
…

Repetitive Negative thinking ⟷ Low mood

Background: Thoughts and emotions – how do they connect?

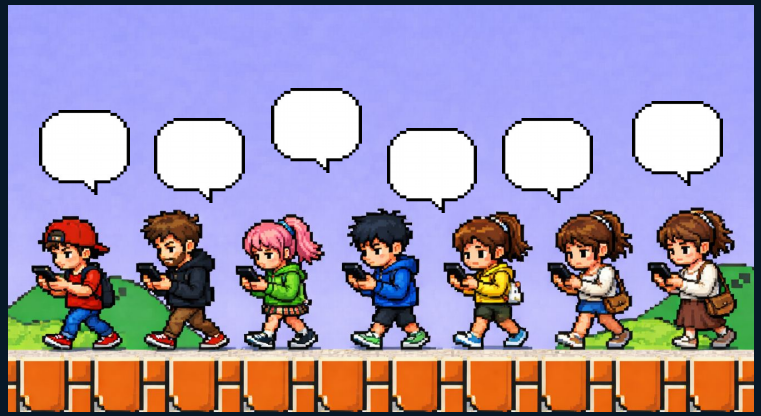
Non-clinical population



- Laboratory tasks -> limited ecological validity
- Retrospective self-reports -> prone to memory bias
- A small sets of dimensions studied -> thoughts can be heterogeneous

- Our approach: Multi-dimensional experience sampling

Background: Thoughts and emotions – how do they connect?



- How do **individual differences** modulate thought–emotion connections?

Alexithymia as a key emotional trait

"High-resolution"

"Pixelated"

Greater emotional awareness and regulation

Limited understanding of emotions

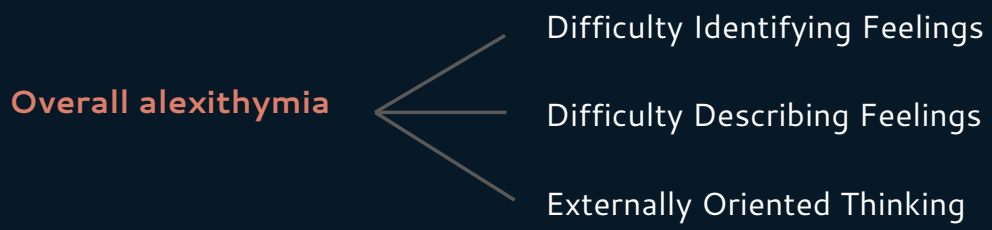
Affect dysregulation

Low alexithymia

High alexithymia

A trait reflecting the degree of difficulty to cognitively process emotions

3 Different facets of **Alexithymia**



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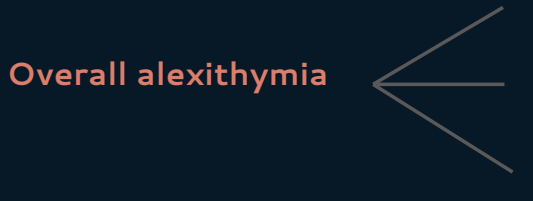


Problem with appraising **negative emotions**

→ Prediction: disrupt thought patterns during sadness?

3 Different facets of **Alexithymia**

Overall alexithymia

- Difficulty Identifying Feelings
- Difficulty Describing Feelings
- Externally Oriented Thinking

** tendency to focus on external, concrete events, not internal feelings*

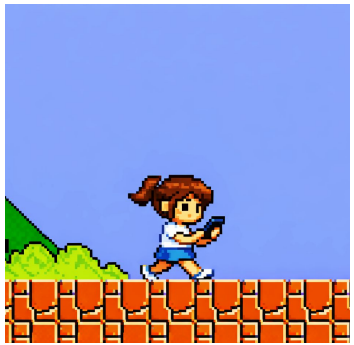
Less attention to internal emotions

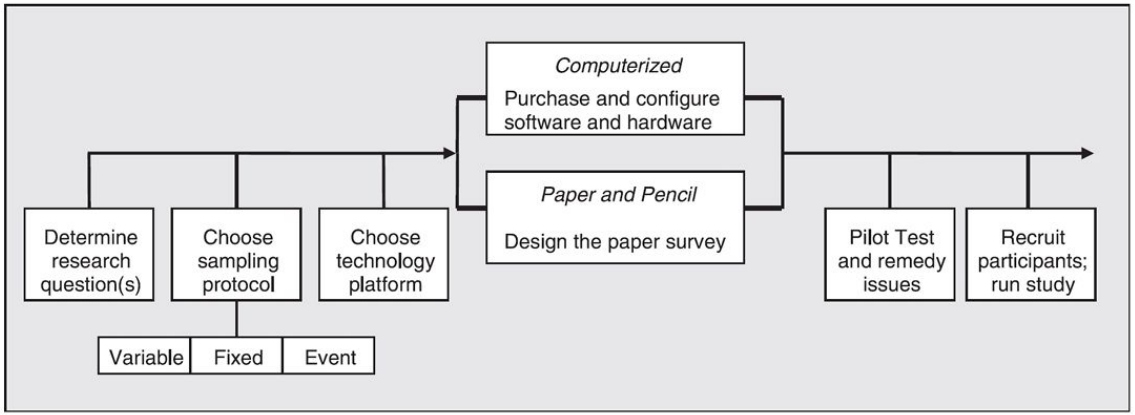
→ Prediction: less emotion-driven changes in thoughts?

Research focus

1. Identify patterns of thought through multidimensional experience sampling
2. Explore how thought patterns couple with emotional states
3. Test alexithymia as a trait-level moderator of thought-emotion interactions

Key steps to conducting an experience sampling study



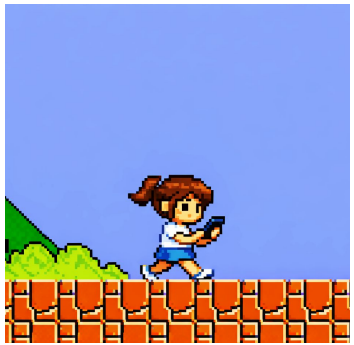


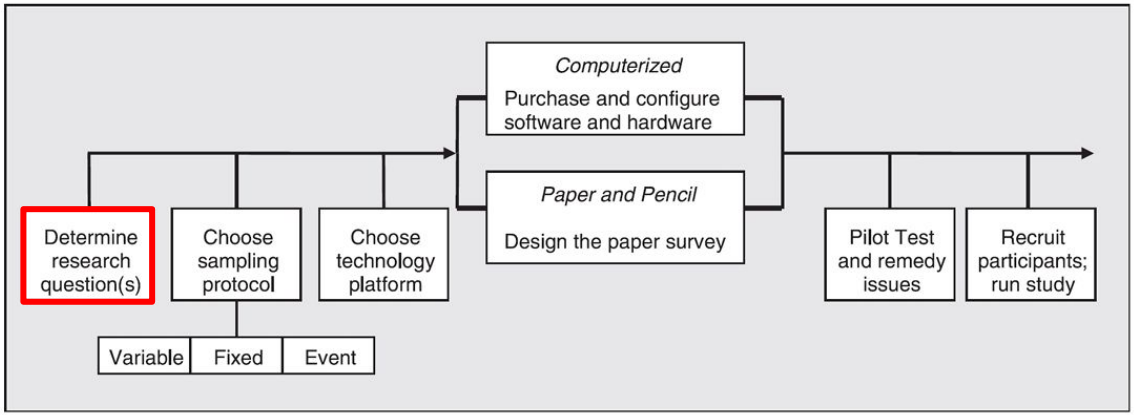
(Conner et al., 2009)

General considerations:

- Participant burden
- Control over timing
- Complexity
- Cost

Key steps to conducting an experience sampling study





Multi-dimensional experience sampling questionnaire

Smallwood et al. (2021)

Task
Future
Past
Self
People
Emotion
External
Images
Words
Sounds
Detailed
Deliberate
Solution
Intrusive
Knowledge
Absorption
Distracting
Meaningful

1 10

Multi-dimensional experience sampling questionnaire

Smallwood et al. (2021)

Task	“My thoughts were focused on a task”
Future	“My thoughts involved future events”
Past	“My thoughts involved past events”
Self	“My thoughts involved myself”
People	“My thoughts involved other people”
Emotion	…
External	
Images	
Words	
Sounds	
Detailed	
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1  10

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+

Emotional states

Valence (sad -> happy)

Arousal (weak -> strong)

Stress (calm -> stress)

1 10

Multi-dimensional experience sampling questionnaire

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Emotional states

Valence (sad -> happy)

Arousal (weak -> strong)

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1 10

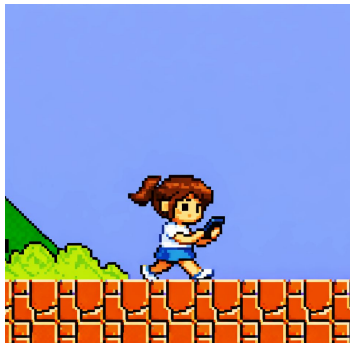
Other contexts

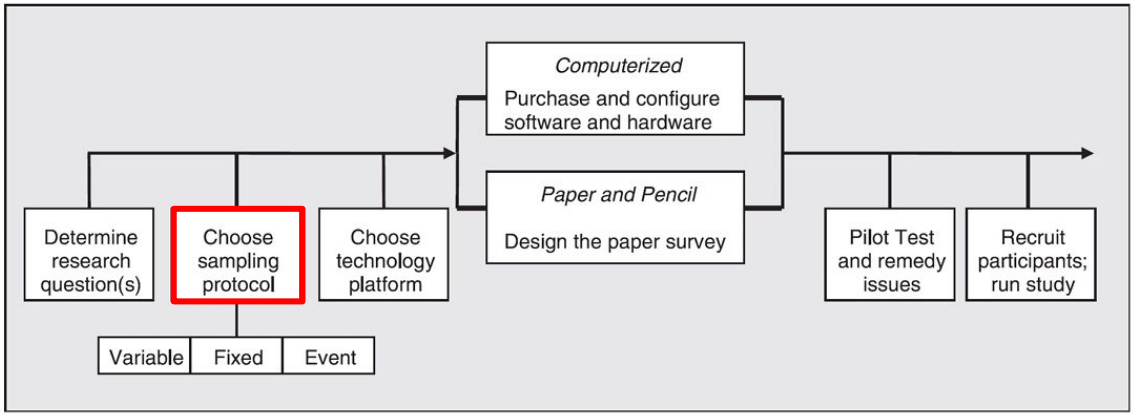
Social Environments

Activities

Locations

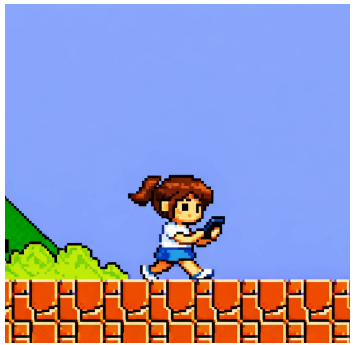
Sampling protocol

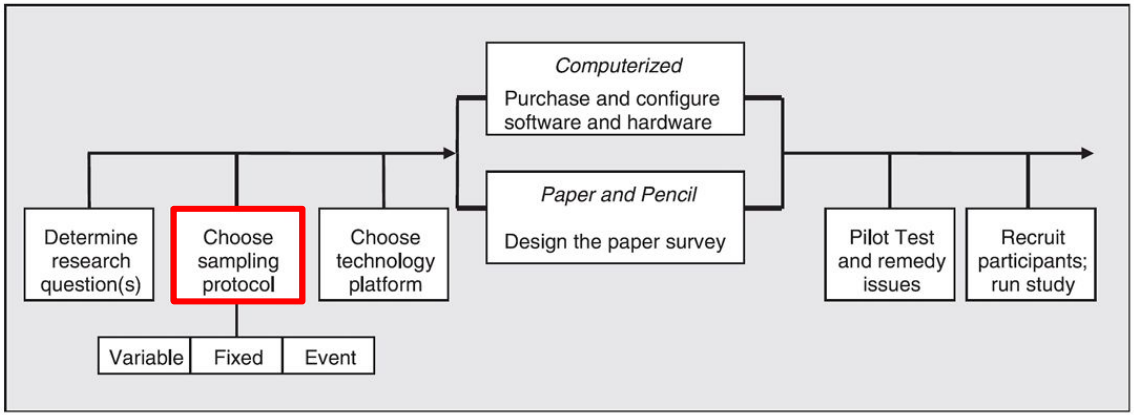




- Variable-time sampling
- Fixed-time sampling
- Event triggers

Sampling protocol



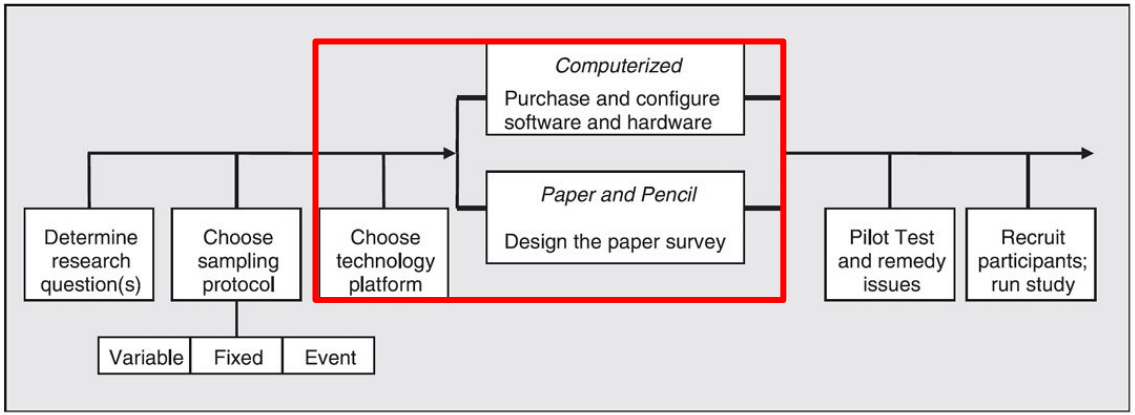


- Variable-time sampling
- Fixed-time sampling
- Event triggers

- Quasi-random intervals **from 9am-9pm** (at least 1 hour in between)
- **7 times** per day
- **across 5 days** (Friday to Tuesday)

35 responses per person

Technology platform for self-reports



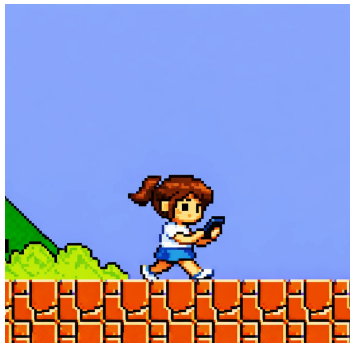
Opens an URL to complete the questionnaire on Qualtrics

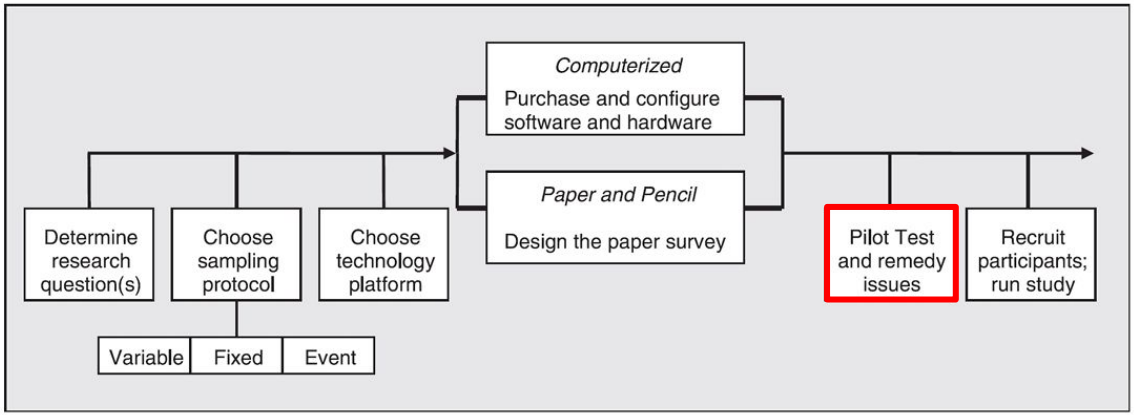
Samply -> Open-source platform for scheduling notifications

Free
Control over timing
Customizable link

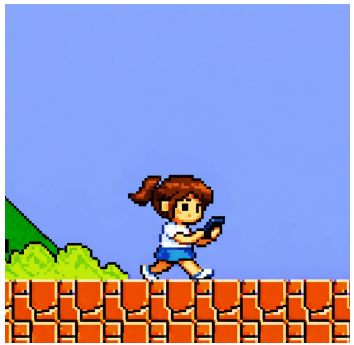
qualtrics XM (Each survey expires after 30 mins)

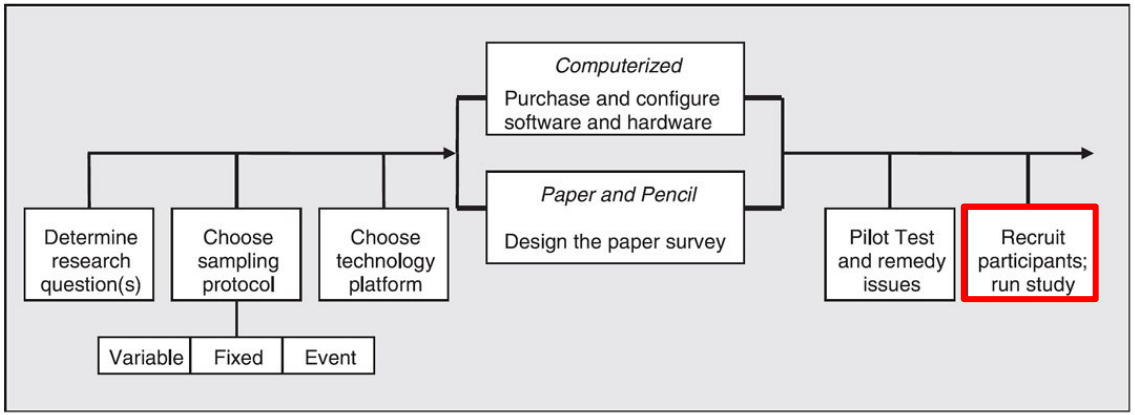
Piloting




Computerized
Purchase and configure software and hardware
Paper and Pencil
Design the paper survey
Determine research question(s)
Choose sampling protocol
Choose technology platform
Pilot Test and remedy issues
Recruit participants; run study
Variable
Fixed
Event

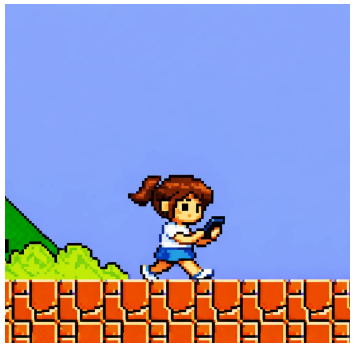
Study recruitment



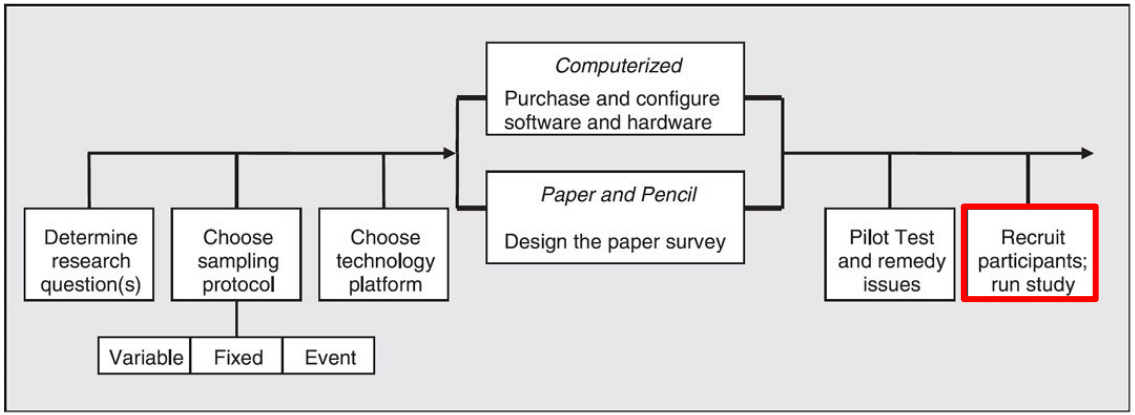


- A university participant pool (assign credits)
- **Sample size: *N* = 225** undergraduate students
- Age range: 18-36 (mean age = 21)

Study recruitment



Anonymous ID



- Personality questionnaires
  20-item Toronto-Alexithymia Scale (Bagby et al.,1994)
- Study sign-up (on Samply app)

- A university participant pool (assign credits)
- **Sample size: *N* = 225** undergraduate students
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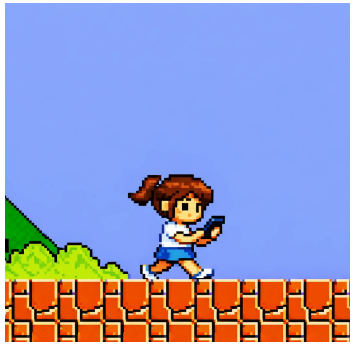
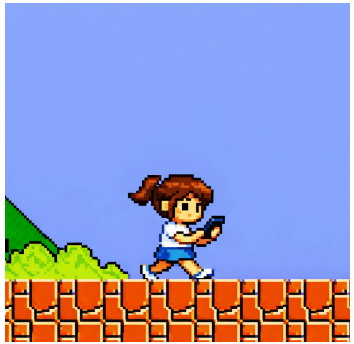
Data collection -> 12 weeks in total

Expected challenges (data collection)



- Insufficient responses
  - Assign course credits only for > 70% completion rate
  - Follow-up with more notifications (extra 1-2 days)
- Invalid participants/responses
  - Cleaning pipeline

Cleaning pipeline



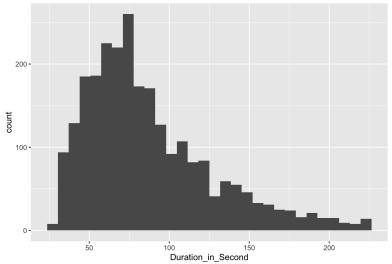
Problematic participants

- Insufficient responses (less than 50%)
- Too many same responses across surveys (e.g., 1 for all items)

Problematic survey responses

- Response time outliers (± 3 standard deviation, too fast/slow)
- Exact same responses across items (e.g., 1 for all)

Response time (*Mean* = 88 s)

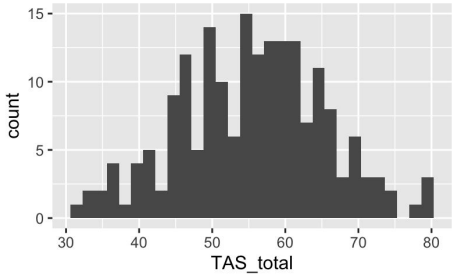


Checking data distribution :

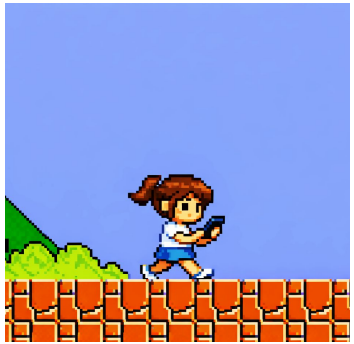
- Response time distribution
- Rating characteristics
- Number of responses

...

e.g., Overall alexithymia



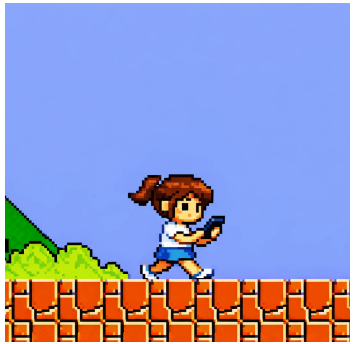
Unexpected problem



A few participants submitted more than the maximum number of surveys

- Intentionally completed the same survey many times
- Researcher’s mistake in scheduling notifications (doubled)

Updated cleaning procedure



Problematic participants

- Insufficient responses (less than 50%)
- Too many same responses across surveys
- Too many extra survey responses

***N* = 225 –> *N* = 190**

Problematic survey responses

- Response outliers (+/− 3 std., too fast or too slow)
- Same responses across the survey
- Remove extra responses

Final dataset = 5063 observations (removed data = ~8%)

Dimension reduction:
Identifying latent structures of thought

18 items of thought

“Thought items”

Task
Future
Past
Self
People
Emotion
External
Images
Words
Sounds
Detailed
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Dimension reduction:
Identifying latent structures of thought

PCA

(Principal Component Analysis)

18 items of thought

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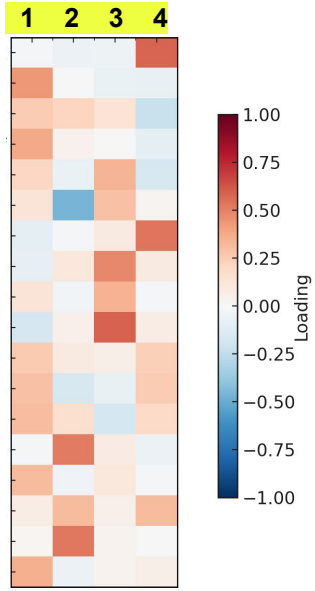
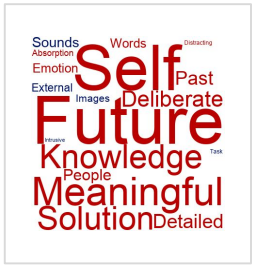
“Thought patterns”



4 principal components
accounted for ~50% of the total variance

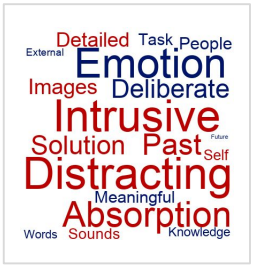
Thought patterns, visualized as word clouds

Future-self



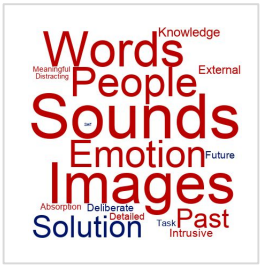
~24% variance

Intrusive distraction



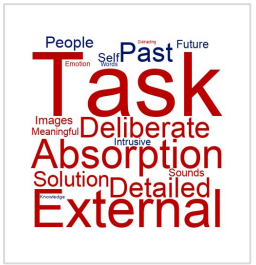
~12% variance

Sensory engagement



~8% variance

Task-focus

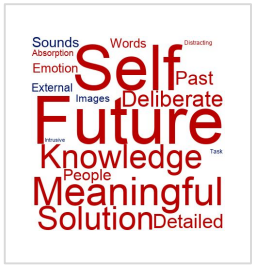


~6% variance

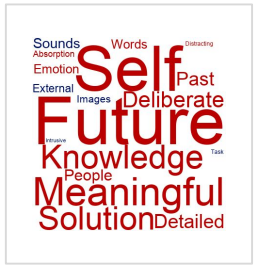
How to check the stability of thought patterns?

Split-half reliability

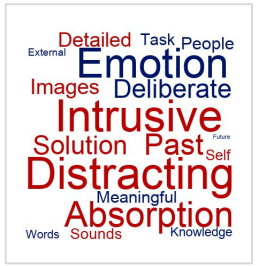
Future-self



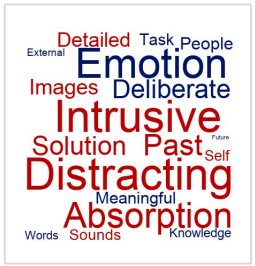
X



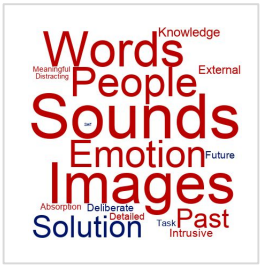
Intrusive distraction



X



Sensory engagement



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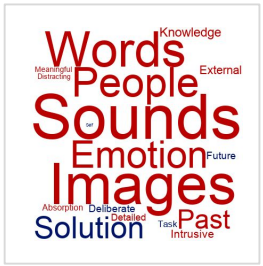
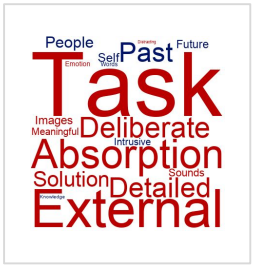


Task-focus



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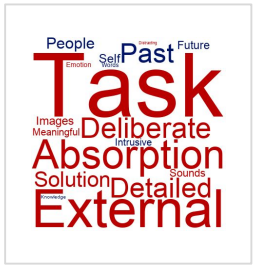
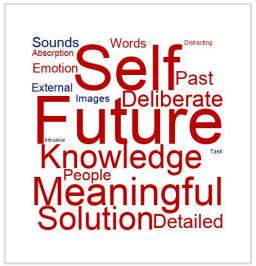
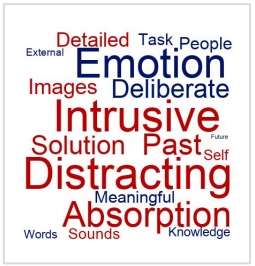
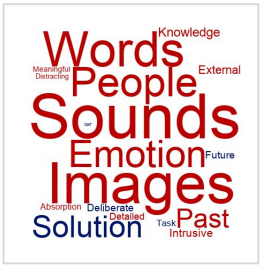
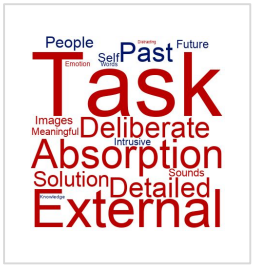
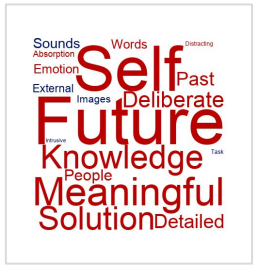
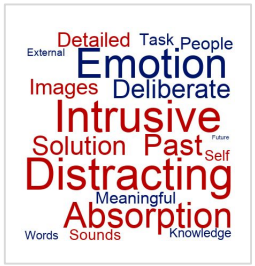
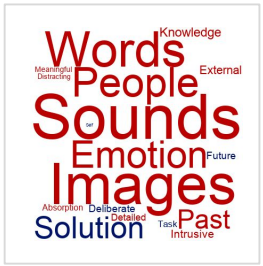
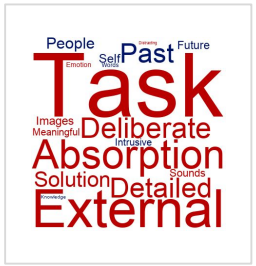


How to check the stability of thought patterns?

Split-half reliability

	Future-self	Intrusive distraction	Sensory engagement	Task-focus
1000 iterations				
	X	X	X	X
				

Strong internal reliability of the PCA, with an **average similarity score (r = 0.992)**

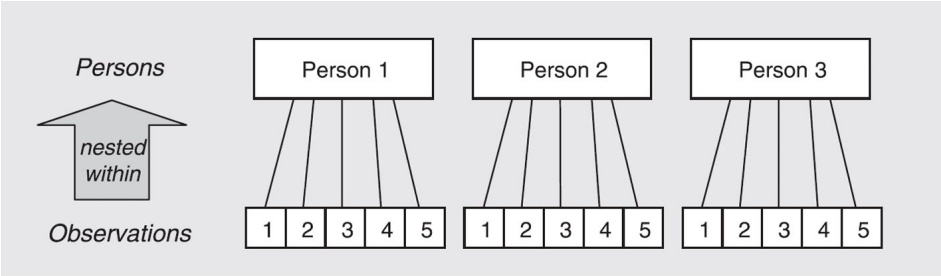
Analyzing multi-level experience sampling data

- Observations are nested within individuals, **not independent**

Level 2

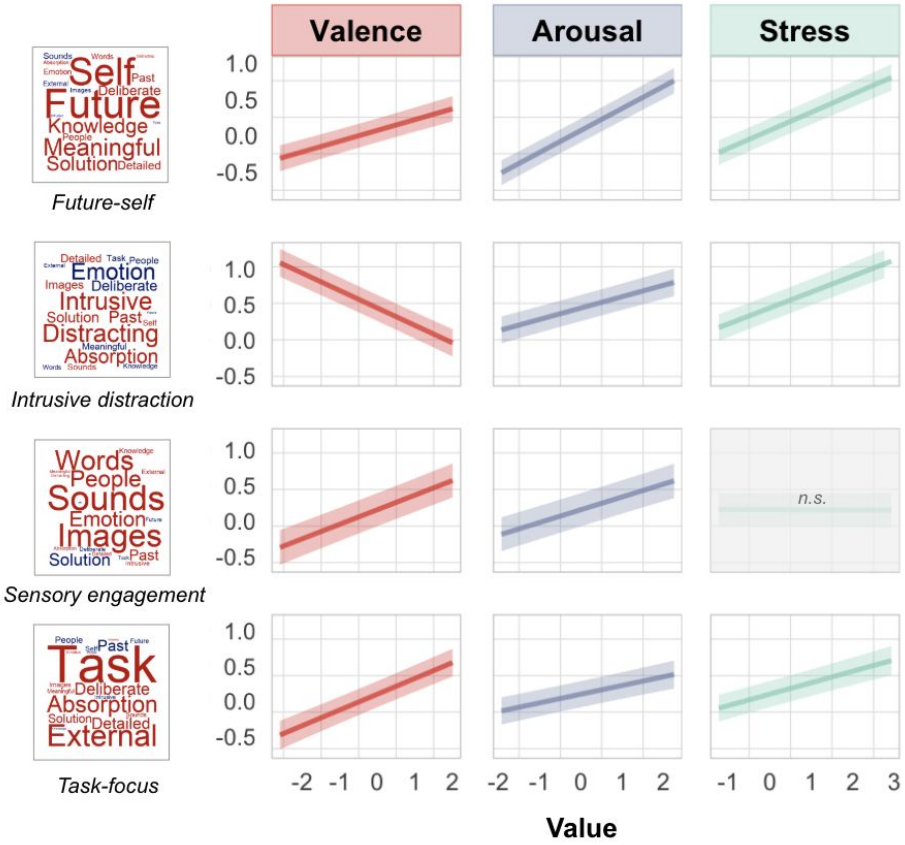
Multi-level modelling

Level 1



- Linear Mixed Effects Models (in R)
  - Fixed effects (e.g., emotional states, alexithymia traits…)
  - **Random intercepts** (“Participant ID”)

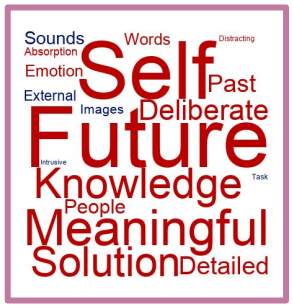
Patterns of thought vary across emotional states

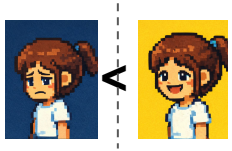


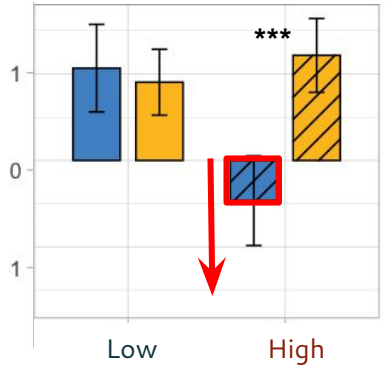
Difficulty Identifying Feelings

selectively modulates thought–emotion interactions

Future–self





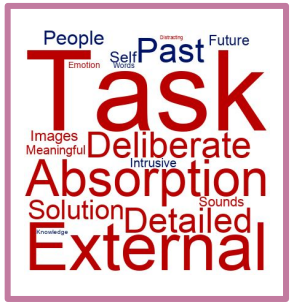


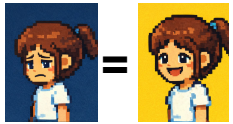
Sadness-specific reduction:
Reduced future-self focus

Difficulty Identifying Feelings

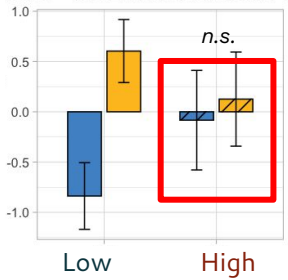
High Externally Oriented Thinking:
less changes in external task-focus across emotional states

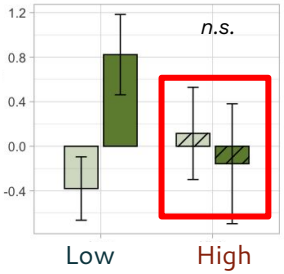
Task-focus





Low Stress = High Stress



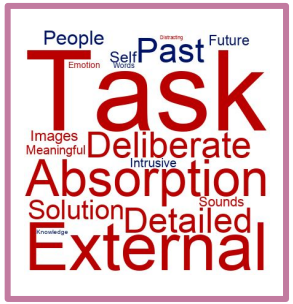


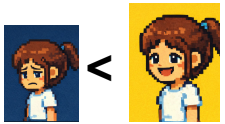
high Externally Oriented Thinking

Reduced coupling between task-relevant thought and emotional states

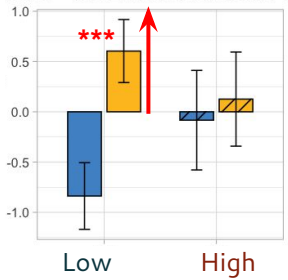
Low Externally Oriented Thinking:
more changes in external task-focus across emotional states

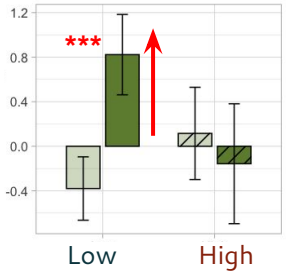
Task-focus





Low Stress < **High Stress**





low Externally Oriented Thinking

Checking potential confounds

1. People with higher alexithymia respond in a more careless and restricted way?

   No differences in response characteristics

   - Response time, Number of response, Scale use restriction, Variability across time

2. Do people with high alexithymia engage in different contexts?

   No differences in Social environments (Alone/Social) and Activities (Work/Leisure/Rest/..)

Takeaway: Studying thought–emotion interactions in daily Life

- Ongoing thought patterns as stable, meaningful constructs
- Differentiated associations with emotional states
- Modulated by individual differences in alexithymia traits

Other reflections

- Sampling both qualitative + quantitative data

- Analyze dynamics

  -> Time-lagged models (e.g., does earlier mood predict later thought?)

  -> Time-varying indices (e.g., emotion inertia/variability)

- Reuse & transparency: sharing the (de-identified) dataset and code!

  ...

Other (very personal) reflections: Experience sampling as a tool for "self-insights"

Experience Sampling on yourself (*N* = 1)

- Self-tracking -> discover your own patterns
- Testing small hypotheses about yourself
- Self-experimentation!

- Shifts perspective as a researcher -> treating yourself as a participant

Thank you for your attention!