



Behind the spotlight

Using **EMA** and **passive sensing** to depict assessment **context** in a clinical sample

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Ambulatory Context Assessment

What is “context”?

- “*sum of environmental conditions or situational circumstances under which behaviour occurs, distinct from person-characteristics or inner states*” Sansone et al., 2004
- different ambulatory approaches depending on **outcome of interest**

| Active context assessment (EMA) | Passive (objective) context assessment |
|--|--|
| <ul style="list-style-type: none">- Subjective Description: Diamonds Scale (Rauthmann & Shermann, 2016)- Social, i.e. presence of close or non-close others (Paul et al., 2023)- Idiographic, i.e. personalized responses (van Klipstein et al., 2023) | <ul style="list-style-type: none">- Social interactions, i.e. call log (Kaplan et al., 2022)- Environmental, i.e. weather (Peters et al., 2024)- Location and movement (Zhang et al., 2023)- Time, i.e. weekday/weekend (Zhang et al., 2024)- Surrounding (i.e. ambient light) |

→ incorporating context leads to improved prediction of proximal (i.e. mood) and distal (i.e. long term mental health) outcomes!

Addressing context in psychotherapy research

Understand blackbox of patients' **between-session** behavior and context

- **Active assessments (EMA):**
 - Individual conditions and associations driving patients' symptoms can be clarified and addressed in therapy
- **Passive assessments**
 - increase information coverage with low patient burden
 - potentially: replace or reduce self-reports
 - automatically detect critical contexts (i.e. low mood in the morning, at home) and i.e. trigger an appropriate exercise on the phone → base for JITAIs

Current presentation

Address **situational context** in a sample of patients undergoing CBT for internalizing disorders (PREACT-study)

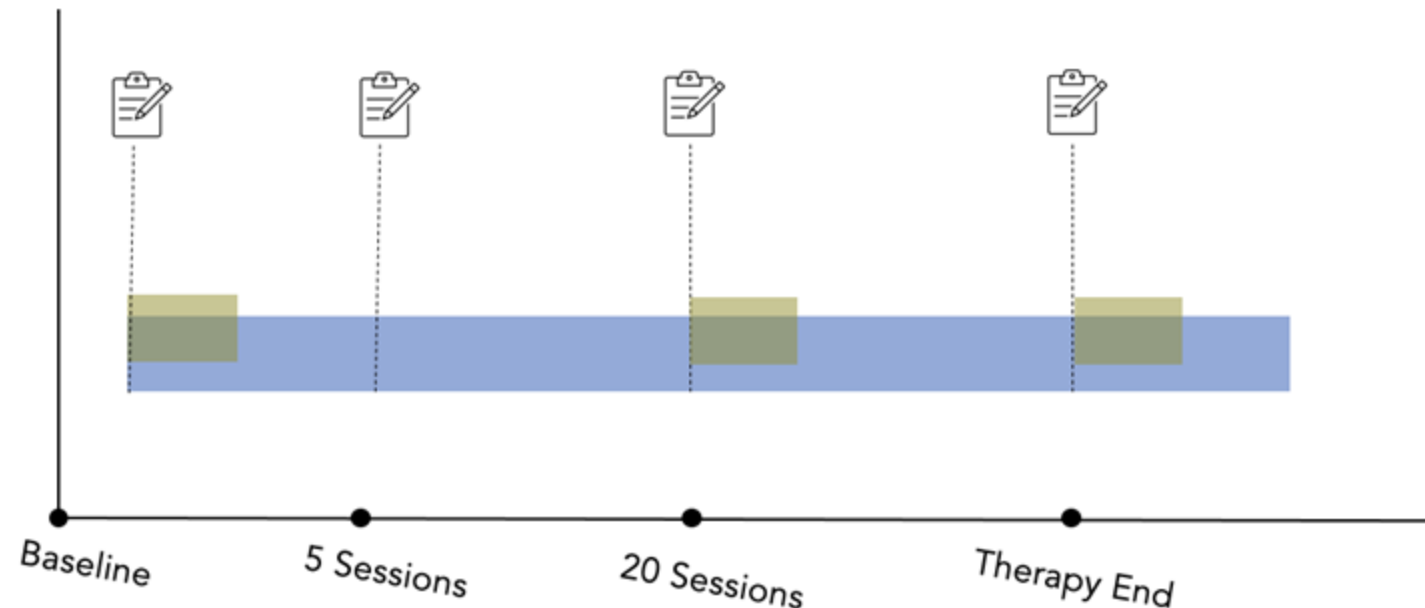
1. How does described **situational context** vary within and between patients and diagnoses ?
 - New ESM measure based on previous studies
2. Can situation compositions be depicted using **passive data** ?
 - location features, step count and time-based features
 - multilabel classification algorithm



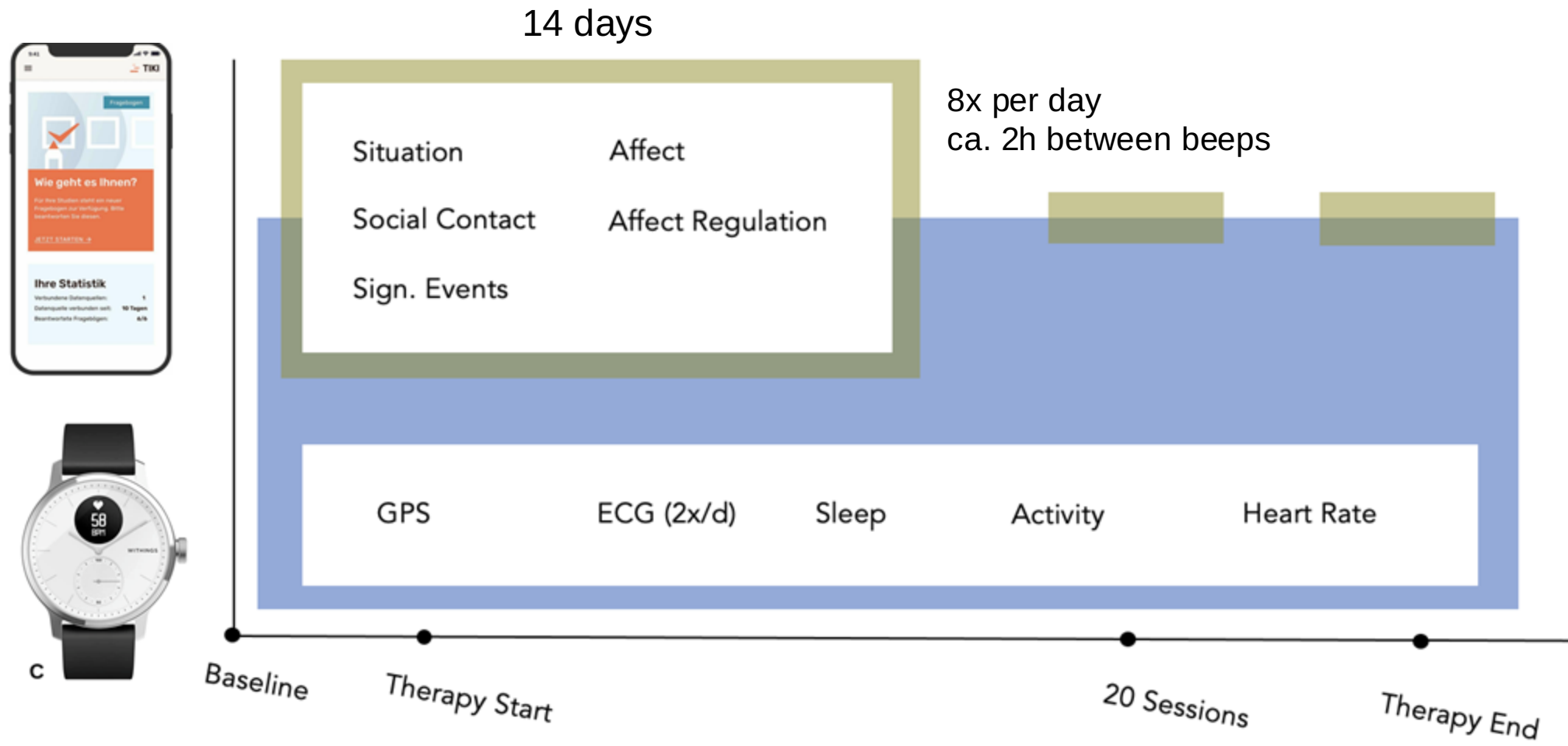
The PREACT-study

PREACT-Study

- **Goal:** clinically meaningful prediction of **CBT** non-response in internalizing disorders
- Collection of multimodal and transdiagnostic features; emotion regulation = common
- Naturalistic study design; representative sample of patients starting a CBT at one of four outpatient clinics in Berlin



PREACT-Study



PREACT-Study: Situation assessment

How did you
spend your time
since the last
beep?

☐ work or study

☐ chores

☐ care work

☐ eating/ drinking/ self-care

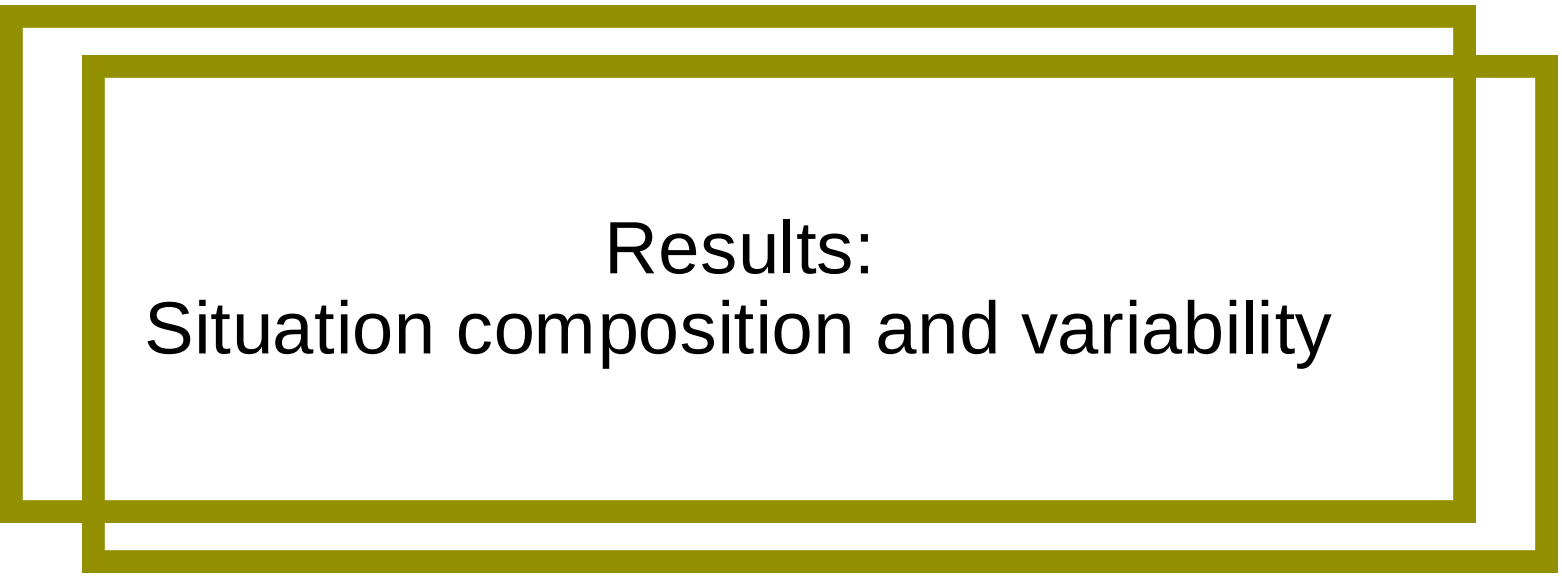
☐ travelling

☐ smartphone - social media

☐ passive leisure

☐ active leisure

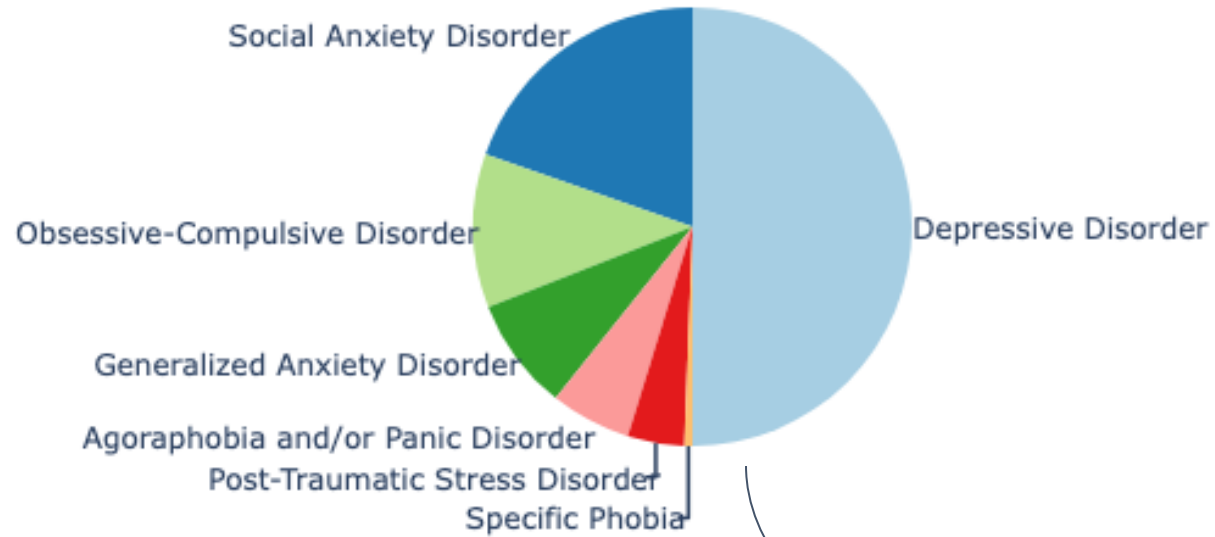
☐ other



Results:
Situation composition and variability

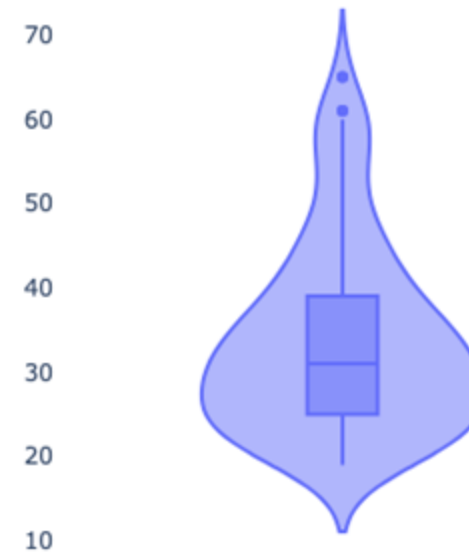
Sample

N = 173
Total beeps = 11055
Average = 63 ± 22 pP



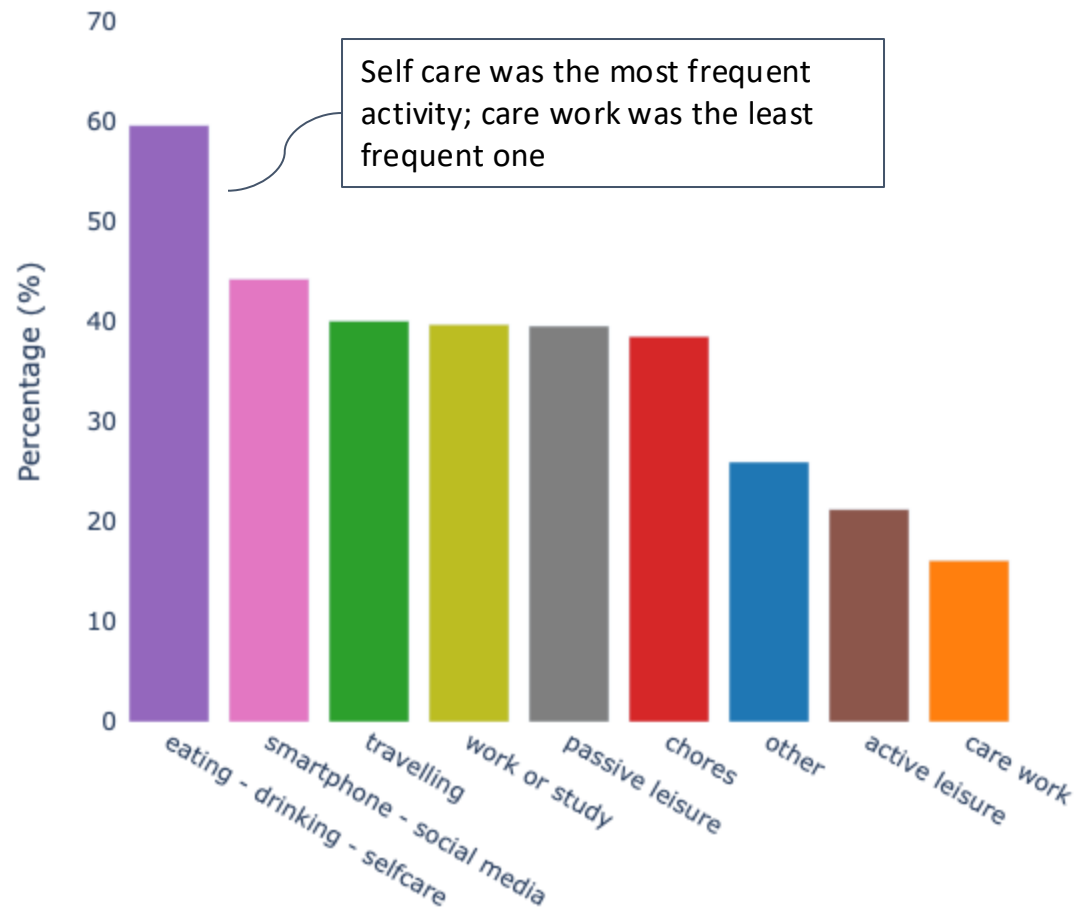
~50% Depressive disorder,
mean age = 33.7, 58% female

Age Distribution

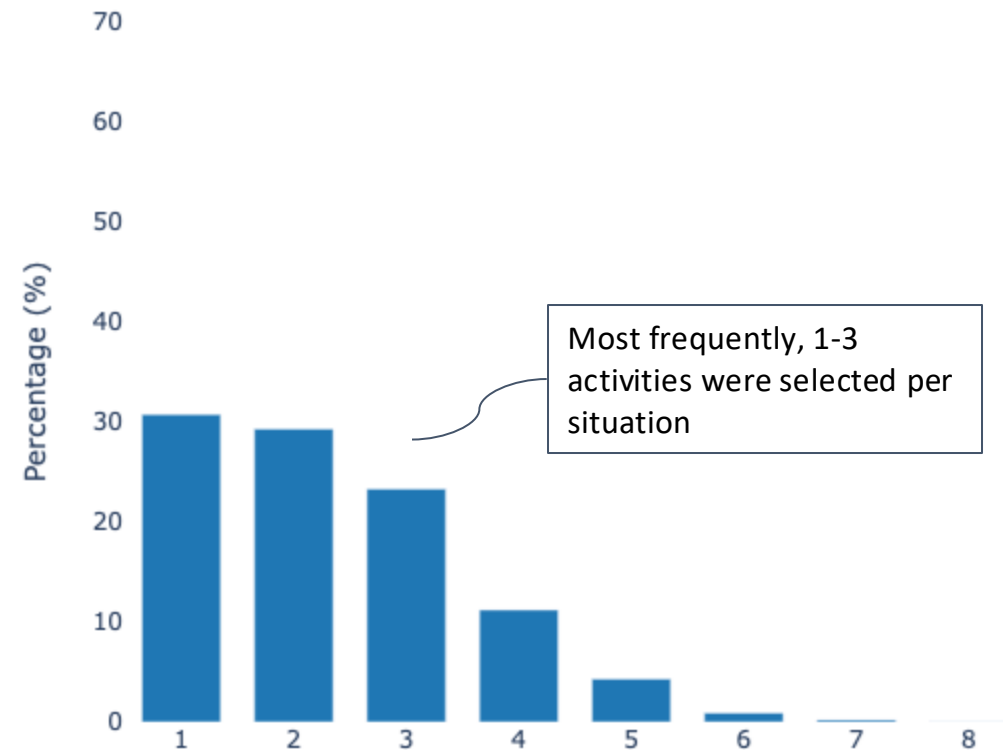


Situation count and composition

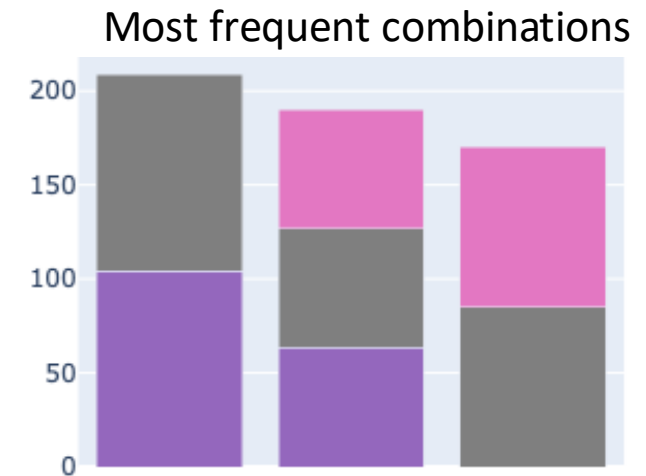
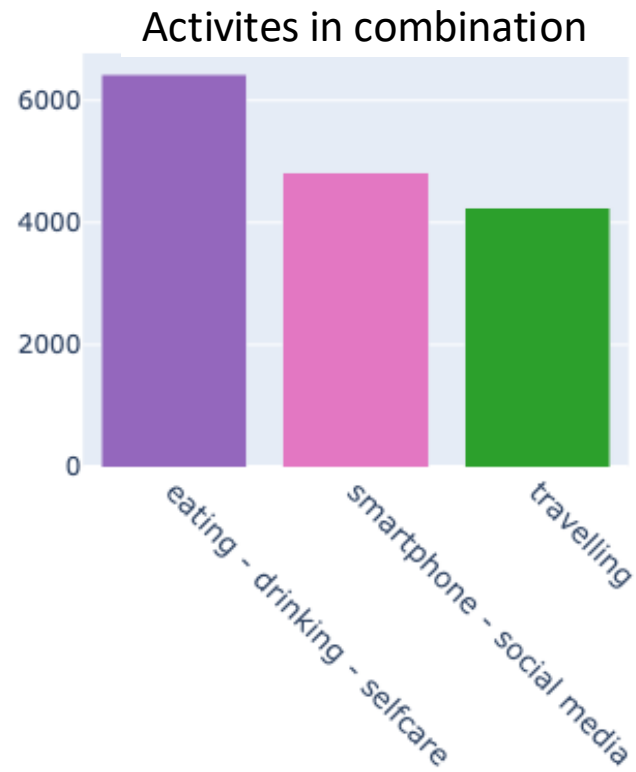
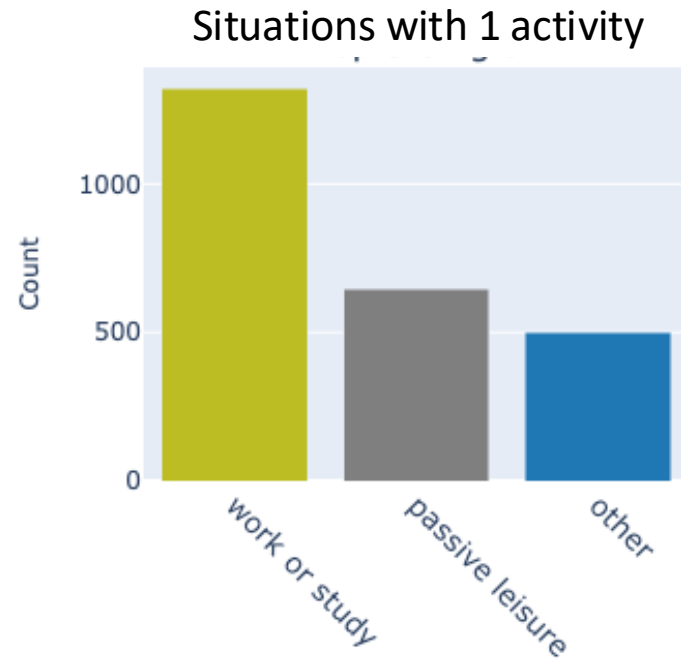
Number of activities total



Number of activities per situation

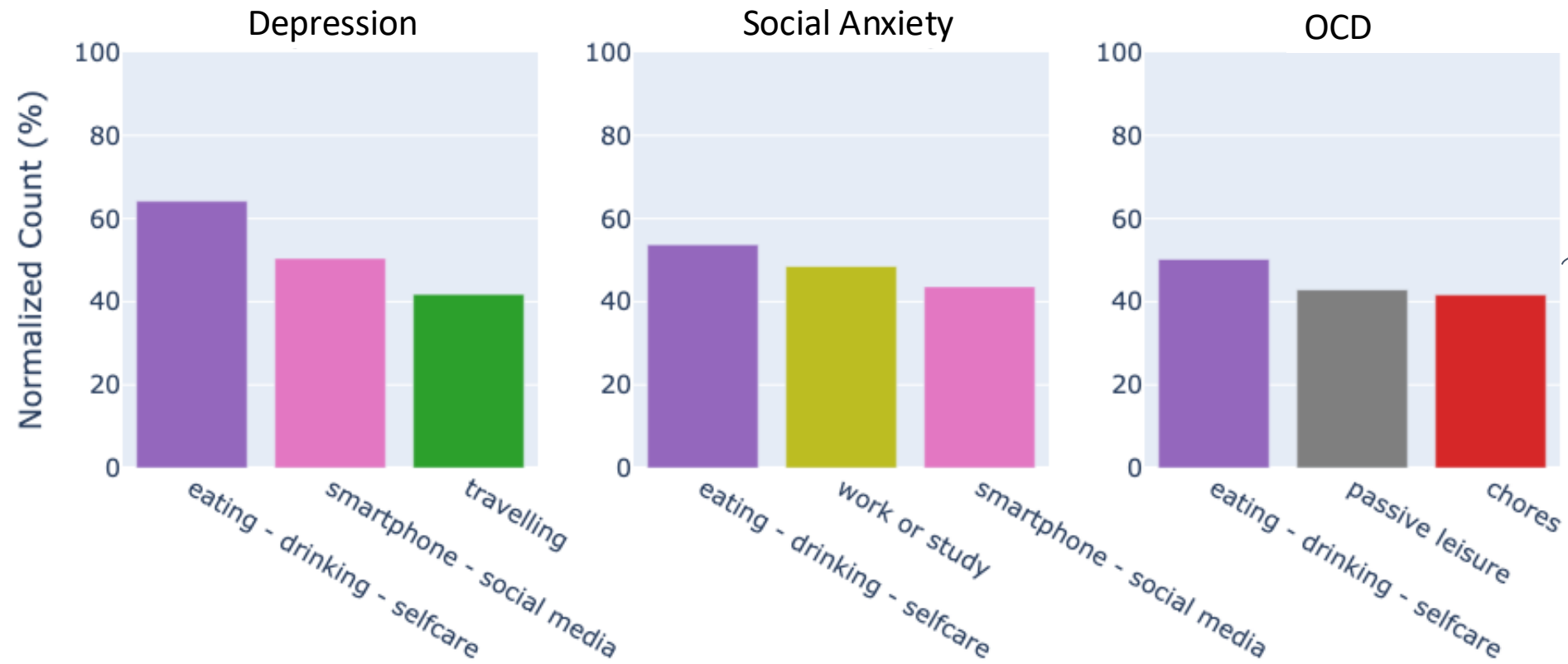


Situation composition



Most frequent are combinations of self care, passive leisure and smartphone usage;
746 unique

Situation distribution: 3 most frequent SCID diagnoses

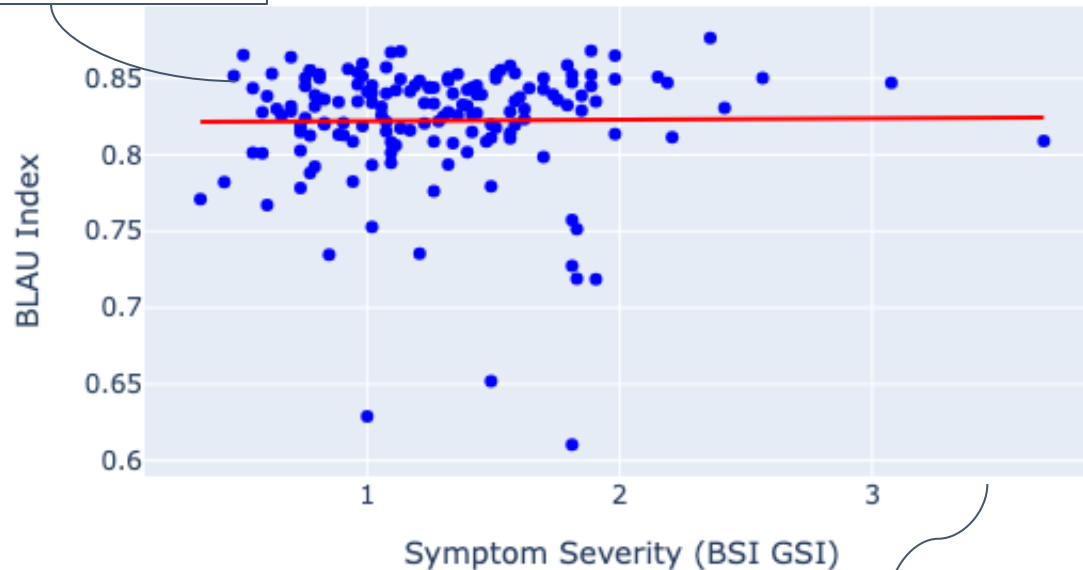


Situation distribution: BLAU Index

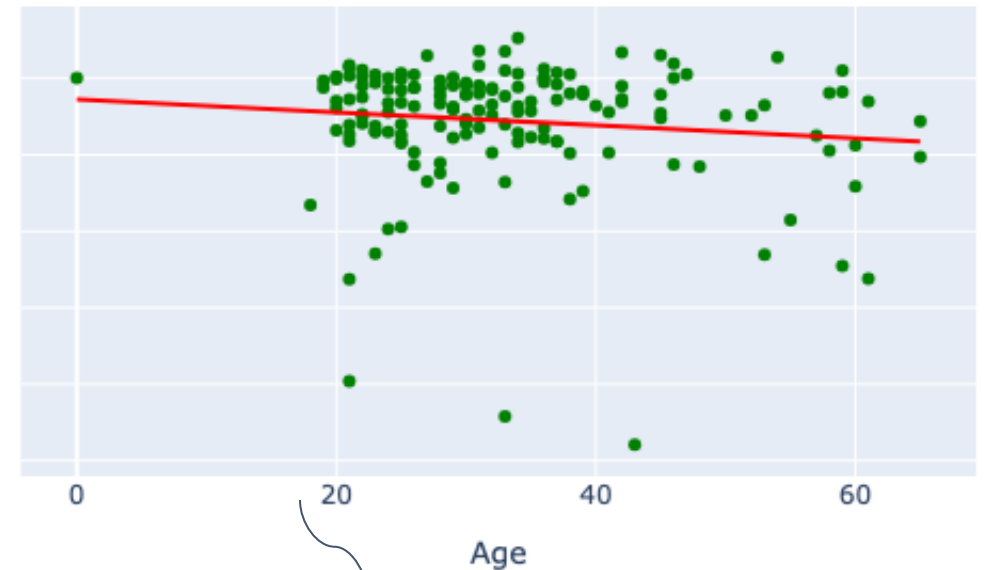
Blau Index = measure of situation diversity within individuals (0-1)

High situation diversity
within individuals
(.83 ± .03)

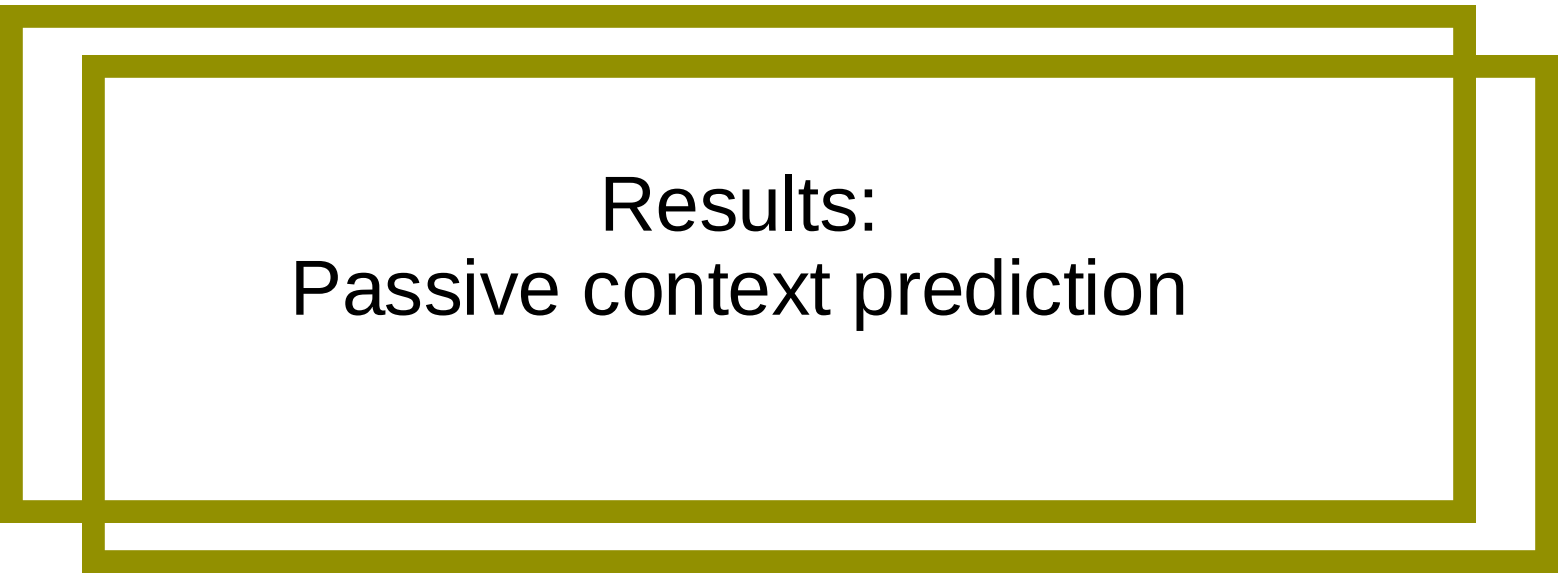
BLAU Index vs. Symptom Severity



BLAU Index vs. Age



No significant correlations between
BLAU-Index and BSI_GSI or age



Results:
Passive context prediction

Passive situation prediction

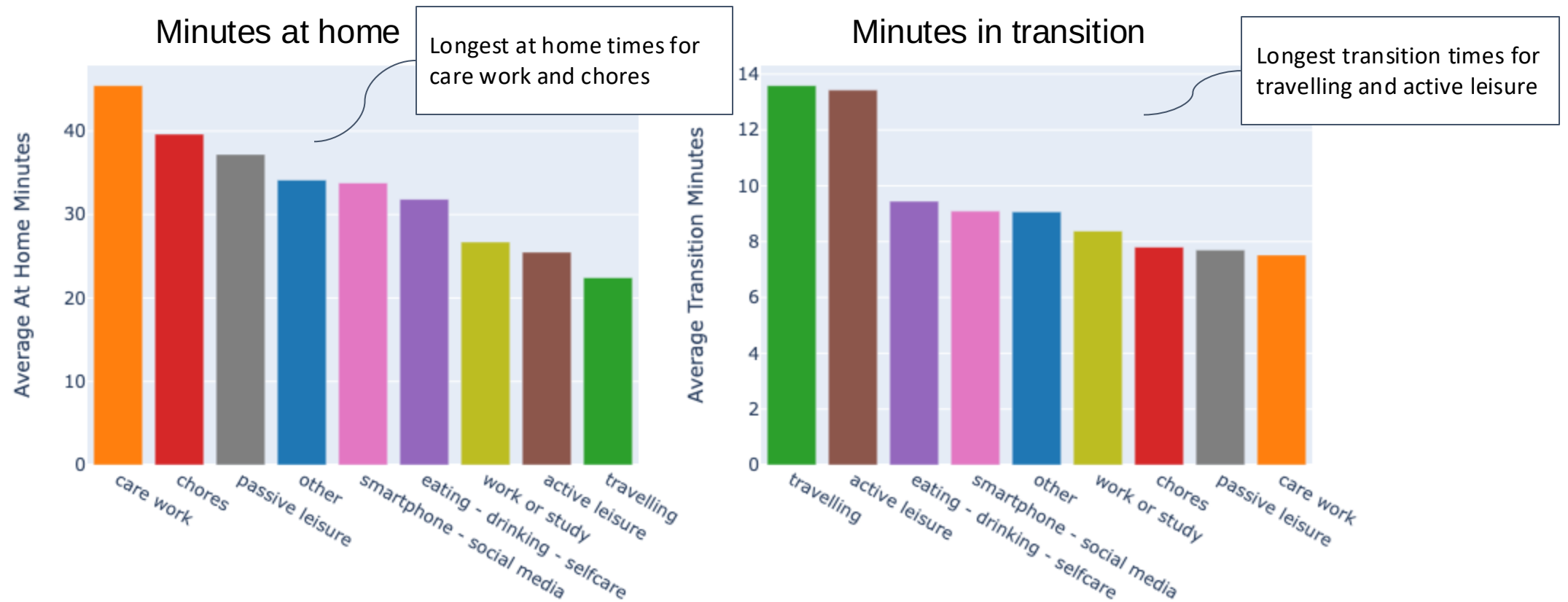
Can we depict **situational context** using data on **activity, location and time**?

Data:

- 2h previous to each assessment
- **GPS**: total distance travelled (km), minutes in transition, minutes at home, number of GPS points
- **Activity**: total step count
- **Time**: season, weekday, time of day

→ 45 features in total

Passive situation prediction



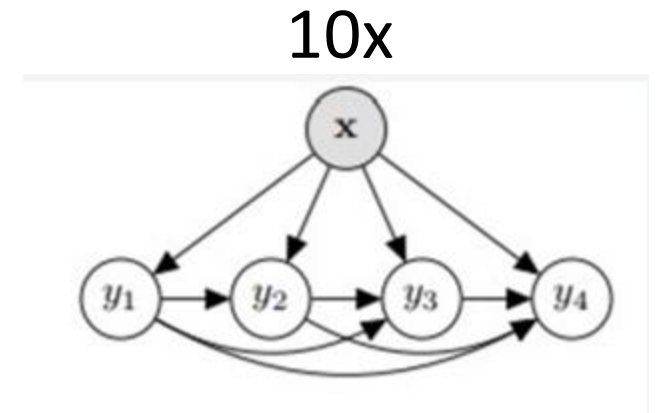
Passive situation prediction

Can we depict **situational context** using data on **activity, location and time**?

Model:

- Ensemble of 10 Classifier Chains using Random Forests;
- 5-fold cross validation, 80/20 Train Test split
- Outcome: situation composition

| | | |
|-------------------------------------|--|---|
| <input checked="" type="checkbox"/> | Arbeit oder Studium | 1 |
| <input type="checkbox"/> | Hausarbeit oder Erledigungen | 0 |
| <input type="checkbox"/> | Kümmern um Kinder / Angehörige | 0 |
| <input checked="" type="checkbox"/> | Essen/ Trinken/ Körperpflege | 1 |
| <input type="checkbox"/> | Unterwegs (z.B. in der U-Bahn) | 0 |
| <input type="checkbox"/> | Smartphone/ Soziale Medien | 0 |
| <input type="checkbox"/> | Freizeitaktivität, eher passiv (z.B. Film schauen, Lesen) | 0 |
| <input type="checkbox"/> | Freizeitaktivität, eher aktiv (z.B. Sport, Unternehmungen) | 0 |
| <input type="checkbox"/> | Etwas Anderes | 0 |



Passive situation prediction

Can we depict **situational context** using data on **activity, location and time**?

Model:

- Ensemble of 10 Classifier Chains using Random Forests;
- 5-fold cross validation, 80/20 Train Test split
- **Outcome**: situation composition
- **Evaluation**: accuracy and hamming loss

| Accuracy 0% | | | Hamming Loss 11% |
|---|---|---|---------------------|
| | | | |
| <input checked="" type="checkbox"/> Arbeit oder Studium | 1 | 1 | |
| <input type="checkbox"/> Hausarbeit oder Erledigungen | 0 | 1 | |
| <input type="checkbox"/> Kümern um Kinder / Angehörige | 0 | 0 | |
| <input checked="" type="checkbox"/> Essen/ Trinken/ Körperpflege | 1 | 1 | |
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| <input type="checkbox"/> Etwas Anderes | 0 | 0 | |

Passive situation prediction

Can we depict **situational context** using data on **activity, location and time**?

Model:

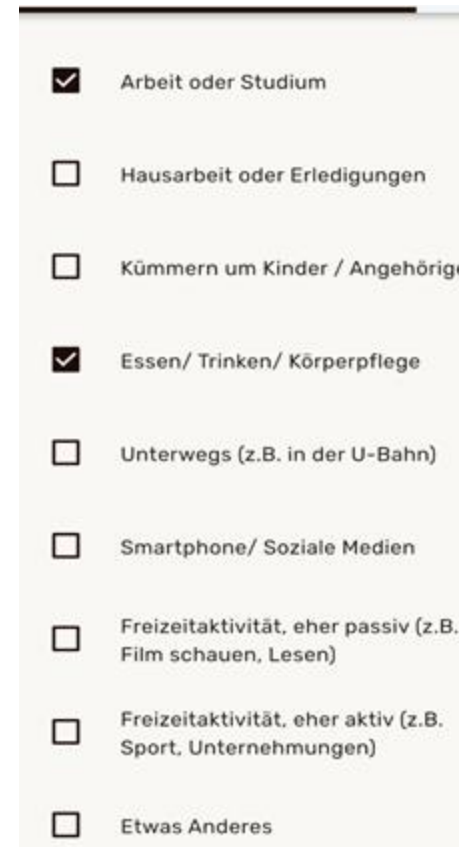
- Ensemble of 10 Classifier Chains using Random Forests;
- 5-fold cross validation, 80/20 Train Test split
- Outcome: situation composition

Result:

- Accuracy: **12%**
- Hamming Loss: **25%**

→ 12% of situation compositions were completely correctly predicted

→ “only” $\frac{1}{4}$ of labels were wrongly predicted



A screenshot of a mobile application interface showing a list of situational context labels. Each label is preceded by a checkbox. The labels are: 'Arbeit oder Studium' (checked), 'Hausarbeit oder Erledigungen' (unchecked), 'Kümmern um Kinder / Angehörige' (unchecked), 'Essen/ Trinken/ Körperpflege' (checked), 'Unterwegs (z.B. in der U-Bahn)' (unchecked), 'Smartphone/ Soziale Medien' (unchecked), 'Freizeitaktivität, eher passiv (z.B. Film schauen, Lesen)' (unchecked), 'Freizeitaktivität, eher aktiv (z.B. Sport, Unternehmungen)' (unchecked), and 'Etwas Anderes' (unchecked).

| | |
|-------------------------------------|--|
| <input checked="" type="checkbox"/> | Arbeit oder Studium |
| <input type="checkbox"/> | Hausarbeit oder Erledigungen |
| <input type="checkbox"/> | Kümmern um Kinder / Angehörige |
| <input checked="" type="checkbox"/> | Essen/ Trinken/ Körperpflege |
| <input type="checkbox"/> | Unterwegs (z.B. in der U-Bahn) |
| <input type="checkbox"/> | Smartphone/ Soziale Medien |
| <input type="checkbox"/> | Freizeitaktivität, eher passiv (z.B. Film schauen, Lesen) |
| <input type="checkbox"/> | Freizeitaktivität, eher aktiv (z.B. Sport, Unternehmungen) |
| <input type="checkbox"/> | Etwas Anderes |



Discussion

Discussion

Summary

- Medium situation complexity (1-3 activities); 746 unique combinations of activities
- High within-person diversity in situational context; however, patients are **homogeneous** in situational diversity → no adequate measure to distinguish individuals
- Differences in situational contexts between diagnoses, i.e. OCD
- Passive data descriptively match with situational contexts; data used in these analyses **do not suffice** to cover relevant aspects of situational contexts
 - add further available variables like heart rate, weather, physical activity
 - train **idiographic, i.e. individual** models (complexity)
 - outlook: predict above-average negative affect based on active and passive context features

Literature

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Thank you!

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