

Persons, Situations, and Time: Idiographic Behavior Prediction

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Personalized Behavior Prediction: An Idiographic Person-Situation Test

[Edit preprint](#)**AUTHORS**

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AUTHOR ASSERTIONS

Conflict of Interest: No ▾

Public Data: Available ▾

Preregistration: Available ▾

Accepted: PsyArXiv uses post-moderation. This preprint has been accepted by a moderator and is publicly available and searchable.

The screenshot shows a preprint page from PsyArXiv. At the top, there's a navigation bar with icons for search, zoom, and orientation, followed by a page number (1 of 33) and an 'Automatic Zoom' dropdown. To the right, there are download statistics (Views: 826 | Downloads: 443) and social sharing icons for Twitter, Facebook, LinkedIn, and Email. A 'plaudit' button is present, encouraging users to endorse the work. Below the header, the running head 'PERSONALIZED BEHAVIOR PREDICTION' is visible. The main content area contains the title 'Personalized behavior prediction: An idiographic person-situation test', authors 'Emorie D. Beck' and 'Joshua J. Jackson', their institutions 'Northwestern University Feinberg School of Medicine' and 'Washington University in St. Louis', and a short abstract. The abstract discusses the goal of psychology to predict future behaviors and how machine learning approaches were used to investigate loneliness and procrastination in a longitudinal study of 104 participants with 5,971 assessments.

Running head: PERSONALIZED BEHAVIOR PREDICTION 1

Personalized behavior prediction: An idiographic person-situation test

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A longstanding goal of psychology is to predict the things people do, but tools to accurately predict future behaviors remain elusive. In the present study, we used intensive longitudinal data ($N = 104$; total assessments = 5,971) and three machine learning approaches to investigate the degree to which two behaviors – loneliness and procrastination ...

Abstract

Beck & Jackson (in press), *Psych Science*

Pain by the Numbers

~28%
(~50,009,000)

of adults over 18
experience chronic pain



~45%
(~13,574,000)

of adults over 65
experience chronic pain



~30%
(~25,000,000)

of low SES individuals
experience chronic pain



**\$560
billion**

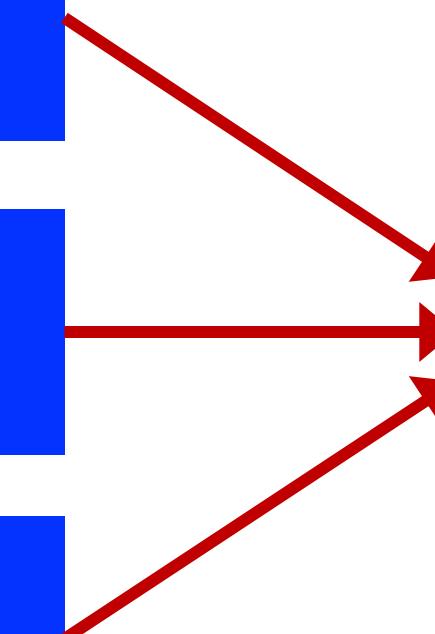
public health cost
annually

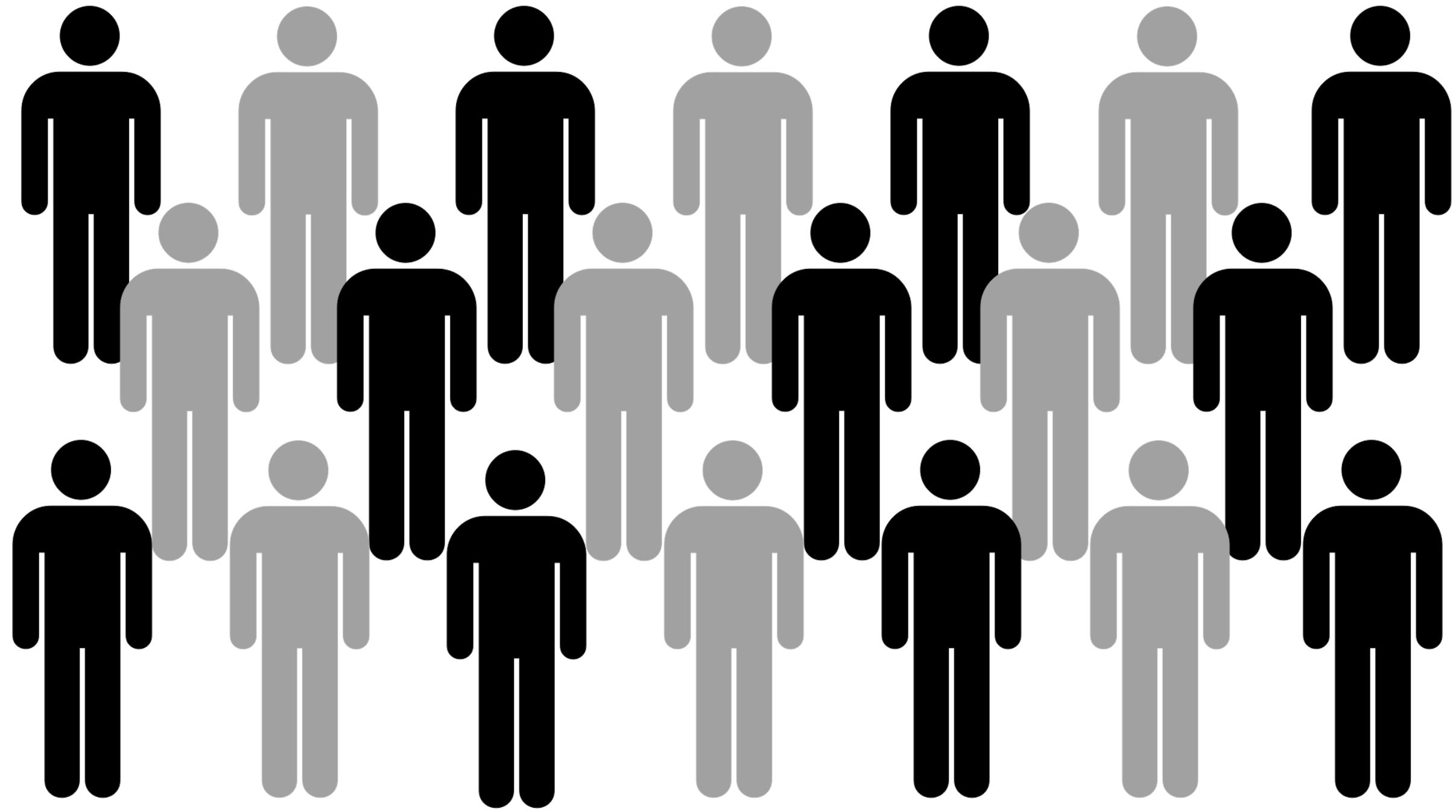
Persons

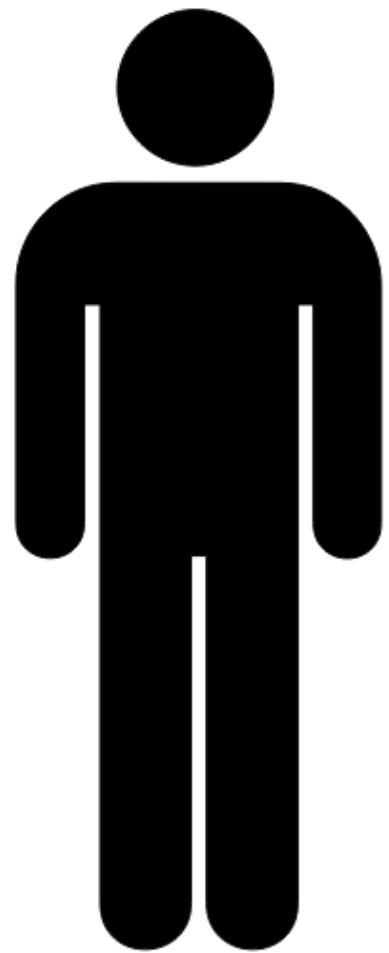
Situations

Behaviors

Pain







Critical Assumption

Situations, behaviors, and experiences should have ***similar*** consequences across people.

People with similar levels of a personality characteristic should behave in ***similar*** ways.

Alternative Assumption

Situations, behaviors,
experiences should have
different consequences
across people.

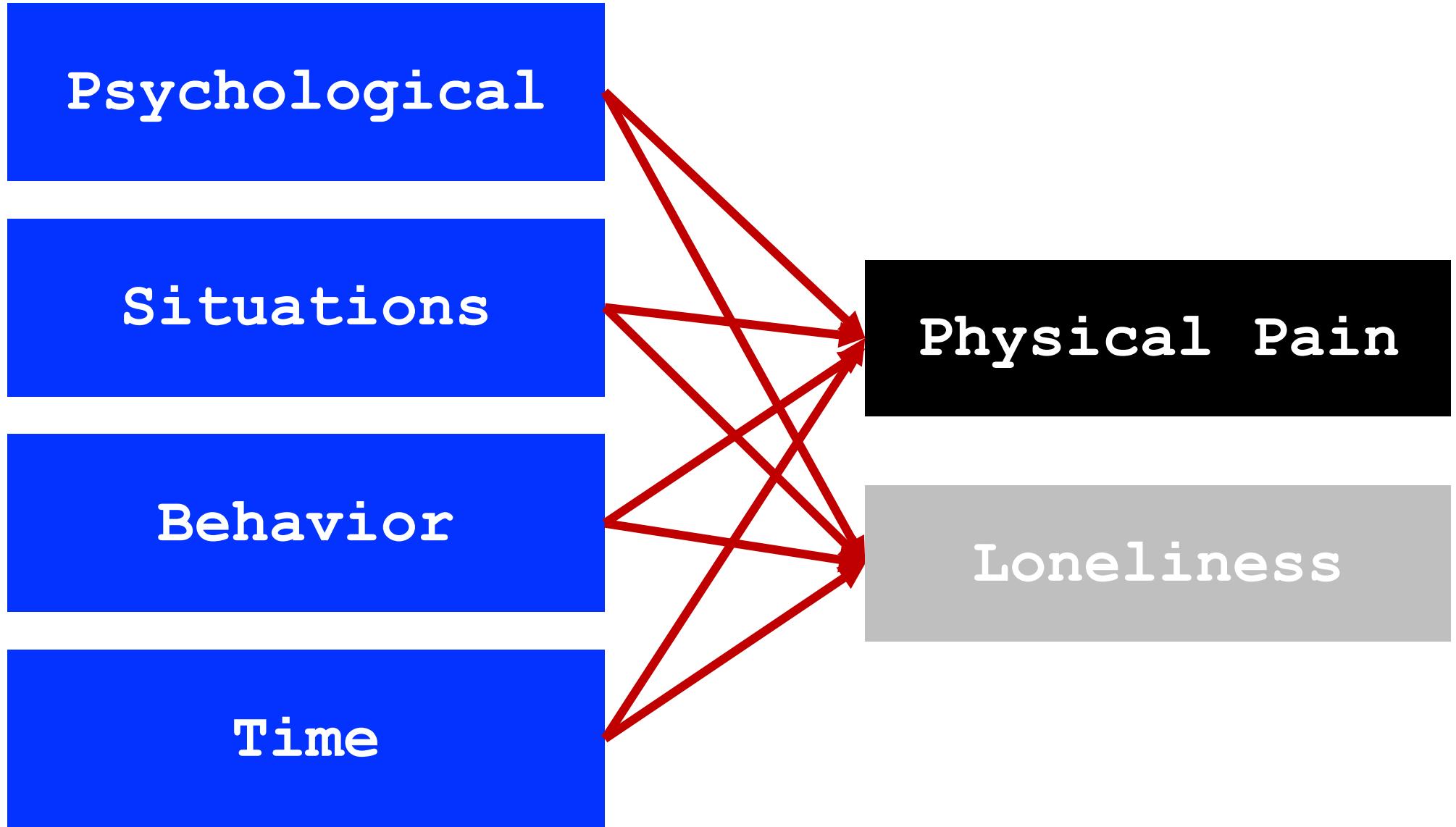
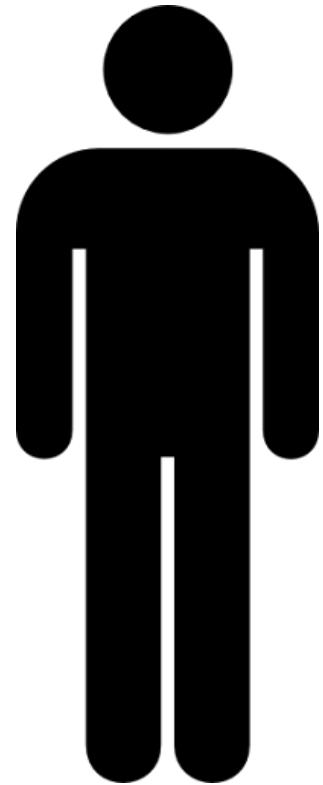
People with similar
levels of a personality
characteristic *may not*
behave in similar ways.

Physical Pain

Loneliness

Physical Pain

Loneliness



Questions

1

How well and for whom can we predict pain experience?

2

Do certain categories of features (e.g., persons, situations, and time) out-predict others?

3

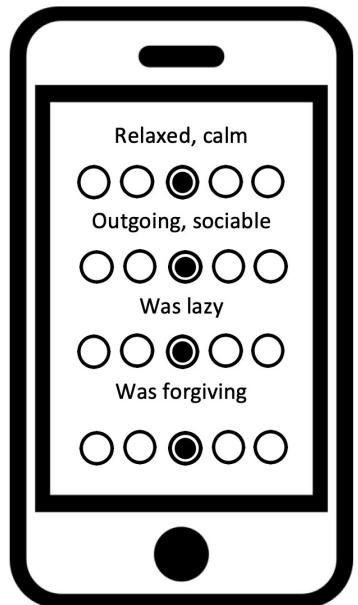
Are there individual differences in which features play the strongest roles?

Method

Preregistration: <https://osf.io/4nm5p>

Participants

Einstein Aging Study



**6x / day,
14 days**

Initial Sample

$N = 316$
(15,356 surveys)
 $M = 54.6$
 $SD = 15.8$

Removed 76
for < 40
surveys

Final Sample

$N = 220$
(13,132 surveys)
 $M = 104.0$
 $SD = 18.6$

67.4% female
 $M_{age} = 77.0$
 $SD_{age} = 4.82$
 $M_{educ} = 15.0$
 $SD_{educ} = 3.53$

72.82% female
 $M_{age} = 76.7$
 $SD_{age} = 4.70$
 $M_{educ} = 15.1$
 $SD_{educ} = 3.55$

Measures

Psychological

Mood, alertness, stress, anxiety, energy, thoughts (14)

101-point scale from 0 (low) to 100 (high).

Situations

Binary indicators capturing social context (e.g., alone, family; 8)

0 = no, 1 = yes

Behaviors

Binary indicators capturing social interaction, caregiving, activity (12)

0 = no, 1 = yes

Time

Derived from time stamps:
1. Time of day (morning, midday, evening, night)
2. Day of week

0 = no, 1 = yes

3. Linear, Quadratic, & Cubic Trends
4. 1 & 2 period sine and cosine

Physical pain & loneliness

0 (low) to 100 (high), scaled to 10 for convergence

Outcomes

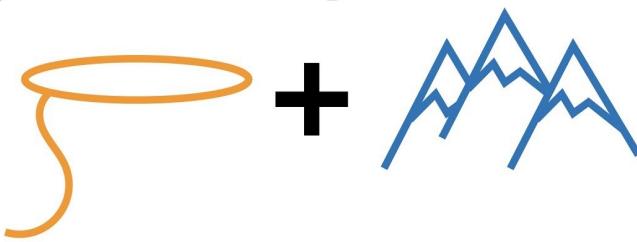
lead 1 (previous features predict future outcomes)

Analytic Plan

- Root Mean Squared Error (RMSE)
- R^2

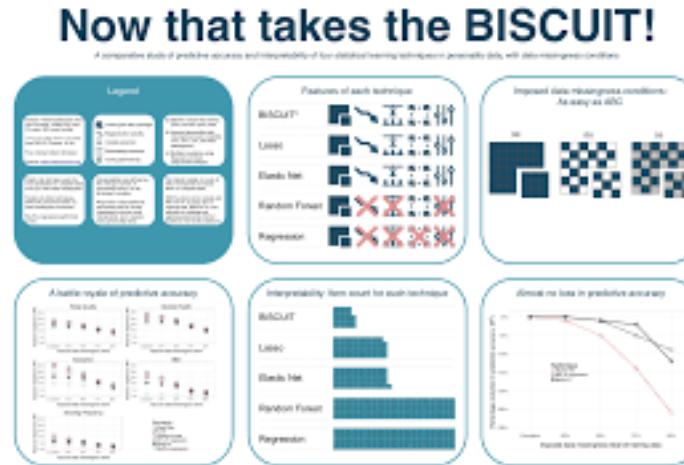
3 machine learning regression methods:

Elastic Net



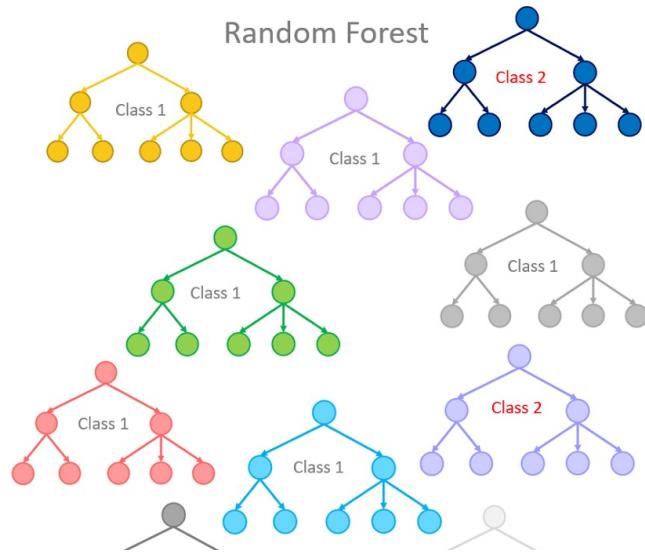
Tuning λ and mixture
(10 values each)

BISCWIT



Tuning number of items
(number possible)

Random Forest



Tuning mtry (# predictors sampled) and min_n (min n to split further)

Rolling origin forecast validation: 15 obs as initial set, 3 obs validation set, skip = 1, which resulted in 10-15 rolling origin "folds."

- Root Mean Squared Error (RMSE)
- R^2

Analytic Plan

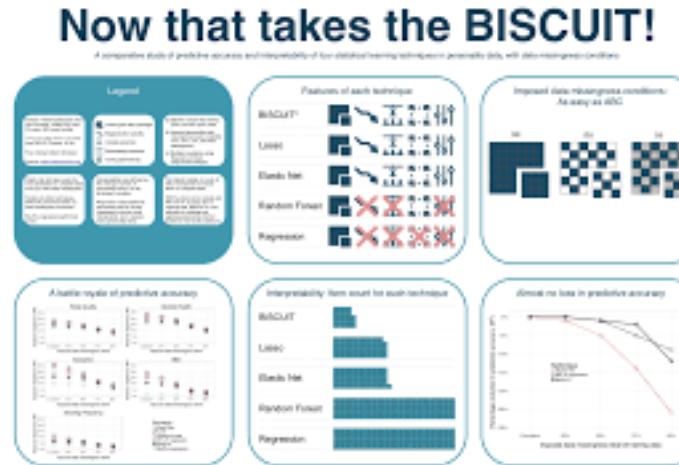
3 machine learning classification methods:

Elastic Net



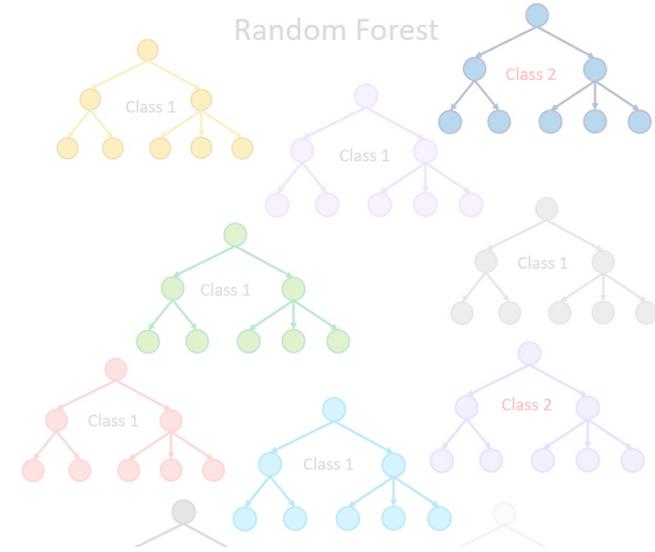
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Results

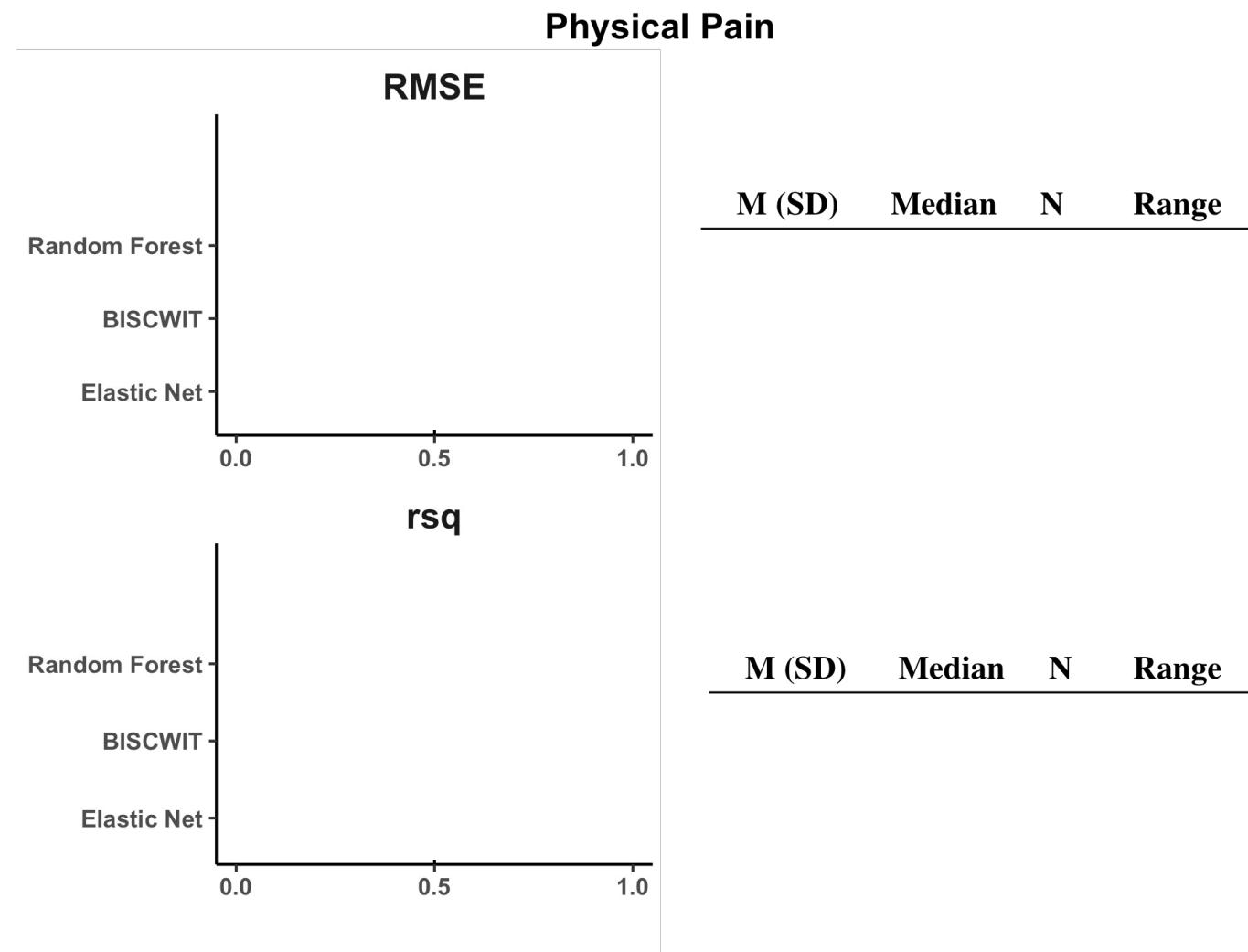
Shiny App: <https://emoriebeck.shinyapps.io/pain-prediction/>

Question 1

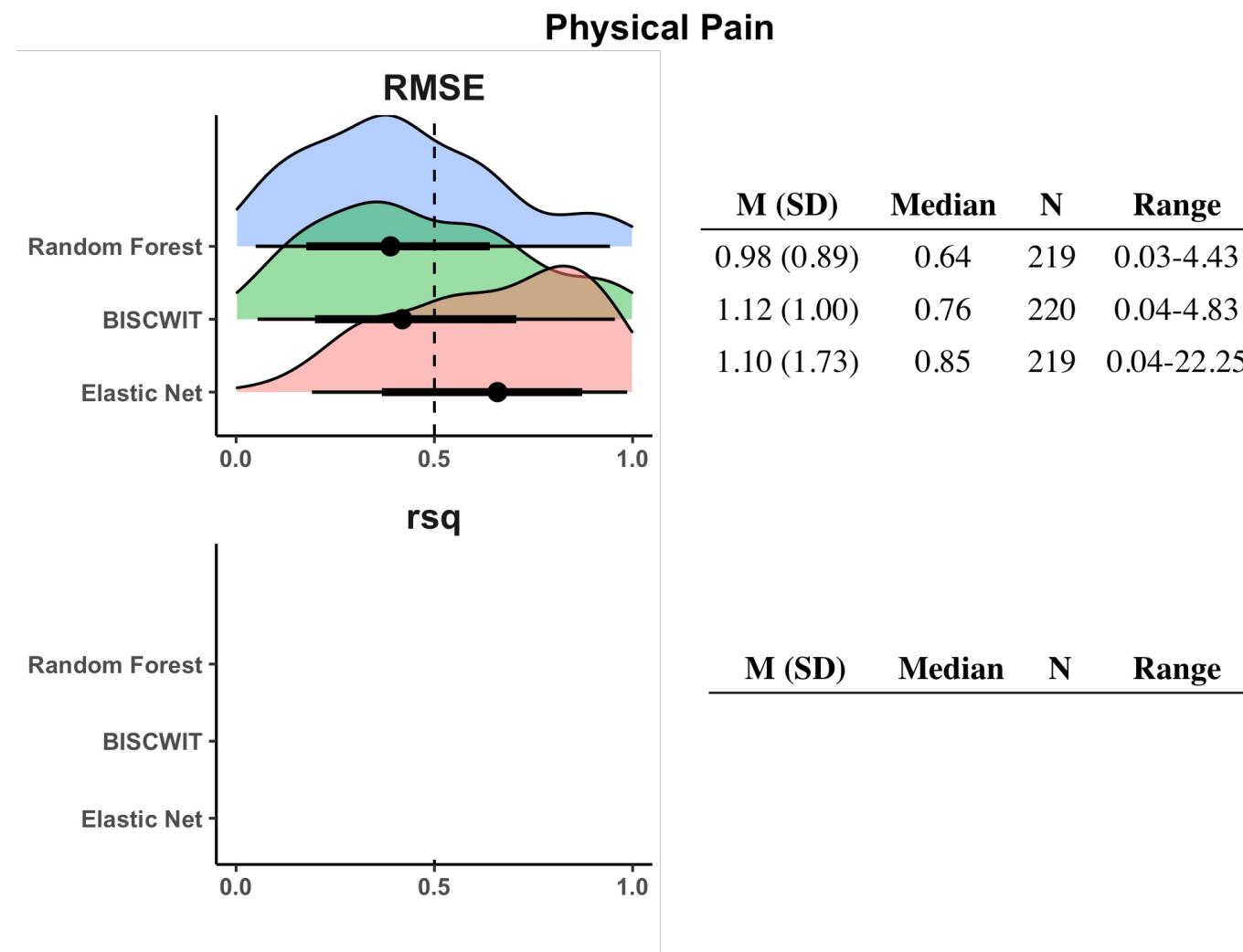
Question 2

Question 3

How well and for whom can we predict pain experience?



How well and for whom can we predict pain experience?

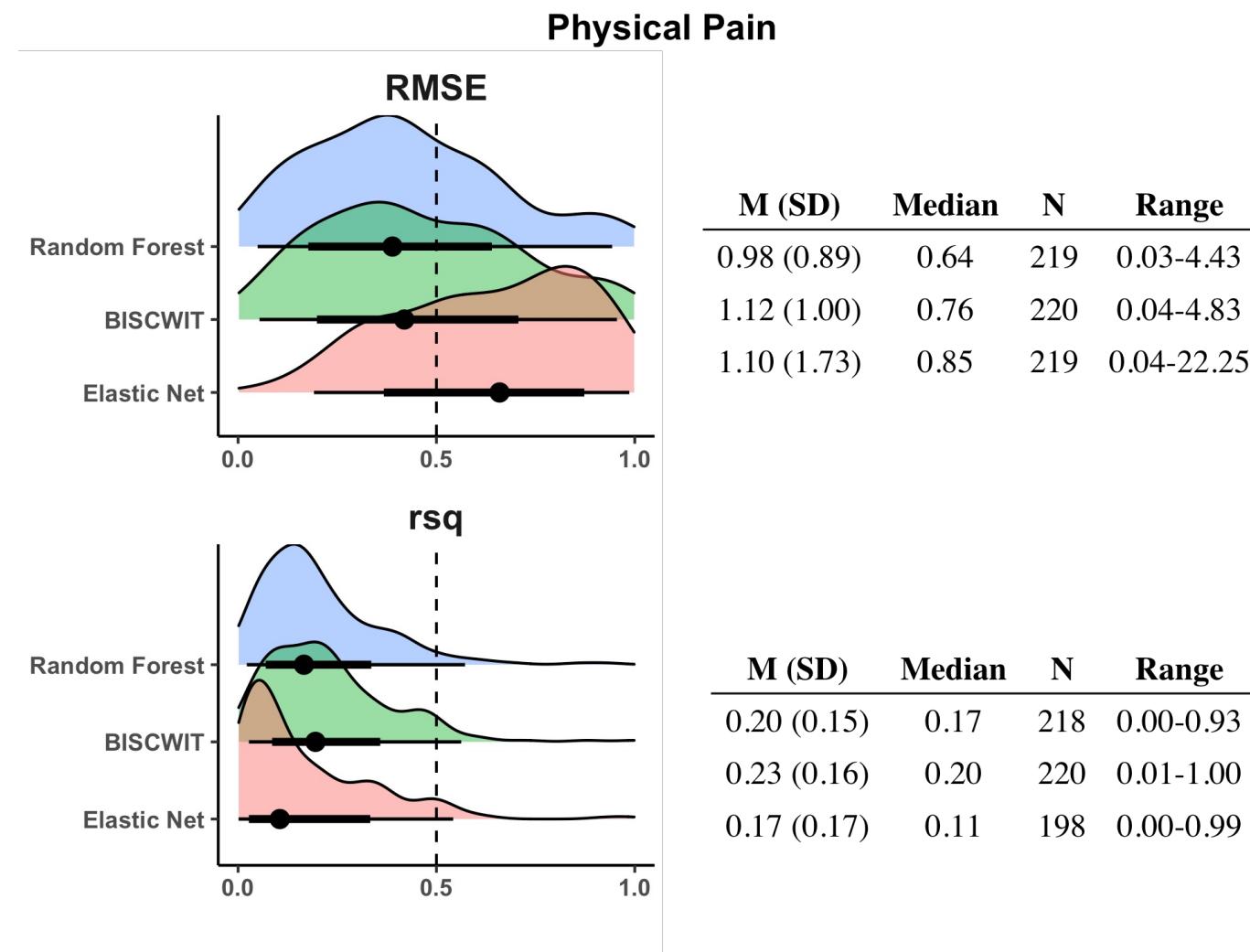


Question 1

Question 2

Question 3

How well and for whom can we predict pain experience?



How well and for whom can we predict pain experience?

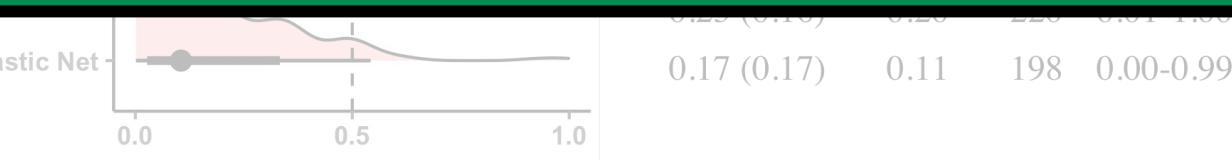
Physical Pain

RMSE

For many people, error remains within boundaries of tolerance.

However, R^2 was well below threshold on average.

Elastic Net



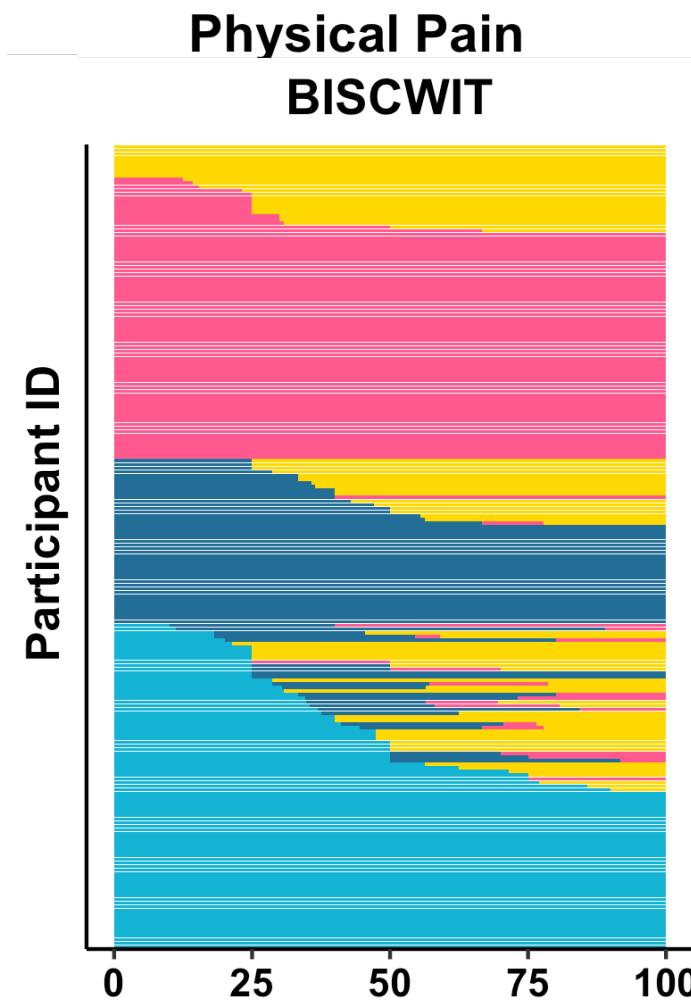
Question 1

Question 2

Question 3

Do certain categories of features out-predict others?

Do certain categories of features out-predict others?



Feature Category Psychological Behavior Situation Time

Do certain categories of features out-predict others?

Physical Pain
BISCWIT

There is no clear-cut optimal feature category across people.

Many people have a mix of features.



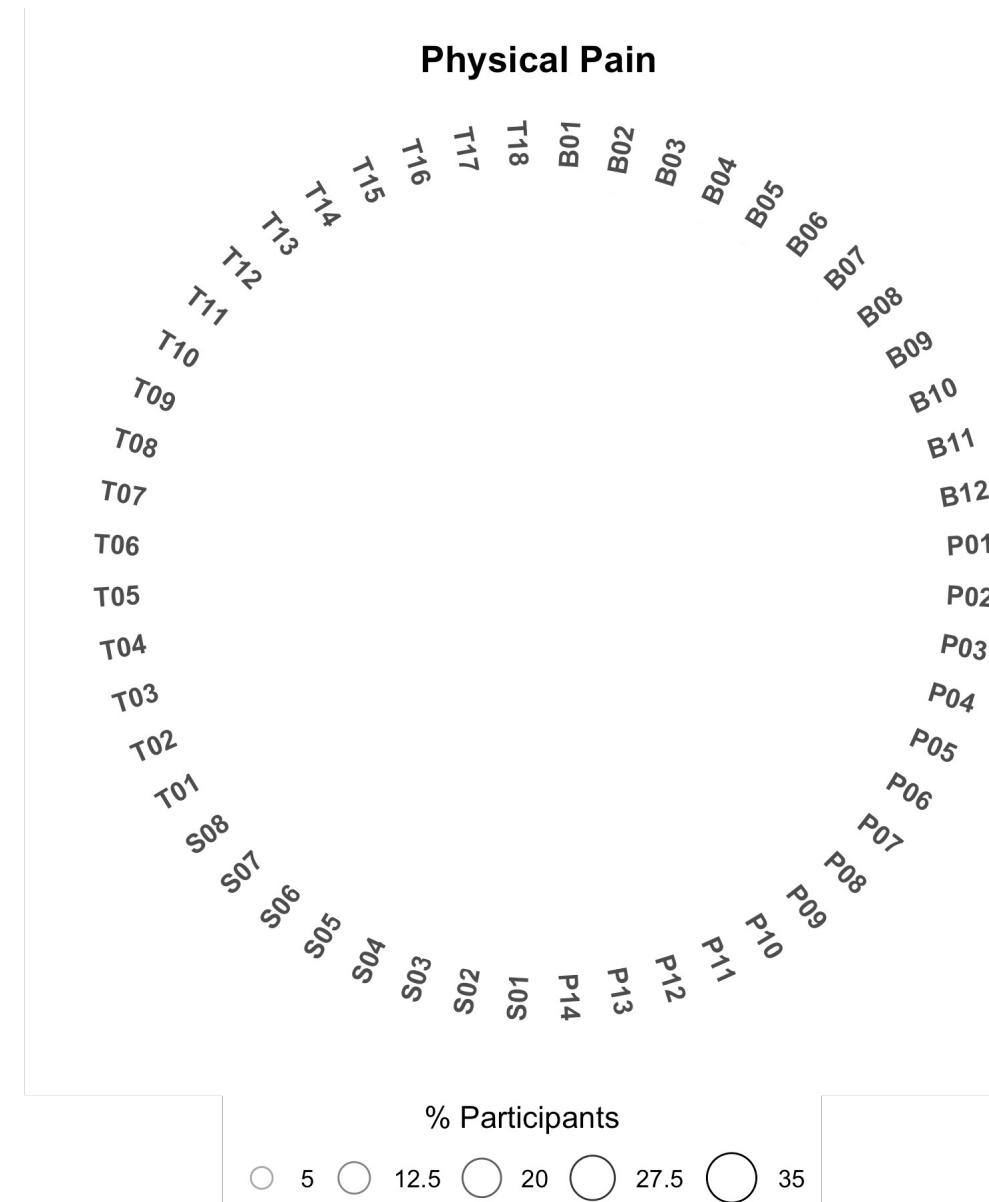
Question 1

Question 2

Question 3

Are there individual differences in strongest features?

Are there individual differences in strongest features?

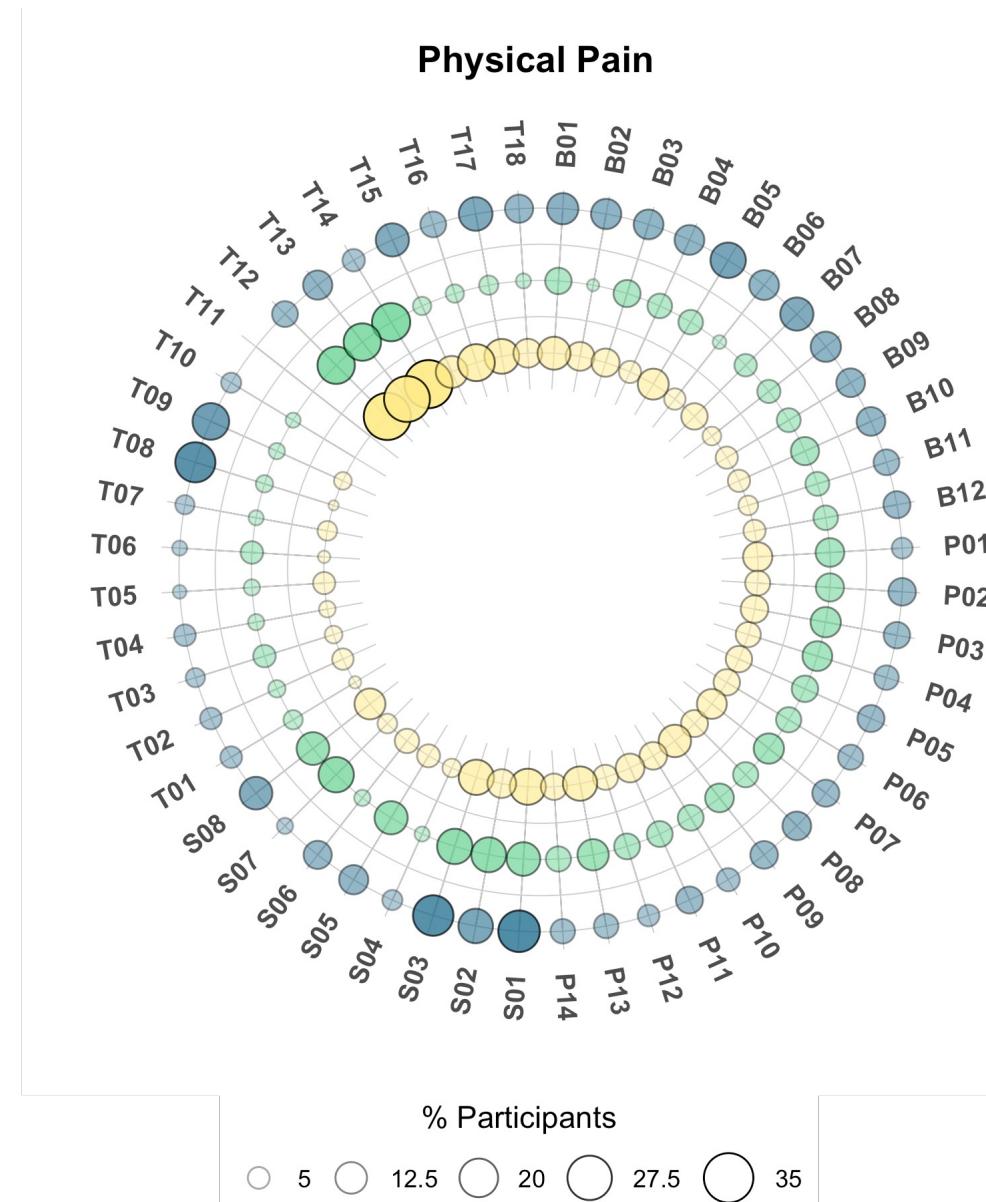


Question 1

Question 2

Question 3

Are there individual differences in strongest features?



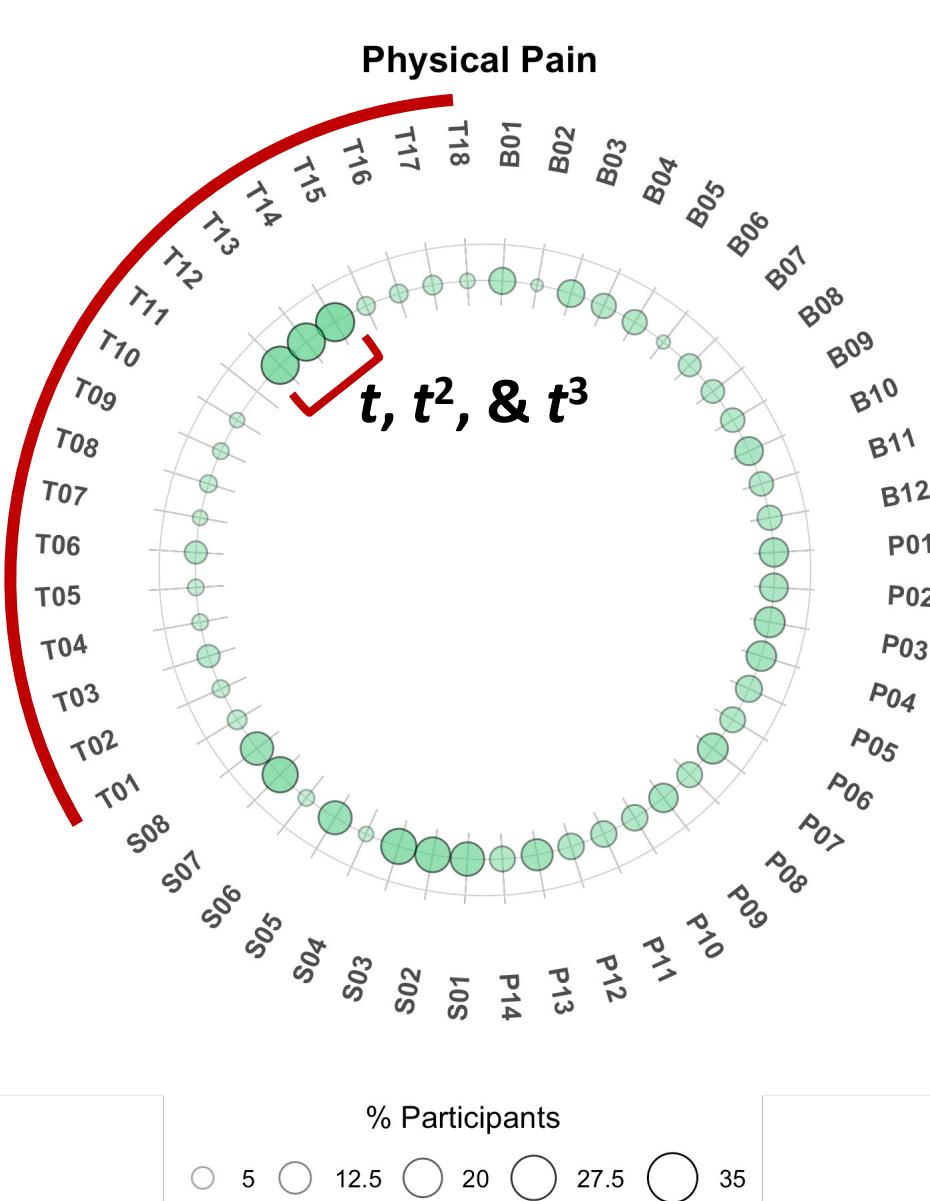
Question 1

Question 2

Question 3

Are there individual differences in strongest features?

- T01: Monday
- T02: Tuesday
- T03: Wednesday
- T04: Thursday
- T05: Friday
- T06: Saturday
- T07: Sunday
- T08: Morning
- T09: Midday
- T10: Evening
- T11: Night
- T12: Linear Trend
- T13: Quadratic Trend
- T14: Cubic Trend
- T15: 24 hour Sinusoidal Cycle
- T16: 12 hour Sinusoidal Cycle
- T17: 24 hour Cosinusoidal Cycle
- T18: 12 hour Cosinusoidal Cycle



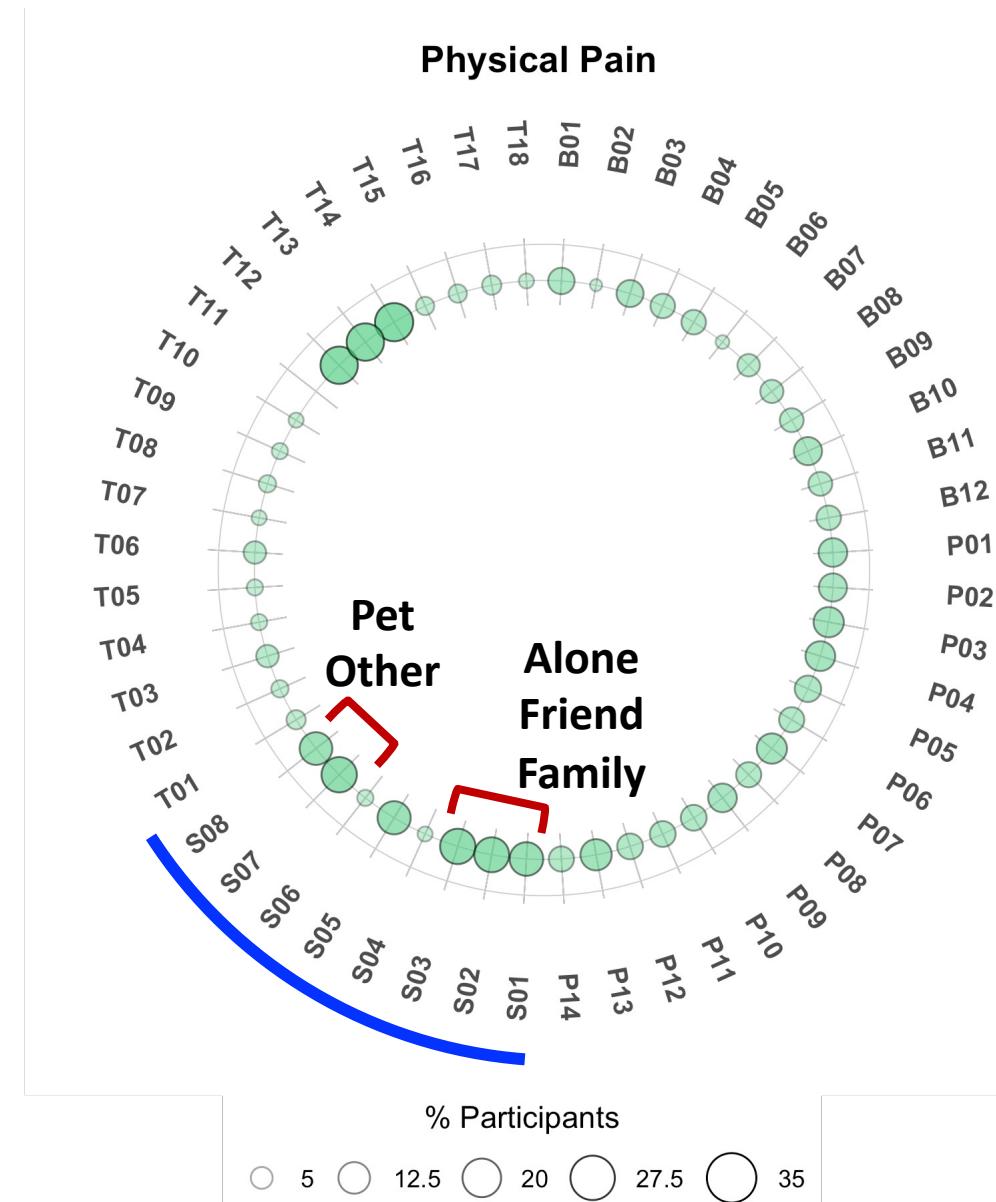
Question 1

Question 2

Question 3

Are there individual differences in strongest features?

- S01: Alone
 - S02: Friend
 - S03: Family (Partner, Kids, + Other Family)
 - S04: Neighbor
 - S05: Acquaintance
 - S06: Stranger
 - S07: Pet
 - S08: Other Person



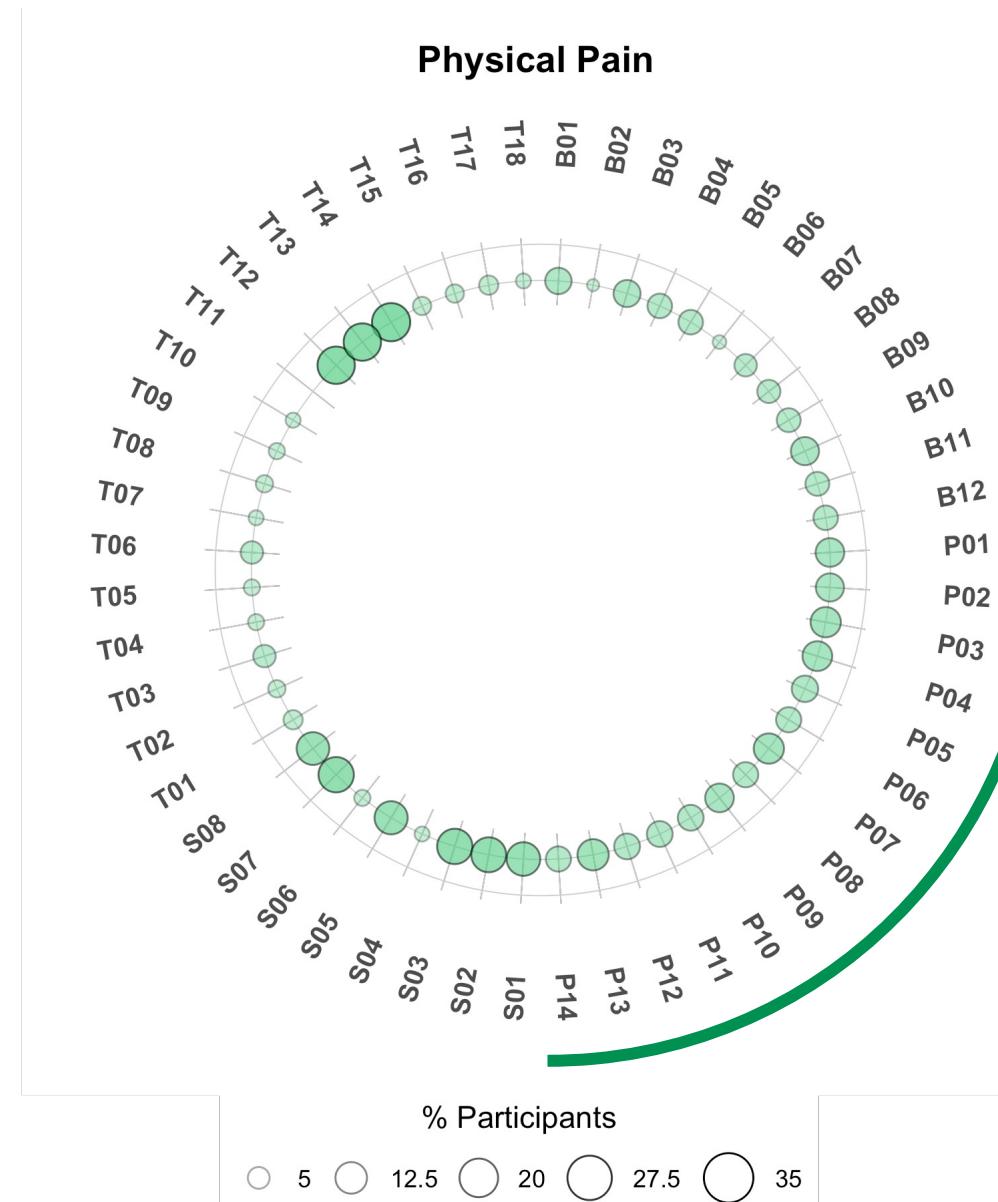
Question 1

Question 2

Question 3

Are there individual differences in strongest features?

- P01: Alert
- P02: Mood
- P03: Stress
- P04: Healthy
- P05: Anxious
- P06: Happy
- P07: Relaxed
- P08: Depressed
- P09: Energetic
- P10: Frustrated
- P11: Thought Valence
- P12: Stuck Thoughts
- P13: Thoughts about worries
- P14: Enjoying



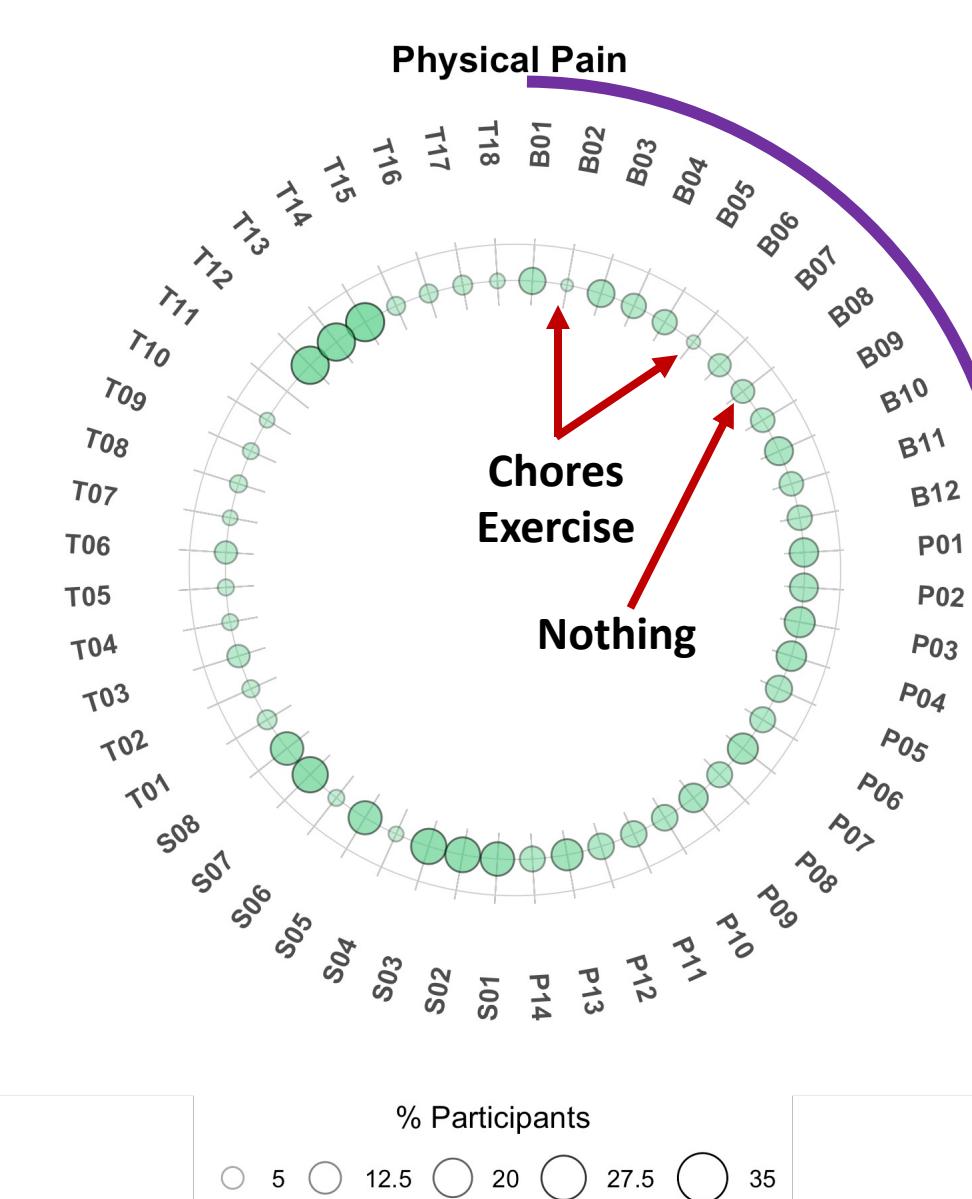
Question 1

Are there individual differences in strongest features?

- B01: Socializing (Online + In Person)
- B02: Chores
- B03: Selfcare
- B04: Caregiving
- B05: Media (TV + Internet)
- B06: Exercise
- B07: Mental Activity
- B08: Nothing
- B09: Other Activity
- B10: Sitting
- B11: Standing
- B12: Reclining

Question 2

Question 3



Are there individual differences in strongest features?

Overall proportions of specific features were quite low across people.

However, most features were top predictors in at least a few individuals' best models.

% Participants

○ 5 ○ 12.5 ○ 20 ○ 27.5 ○ 35

Question 1

Question 2

Question 3

Are there individual differences strongest features?

Question 1

Question 2

Question 3

Are there individual differences strongest features?

BISCWIT Predicting Future Physical Pain Using Best RMSE Models



Question 1

Question 2

Question 3

Are there individual differences strongest features?



Question 1

Question 2

Question 3

Are there individual differences strongest features?



Question 1

Question 2

Question 3

Are there individual differences strongest features?



Question 1

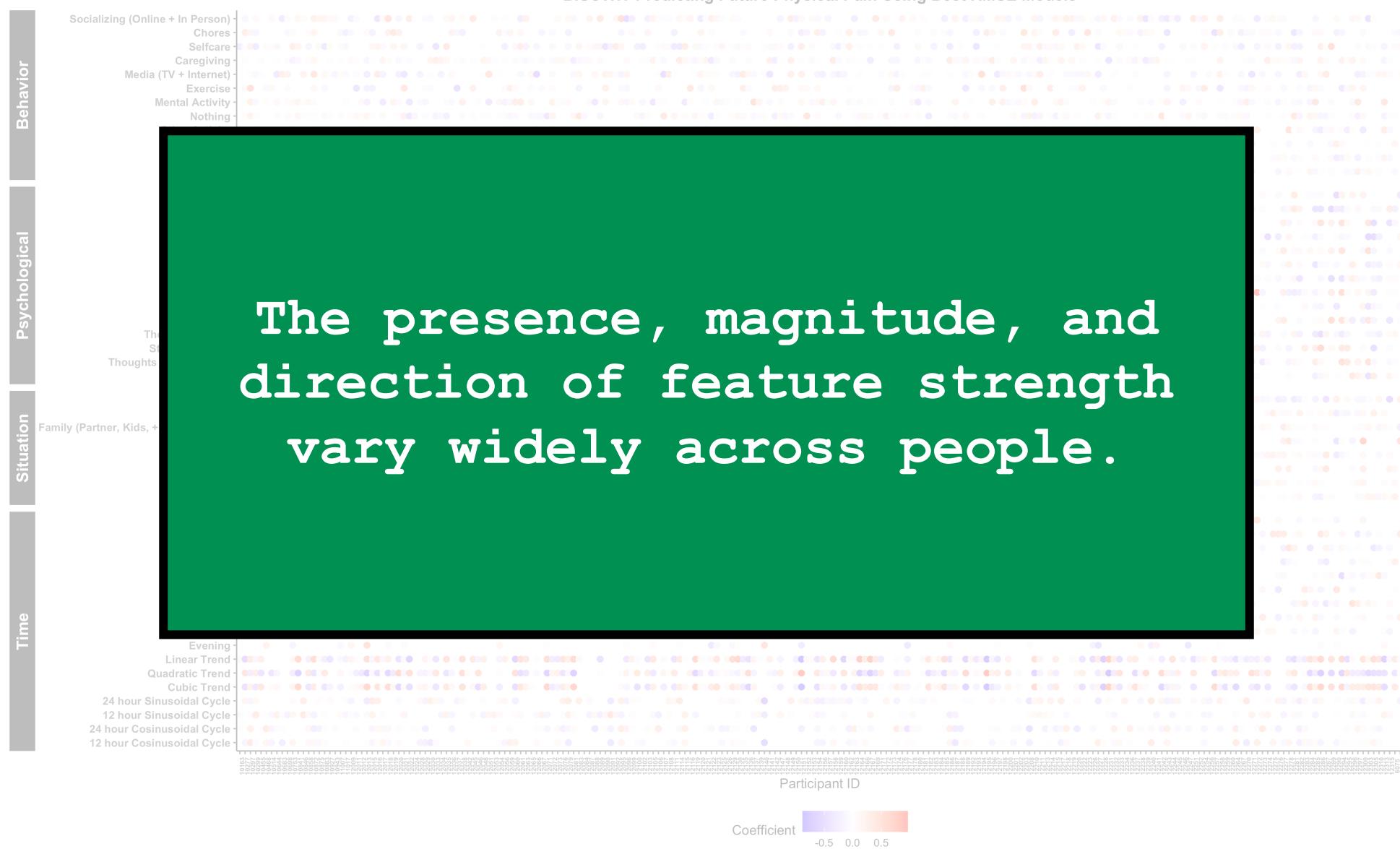
Question 2

Question 3

Are there individual differences strongest features?



Are there individual differences strongest features?



Questions

1

How well and for whom can we predict pain experience?

Some people and mostly only "okay" at best.

2

Do certain categories of features (e.g., persons, situations, and time) out-predict others?

Most feature categories are good predictors for some people.

3

Are there individual differences in which features play the strongest roles?

Lots of individual differences at all levels.

Lingering Questions

Why do classification models out-perform regression models in the context of physical and mental health / pain?

Would tailored, personalized items improve model performance?

To what extent can tailored interventions be developed and scaled for widespread use?

Thank you!



Co-authors:

Anthony Ong

Daniel Mroczek

Stacey Scott

Eileen Graham

GitHub:

<https://github.com/emoriebeck/pain-prediction>

Shiny App:

<https://emoriebeck.shinyapps.io/pain-prediction/>

Preregistration:

<https://osf.io/wruf4>

OSF Repository:

<https://osf.io/gtnwf/>



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Pain

