# *Stress Mindset Matters: Rethinking Mental Stress Detection with Multimodal Wearable Sensors*

*CHI 2026 (Best Paper!)*

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https://researchswinger.org/publications/stress26.pdf

# Introduction

- Wearable detect stress using physiological signals
- But – they treat all users the SAME
- Problem: people experience stress differently

# Stress Mindset

- Enhancing Mindset
  - Stress helps performance
- Debilitating mindset:
  - Stress is harmful

**RQ1:** Do self-report and wearable features discriminate stress is enhancing versus debilitating mindsets?
**RQ2:** How accurately can we infer an individual's stress mindset from user-level wearable features?
**RQ3:** Does including an individual's stress mindset improve prediction of momentary stress from wearables?

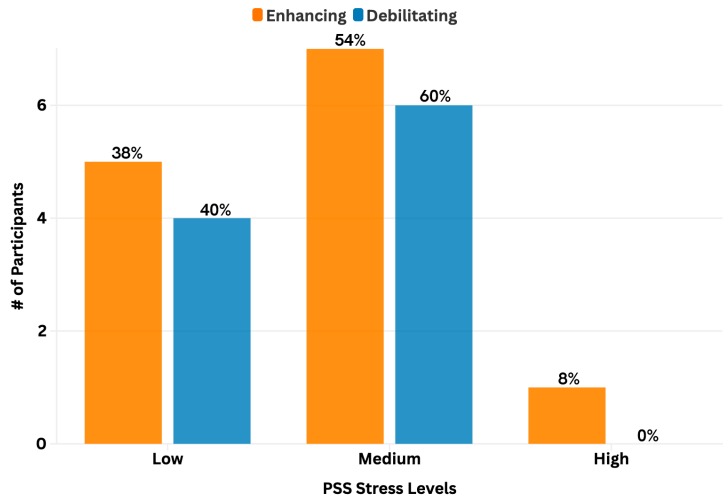
- Mindset affects physiology and behavior

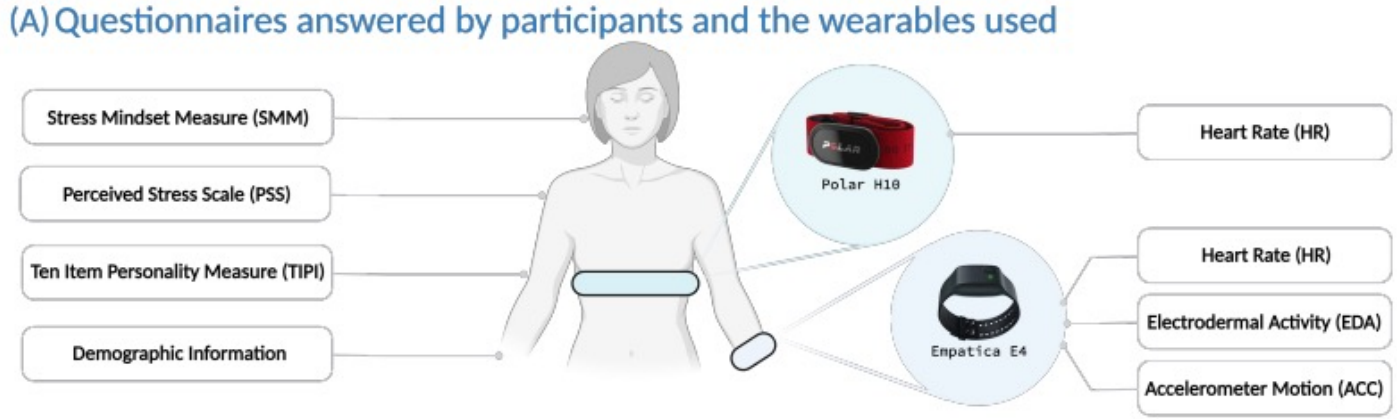
# Method Overview

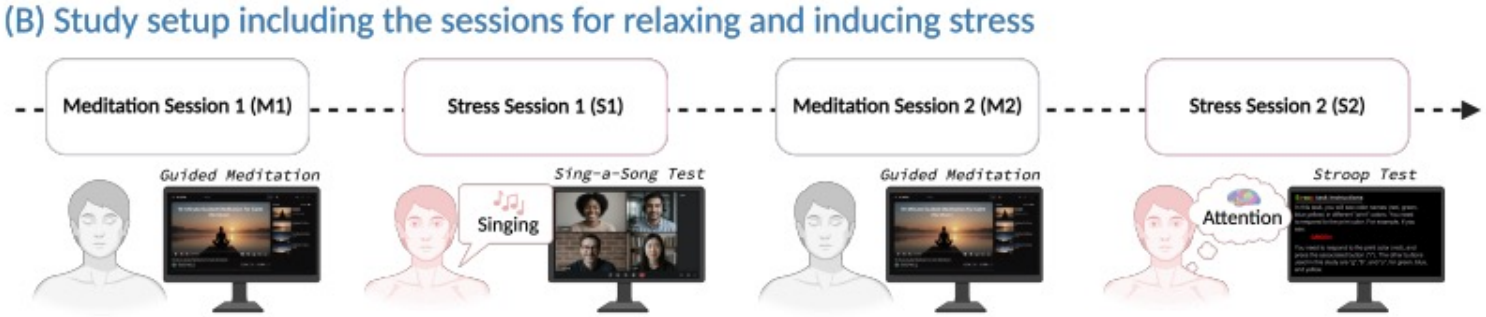
**Table 2: Participant demographics and scale statistics. Ages computed as 2025− birth year.**

| | |
|---|---|
| **Age** | |
| Mean ± SD | 32.7 ± 6.0 |
| Range | 23–52 |
| **Gender identity** | |
| Male | 15 |
| Female | 8 |
| **Education level** | |
| PhD or equivalent | 17 |
| Master's or equivalent | 3 |
| Bachelor's or equivalent | 2 |
| High school | 1 |
| **Employment** | |
| No, I am a student | 16 |
| Yes, I am employed | 7 |
| **Ethnicity** | |
| Asian | 14 |
| White, Caucasian | 6 |
| Another ethnic group | 1 |
| Mixed/multiple ethnic groups | 1 |
| Not specified | 1 |
| **Stress mindset** | |
| Enhancing (≥ 16) | 13 |
| Debilitating (< 16) | 10 |

**Table 3: Descriptive statistics (Mean, Standard Deviation, Min, Max) for the Ten Item Personality Inventory (TIPI), Perceived Stress Scale (PSS), and Stress Mindset Measure (SMM) ($N = 23$).**




Red Green Yellow

Red Green Yellow

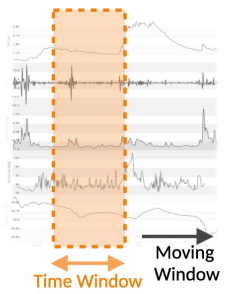
# Method Overview

## (C) Overview of the experimental setup including dataset pre-processing, RQ1, RQ2, and RQ3

Step 0

### Data Collection and Pre-Processing

**Procedure**




1. Collected data from 23 participants.
2. Used a moving time-window to obtain features.
3. Created datasets for windows of 2, 5, 10, 20, and 30 seconds.
4. Aggregated time window level features to obtain user-level features.

**Outcome**

Time-window level and user-level features for windows 2, 5, 10, 20, and 30 seconds.

Step 1

### RQ1: Do dataset features discriminate between with stress is enhancing versus debilitating mindsets?

**Procedure**

Descriptive Analysis

1. Analyzed the relation between personality traits and stress mindset
2. Analyzed the relation between perceived stress scale and stress mindset
3. Visualized sensor signals for enhancing and debilitating mindsets

Statistical Analysis

4. Trained logistic model with generalized estimating equations to understand sensor features that discriminate enhancing and debilitating mindsets.

**Outcome**

A heart rate variability related feature could discriminate the mindsets with high statistical significance.

Step 2

### RQ2: How accurately can we infer an individual's stress mindset from user-level wearable features?

**Procedure**

1. Defined classification tasks for inferring stress mindset from wearables.
   a. Two-class classification: stress is enhancing vs debilitating
   b. Three class classification: low, medium, and high scores for stress mindset.
2. Trained logistic regression, support vector classifier, random forest, and XGBoost models for the classification tasks, with user-level data.
3. Compared performance against a baseline that only uses personality traits to infer mindset.

**Outcomes**

Logistic regression models provide an AUC of 0.88 with a 5s window for two-class mindset inference.

Support Vector classifier provided an AUC of 0.81 with a 2s window for three-class mindset inference

Step 3

### RQ3: Does including an individual's stress mindset improve prediction of momentary stress from wearables?

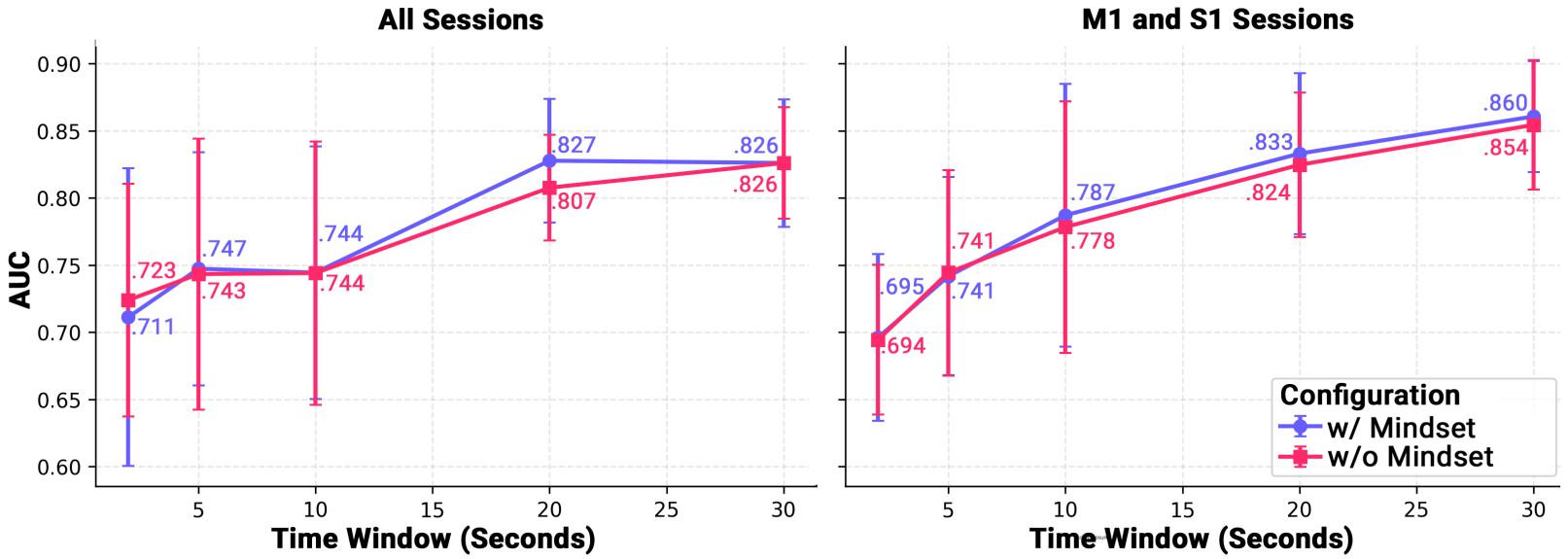
**Procedure**

1. Define a two-class classification task to detect momentary mental stress from wearables.
2. Train models by using stress mindset as an input feature using time-window level features.
3. Train separate models for stress-is-enhancing group and debilitating group with time-window level features.

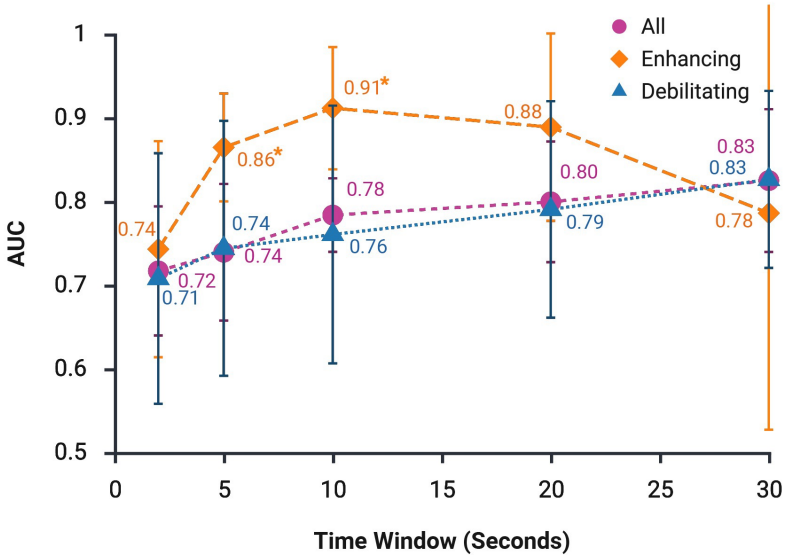
**Outcomes**

Using mindset as a features leads upto 2% AUC increase compared not including mindset as a feature.

Mindset-specific model for "enhancing" group leads to an AUC of 0.91 (10s) beyond the one-size-fits-all model with AUC of 0.84 (30s)




stress detection is more accurate with longer windows (30s+)




For those with an *enhancing* mindset, stress is most detectable at **10s**

# Conclusion

- Prior models were personalized based on history (how your HR looks like?)
- Author proposed physiological personalization - It suggests that two people with the exact same heart rate history might need completely different models because one sees stress as fuel and the other sees it as poison.