

# Mouse dynamics as a surrogate of assessment related stress and anxiety

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JM Pêgo is supported by  iCognitus  Universidade do Minho SPINOFF

 ASSOCIADO DE MEMBER OF  
**Health Cluster Portugal**  
Pólo de Competitividade da Saúde

This work was funded by "EUSTRESS – Sistema de Informação para a monitorização e avaliação dos níveis do stress e previsão de stress crónico" Nº2015/017832 P2020 SI I&DT, (NUP, NORTE-01-0247-FEDER-017832) in co-promotion between Optimizer-Lda and ICVS/3B's-Uminho.

 NORTE2020

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 **ICVS**  
Life and Health Sciences Research Institute  
Instituto de Investigação em Ciências da Vida e Saúde

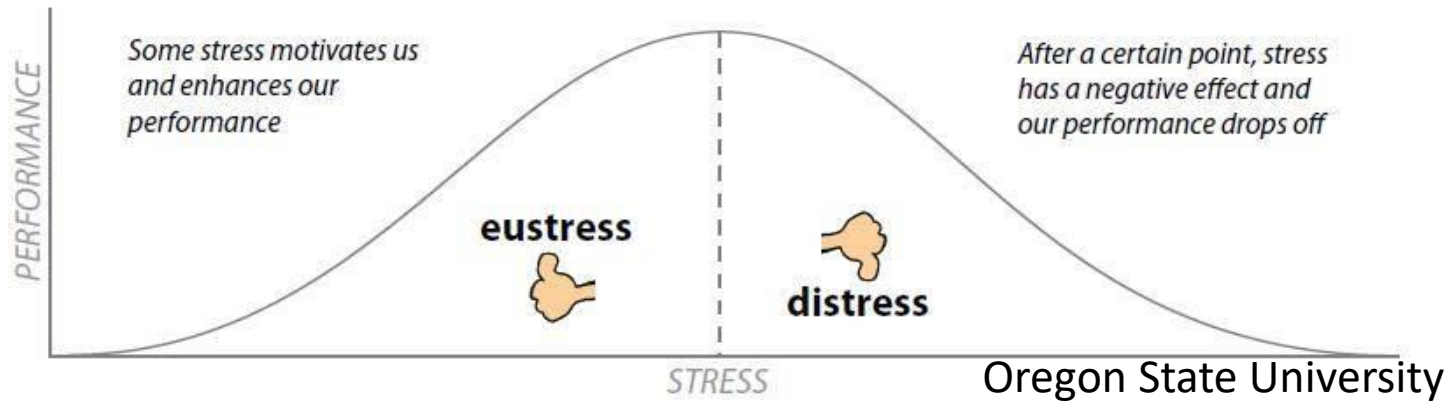
 Universidade do Minho  
Escola de Medicina

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University of Minho

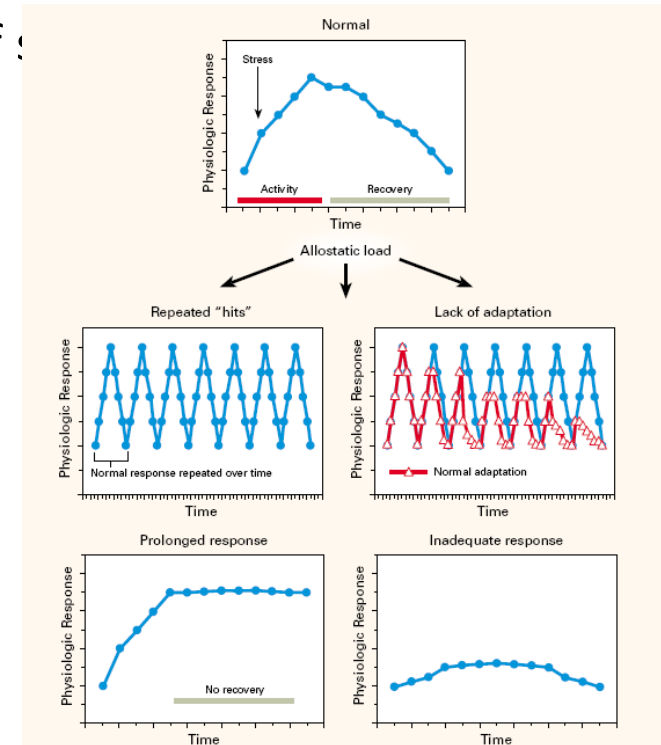
- Performance anxiety is a common phenomenon affecting students' performance in a test administration.
- It is also known that students' psychological traits, namely anxiety, affect their performance in a test.

### Don't worry, you're not the only one.

Everyone is anxious about tests, of course. If you weren't, you wouldn't try. It's fairly obvious that too much stress is a problem. However, a certain amount of stress before the test is good. It acts as a motivator and can enhance performance.



ve of s



ety

McEwen B, NEJM, 1998

## Systematic Review of Depression, Anxiety, and Other Indicators of Psychological Distress Among U.S. and Canadian Medical Students

Liselotte N. Dyrbye, MD, Matthew R. Thomas, MD, and Tait D. Shanafelt, MD

Acad Med. 2006; 81:354–373.

### Conclusions

Medical school is a time of significant psychological distress for physicians-in-training. Currently available information is insufficient to draw firm conclusions on the causes and consequences of student distress. Large, prospective, multicenter studies are needed to identify personal and training-related features that influence depression, anxiety, and burnout among students and explore relationships between distress and competency.

## Depressive Symptoms in Medical Students and Residents: A Multischool Study

Deborah Goebert, DPH, Diane Thompson, MD, Junji Takeshita, MD, Cheryl Beach, PhD, Philip Bryson, LCSW, Kimberly Ephgrave, MD, Alan Kent, PhD, Monique Kunkel, MD, Joel Schechter, PhD, and Jodi Tate, MD

### Conclusions

Depression remains a significant issue for medical trainees. This study highlights the importance of ongoing mental health assessment, treatment, and education for medical trainees.

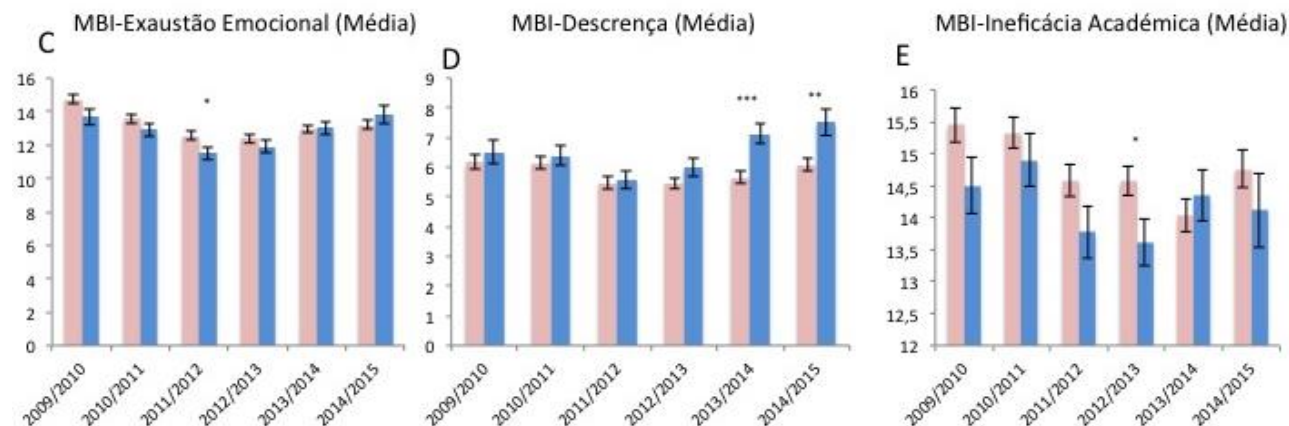
Acad Med. 2009; 84:236–241.



## Monitorização da Saúde Mental dos Estudantes de Medicina – um estudo de 6 anos

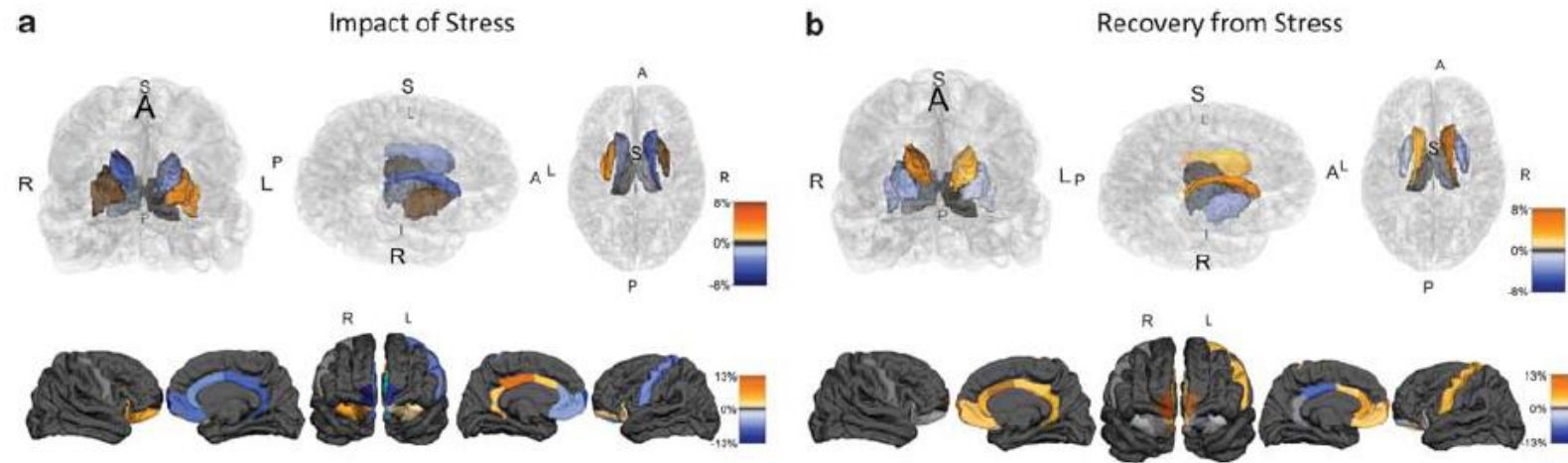
**Pedro Morgado**, Ricardo Gil Pereira, Inês Pereira, Vanessa Silva, Francisco Fernandes, Ana Salgueira, Eunice Magalhães, José Miguel Pego, Ana Raquel Lemos, Manuel João Costa, Patrício Costa, Nuno Sousa, João J Cerqueira

A prevalência de **depressão** ao longo dos seis anos do estudo oscilou entre **12,7 e 20,5%**. A frequência de **ideação suicida** variou entre **2,6 e 6,2%**. Os sintomas mais frequentes foram **problemas de sono e cansaço**, com frequências relativas de 42,4 a 64,4% e 51,9 a 74%, respetivamente. À exceção do último ano estudado, verifica-se uma **tendência de descida dos níveis de depressão**.

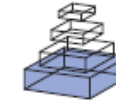


# Stress-induced changes in human decision-making are reversible

JM Soares<sup>1,2,3,5</sup>, A Sampaio<sup>1,4,5</sup>, LM Ferreira<sup>1,2,3</sup>, NC Santos<sup>1,2,3</sup>, F Marques<sup>1,2,3</sup>, JA Palha<sup>1,2,3</sup>, JJ Cerqueira<sup>1,2,3</sup> and N Sousa<sup>1,2,3</sup>



**Figure 3** Volumetric changes in the brain after stress exposure (a) and after recovery from stress (b). Upper panels represent changes in subcortical regions, whereas the lower panels represent volumetric variations in cortical regions. (a) The impact of stress in the structure of corticostriatal loop. The color changes illustrate variations in volumes of stressed subjects in contrast to controls. (b) The amount of recovery from the impact of stress in the structure of cortico-basal ganglia loop. The color changes illustrate variations in volumes in stressed subjects after recovery from stress.



# Plasticity of resting state brain networks in recovery from stress

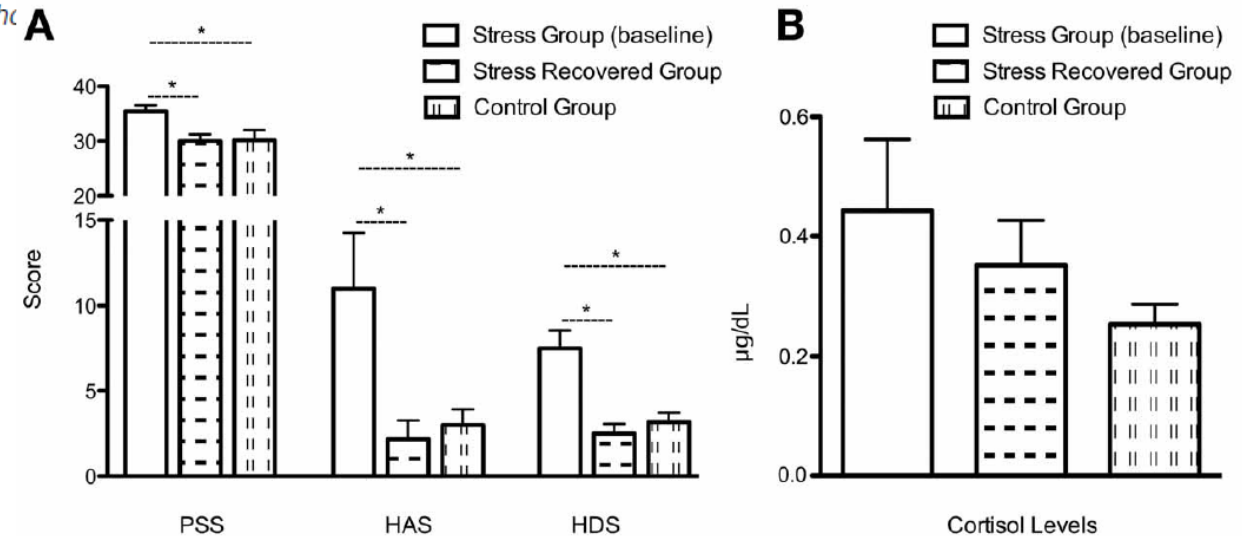
**José M. Soares<sup>1,2,3\*</sup>, Adriana Sampaio<sup>1,4</sup>, Paulo Marques<sup>1,2,3</sup>, Luís M. Ferreira<sup>1,2,3</sup>, Nadine C. Santos<sup>1,2,3</sup>, Fernanda Marques<sup>1,2,3</sup>, Joana A. Palha<sup>1,2,3</sup>, João J. Cerqueira<sup>1,2,3</sup> and Nuno Sousa<sup>1,2,3</sup>**

<sup>1</sup> Life and Health Sciences Research Institute (ICVS), School of Health Sciences, University of Minho

<sup>2</sup> ICVS/3B's - PT Government Associate Laboratory, Braga/Guimarães, Portugal

<sup>3</sup> Clinical Academic Center, Braga, Portugal

<sup>4</sup> Neuropsychophysiology Lab, CIPsi, School of Psychology, University of Minho, Braga, Portugal

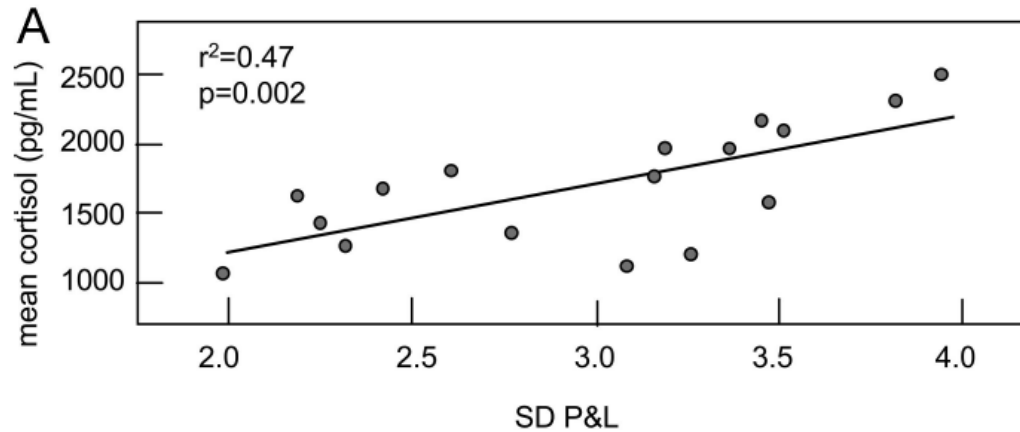


# Endogenous steroids and financial risk taking on a London trading floor

J. M. Coates<sup>\*†‡</sup> and J. Herbert<sup>\*‡§</sup>

<sup>\*</sup>Department of Physiology, Development and Neuroscience, University of Cambridge, Cambridge CB2 3DY, United Kingdom; <sup>†</sup>Judge Business School, University of Cambridge, Cambridge CB2 1AG, United Kingdom; and <sup>§</sup>Cambridge Center for Brain Repair, University of Cambridge, Cambridge CB2 3RQ, United Kingdom

Edited by Bruce S. McEwen, The Rockefeller University, New York, NY, and approved November 6, 2007 (received for review May 1, 2007)



PNAS | April 22, 2008 | vol. 105 | no. 16 | 6167–6172

Journal of Psychosomatic Research 77 (2014) 420–425

## Saliva pH as a biomarker of exam stress and a predictor of exam performance

Miri Cohen<sup>a,\*</sup>, Rabia Khalaila<sup>b</sup>

<sup>a</sup> School of Social Work, Faculty of Social Welfare and Health Sciences, University of Haifa, Haifa, Israel

<sup>b</sup> School of Nursing, Zefat Academic College, Zefat, Israel



Medical Education Online

RESEARCH ARTICLE

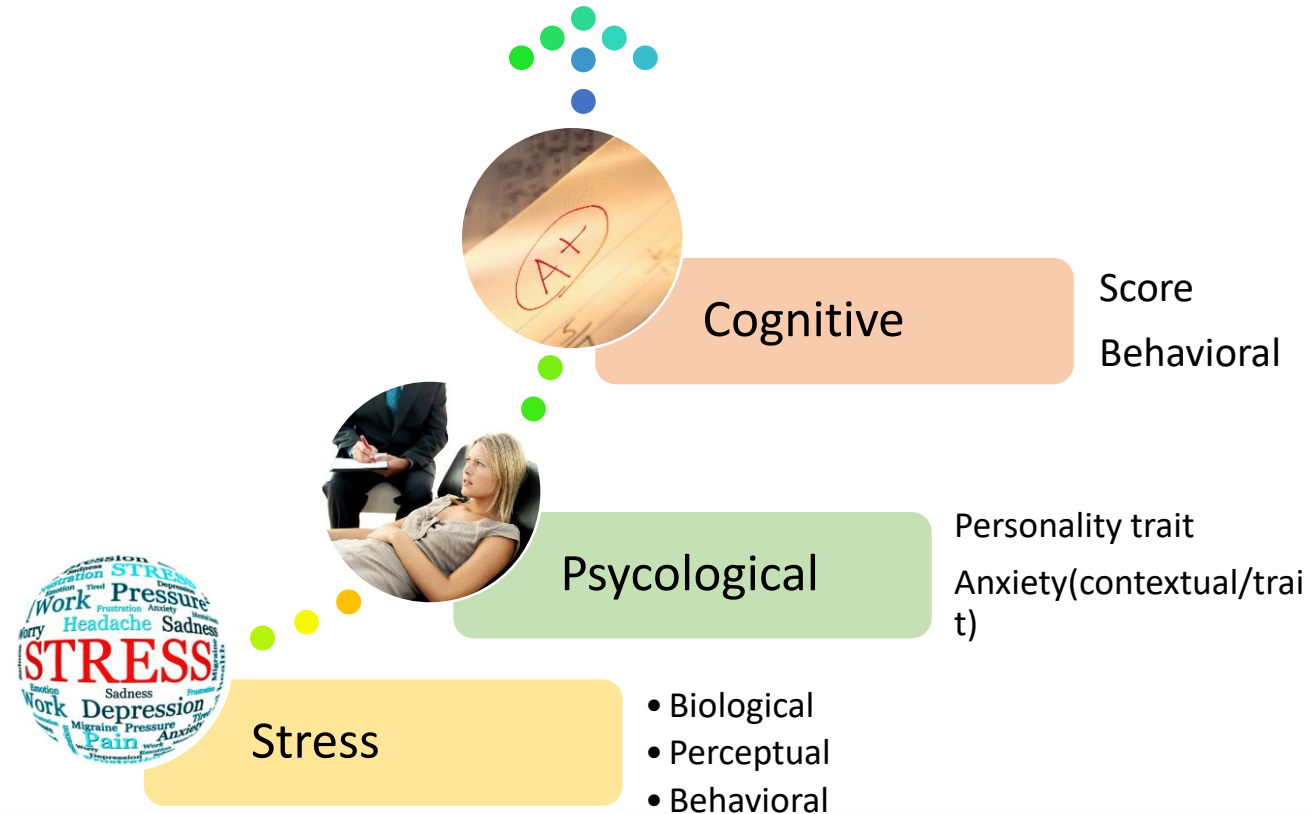
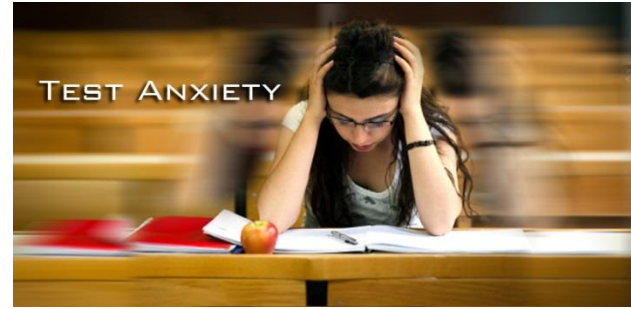
## How does the quality of life and the underlying biochemical indicators correlate with the performance in academic examinations in a group of medical students of Sri Lanka?

Manjula Hettiarachchi<sup>1\*</sup>, Chathuranga Lakmal Fonseka<sup>1</sup>,  
Priyanka Gunasekara<sup>2</sup>, Prasanjanie Jayasinghe<sup>1</sup> and Dasun Maduranga<sup>1</sup>

<sup>1</sup>Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka; <sup>2</sup>Coronary Care Unit, Teaching Hospital, Karapitiya, Galle, Sri Lanka



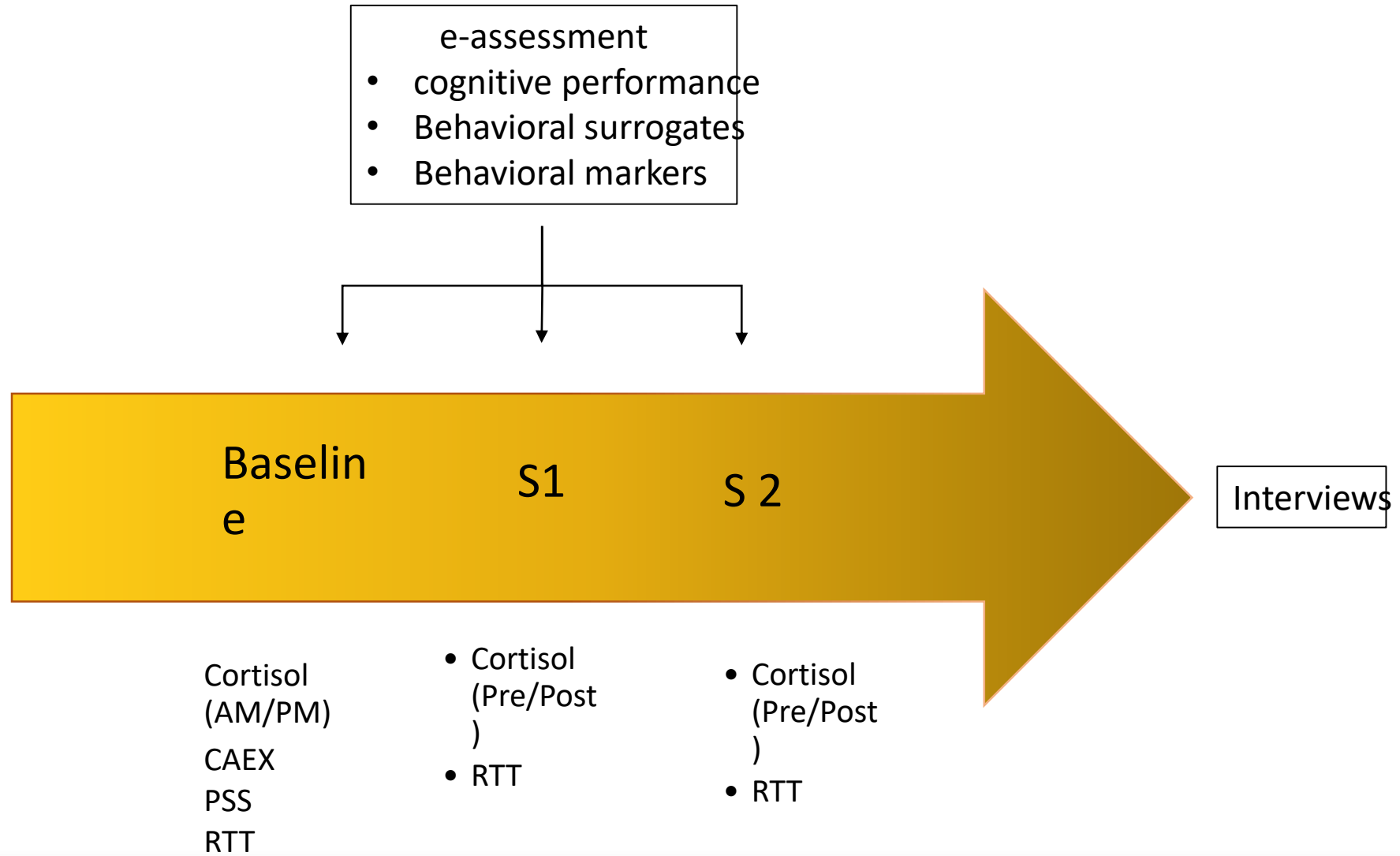






**Mouse dynamics as a surrogate of assessment related stress and anxiety**

- a) Characterize students mouse dynamics during e-assessment;**
  
- b) Test the hypothesis that mouse dynamics can predict a students' response to stress.**
  
- c) Correlate baseline and context levels of stress with anxiety and performance in tests;**



### Surveys

Perceived Stress Scale (13 items)

J.L. Pais Ribeiro & T. Marques [2009]

Reaction to Test Taking Scale (16 items) –

**Tension, Worryness, Irrelevant thoughts to the test, Bodily symptoms**

“Test-Taking Scale” - Benson, J., & Bandalos, D.L. [1992])

CAEX – Exam Anxiety Survey (50 items) – **Worryness, Physiological reactions, Situation, Avoidance reactions**

“Cuestionario de Ansiedad ante Exámenes” – Valero, L. [1997])



## e-Assessment

Score  
Challenges  
Flags

Personality?

Latency to 1st action  
Latency to 1st answer  
Total time to 1st answer  
Answer (1st Entry) (1)  
Answer (1st Entry) (0)  
Answer (1st Entry) (-1)  
Initial answer (1)  
Initial answer (0)  
Initial answer (-1)  
Final answer (1)  
Final answer (0)  
Final answer (-1)

Visualization counts  
Average Time Visualization  
Total Time Visualization

Change of choice

V-X  
X-V  
X-X  
O-O  
O-V  
O-X  
V-V  
V-O  
X-O

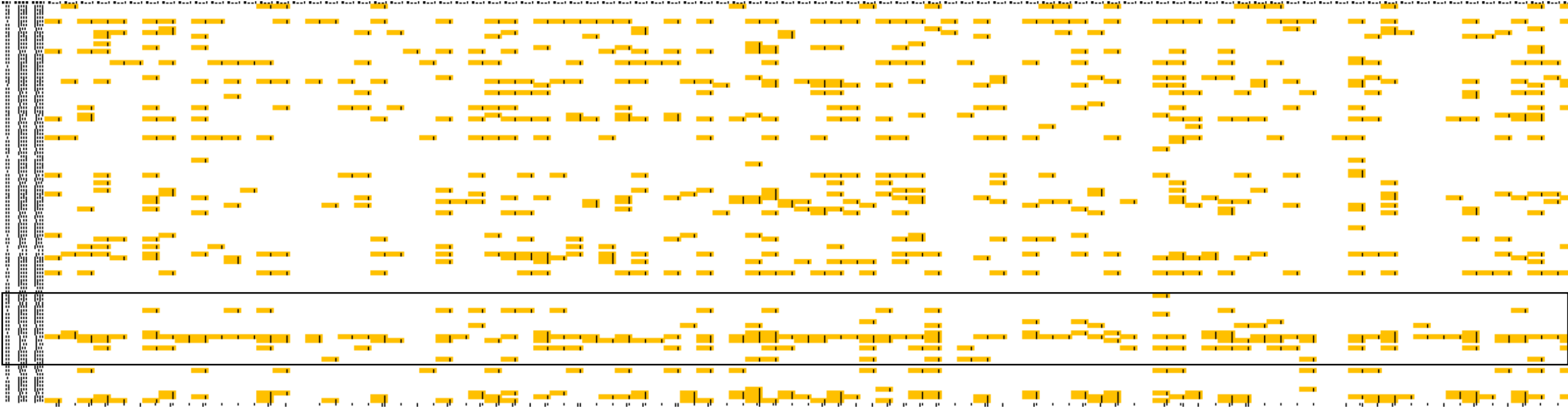
Decision-making

medQuizz  
Your assessment management system.



e-Assessment

**Flagged items**



# Using Mouse Dynamics to Assess Stress During Online Exams

Davide Carneiro<sup>1</sup>(✉), Paulo Novais<sup>1</sup>, José Miguel Pêgo<sup>2,3</sup>, Nuno Sousa<sup>2,3</sup>,  
and José Neves<sup>1</sup>

<sup>1</sup> Algorimti Centre, University of Minho, Braga, Portugal  
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<sup>2</sup> School of Health Sciences, Life and Health Sciences Research Institute (ICVS),  
University of Minho, Braga, Portugal  
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<sup>3</sup> ICVS/3B's - PT Government Associate Laboratory, Braga/Guimarães, Portugal



### Mouse Dynamics

- **MOV**, timestamp, posX, posY

An event describing the movement of the mouse, in a given time, to coordinates (posX, posY) in the screen;

- **MOUSE DOWN**, timestamp, [Left|Right], posX, posY

This event describes the first half of a click (when the mouse button is pressed down), in a given time. It also describes which of the buttons was pressed (left or right) and the position of the mouse in that instant;

- **MOUSE UP**, timestamp, [Left|Right], posX, posY

An event similar to the previous one but describing the second part of the click, when the mouse button is released;

- **MOUSE WHEEL**, timestamp, dif

This event describes a mouse wheel scroll of amount dif, in a given time;

```
MOV, 635296941683402953, 451, 195
MOV, 635296941684123025, 451, 197
MOUSEDOWN, 635296941684443057, Left, 451, 199
MOV, 635296941685273140, 452, 200
MOUSEUP, 635296941685283141, Left, 452, 200
MOV, 635296941685723185, 452, 203
MOV, 635296941685803193, 454, 205
```

# Methods

Using Mouse Dynamics to Assess Stress During Online Exams

Absolute Sum of Degrees (ASD) - \*

Average Distance of the Mouse to the Straight Line (ADMSL) - \*

Average Excess of Distance Between Clicks (AED) - \*

Click Duration (CD) - \*

Distance Between Clicks (DBC) - \*

Distance of the Mouse to the Line (DMSL) - \*

Excess of Distance Between Clicks (ED) - \*

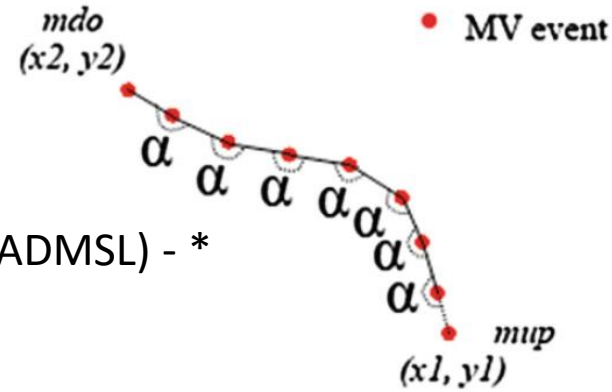
Mouse Acceleration (MA) - \*\*

Mouse Velocity (MV) - \*\*

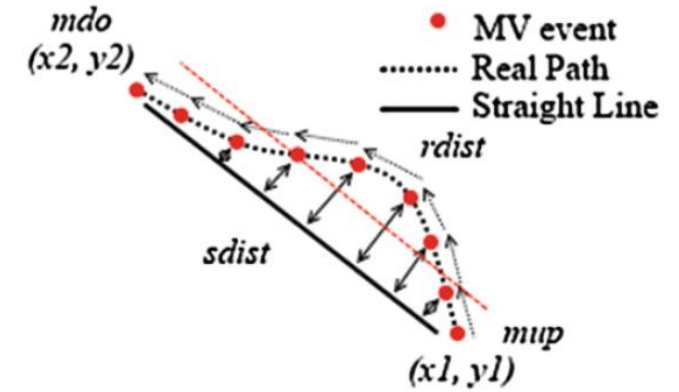
Time Between Clicks (TBC) - \*

\* - increasing value = decreasing performance

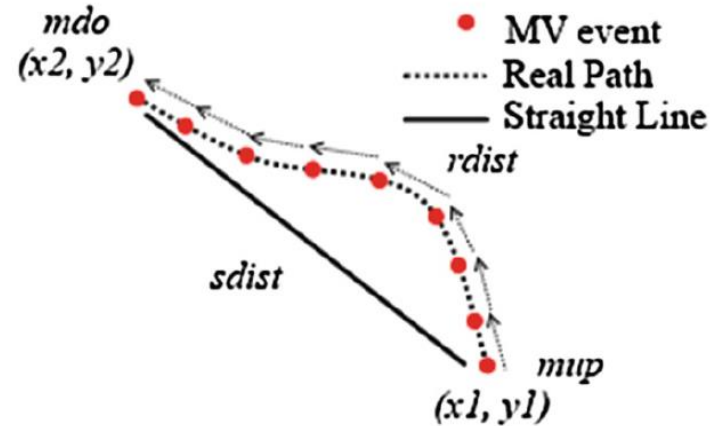
\*\* - variable meaning



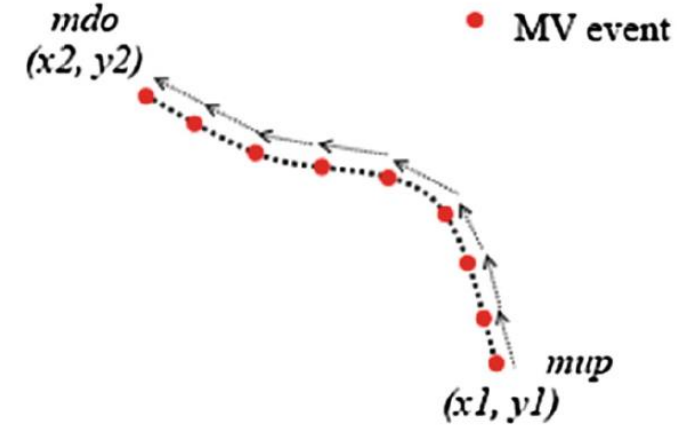
a)



b)



a)



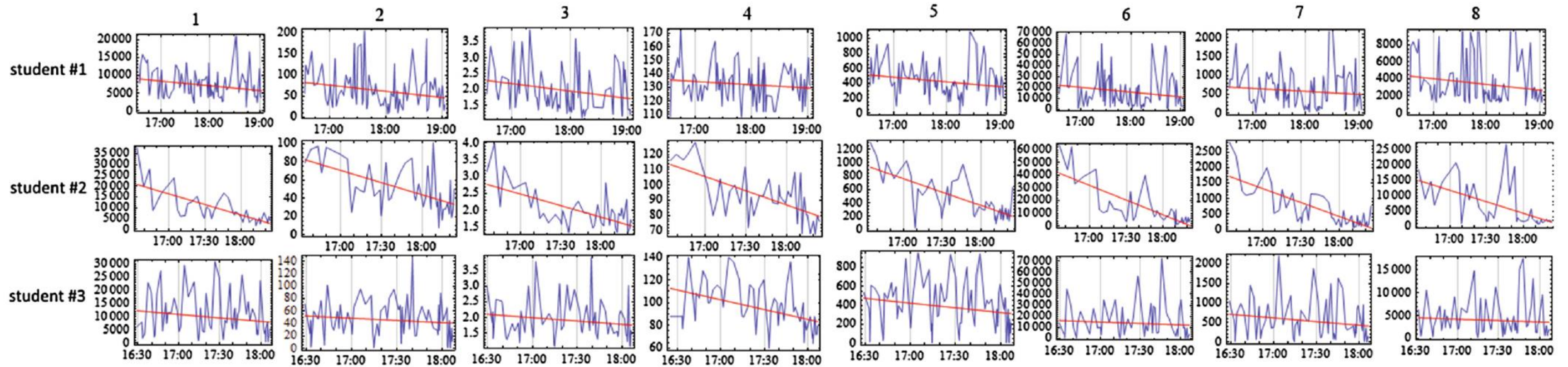
b)

# Results

Using Mouse Dynamics to Assess Stress During Online Exams

N = 53

**Fig. 4.** Time plot of the features for three arbitrary students. The negative correlation with time is visible for all features. Lines depict three different students. Columns depict the following eight features: 1 - ASA, 2 - ADMSL, 3 - AED, 4 - CD, 5 - DBC, 6 - DMSL, 7 - ED, 8 - TBC.





School of Health Sciences – established  
2001

6 years course (2015/2016)

Year 1 – 56/138

Year 2

Year 3 – 104/106 - **62**

Year 3 alt – 17/19

Year 4

Year 5

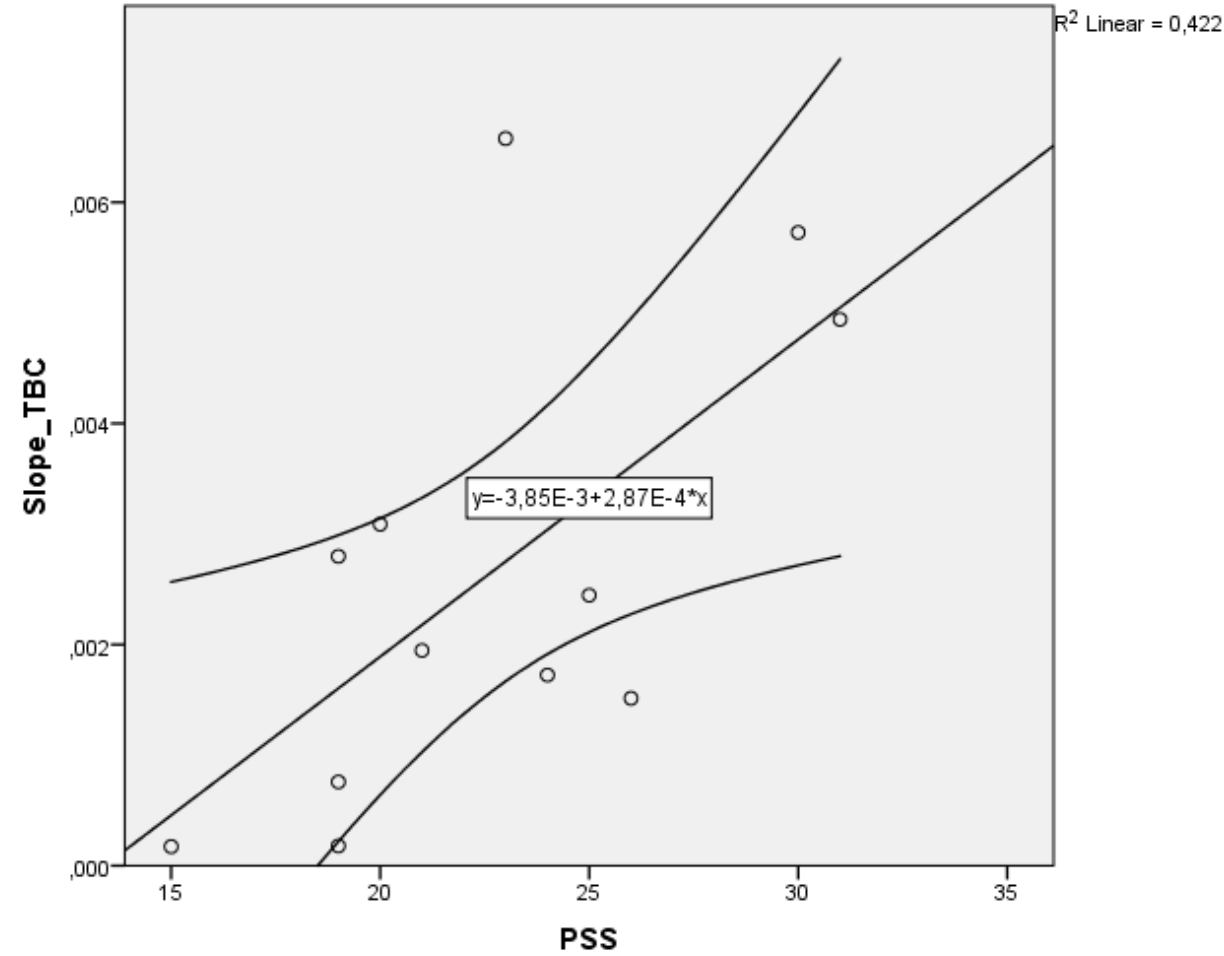
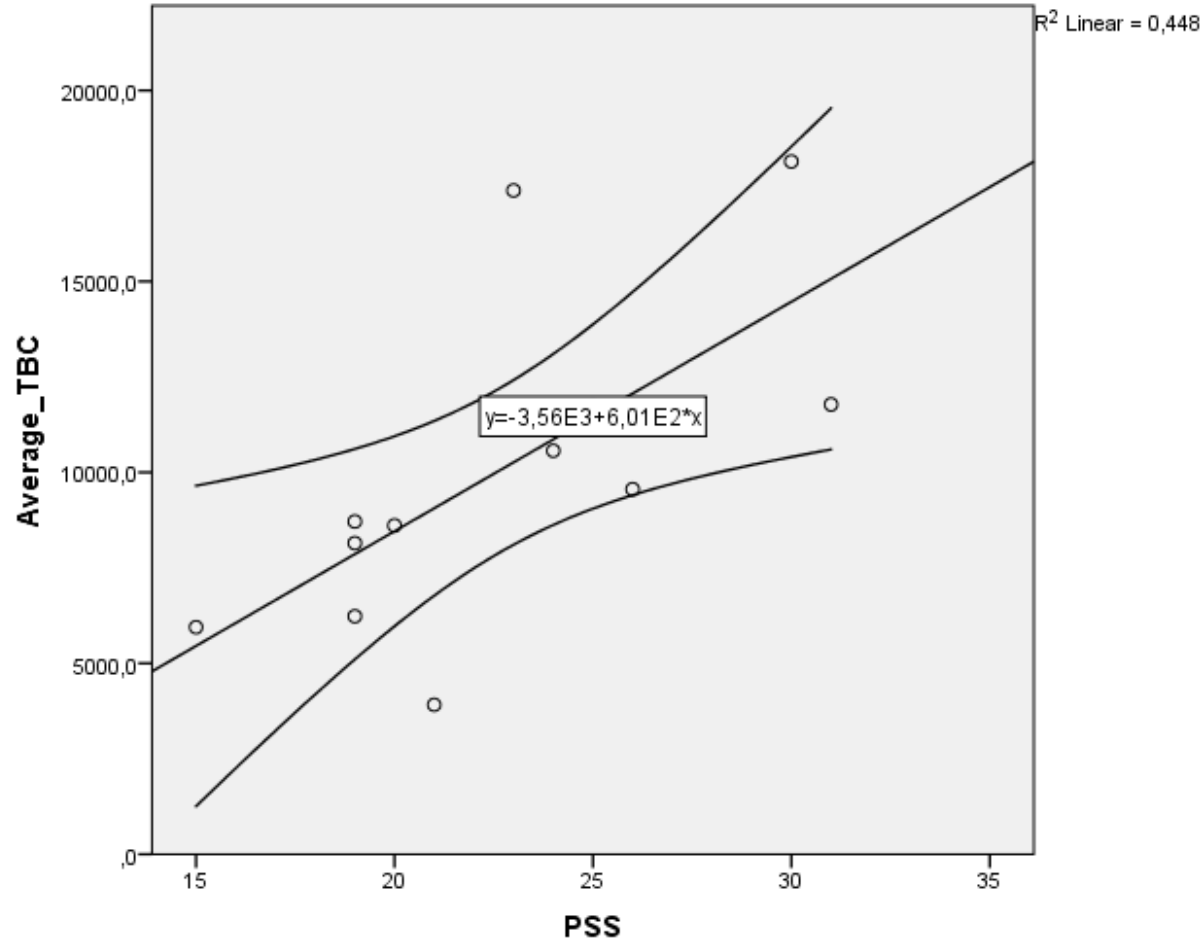
Year 6

100 MCQ item (SBA)

105' / item

Total – 175 min

# Results

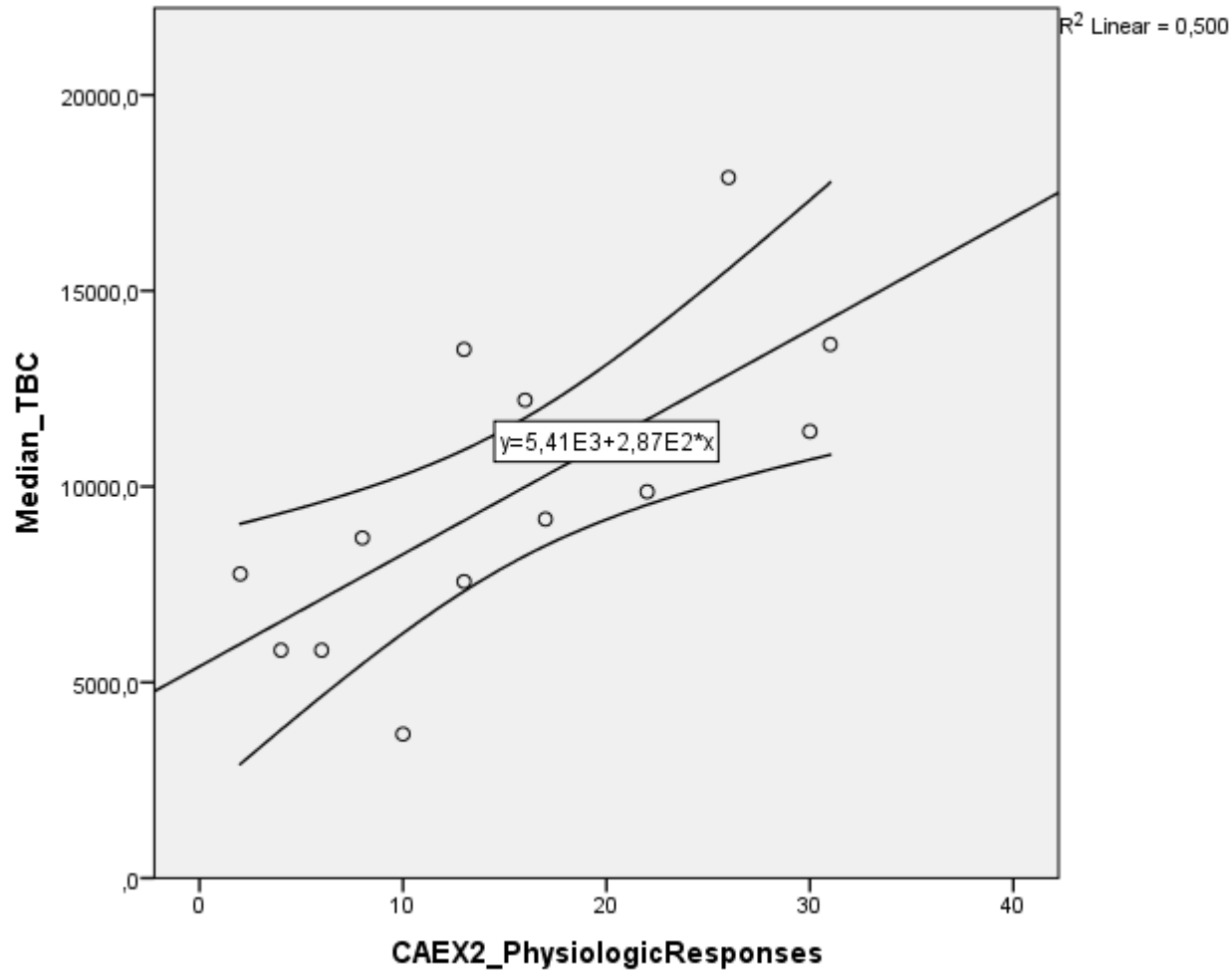


N = 62

R = 0.669; p = 0.017

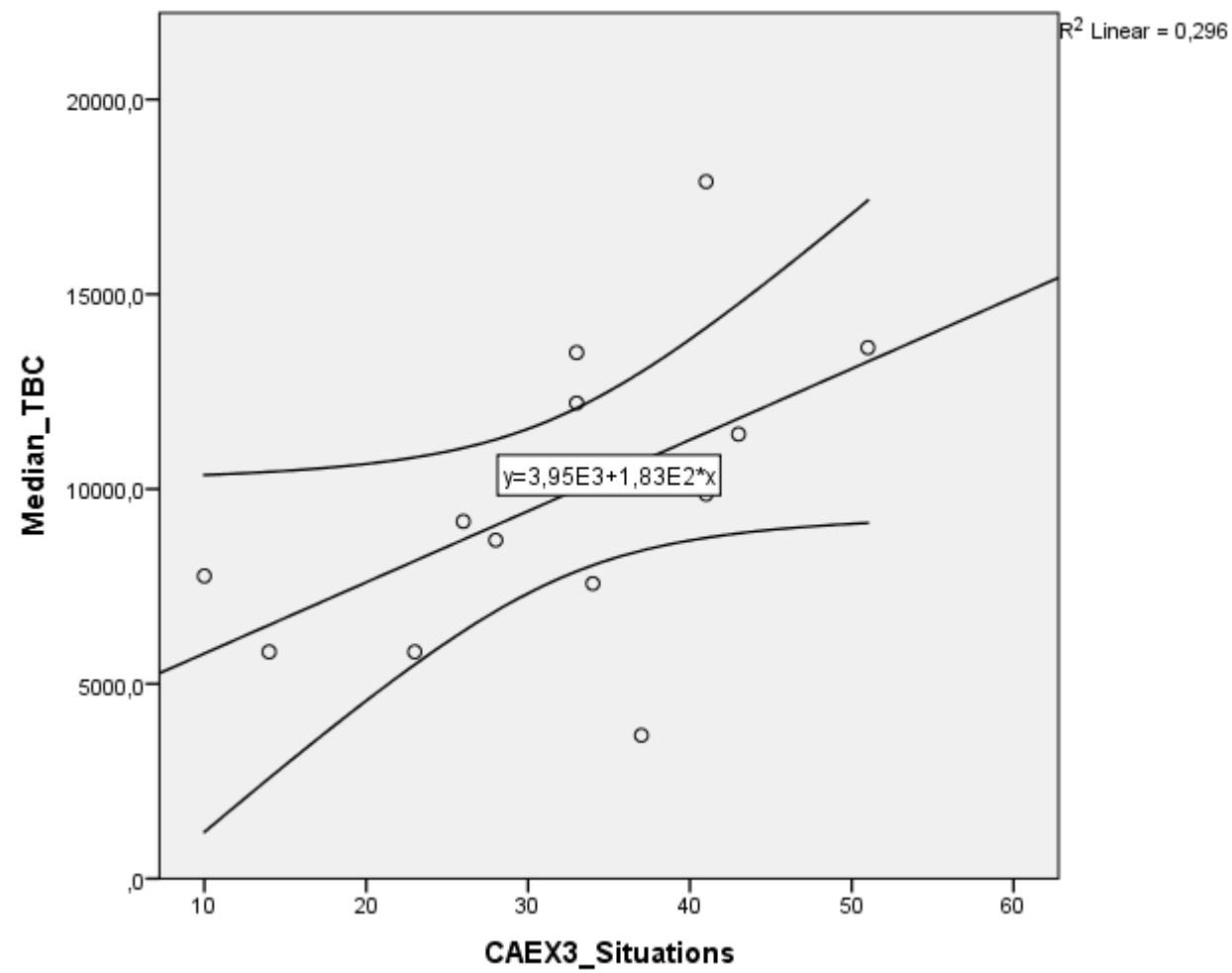
R = 0.650; p = 0.022

# Results



N= 62

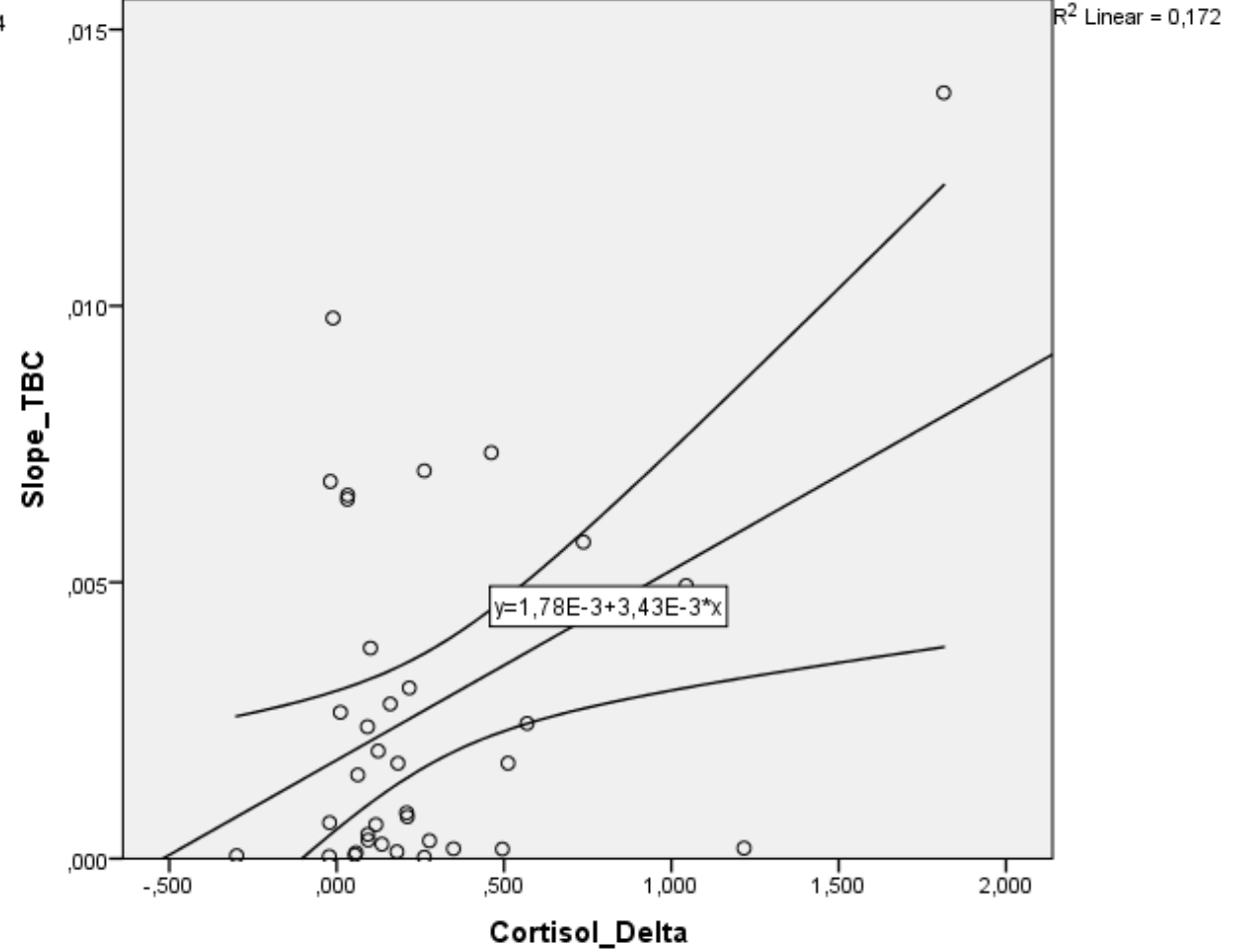
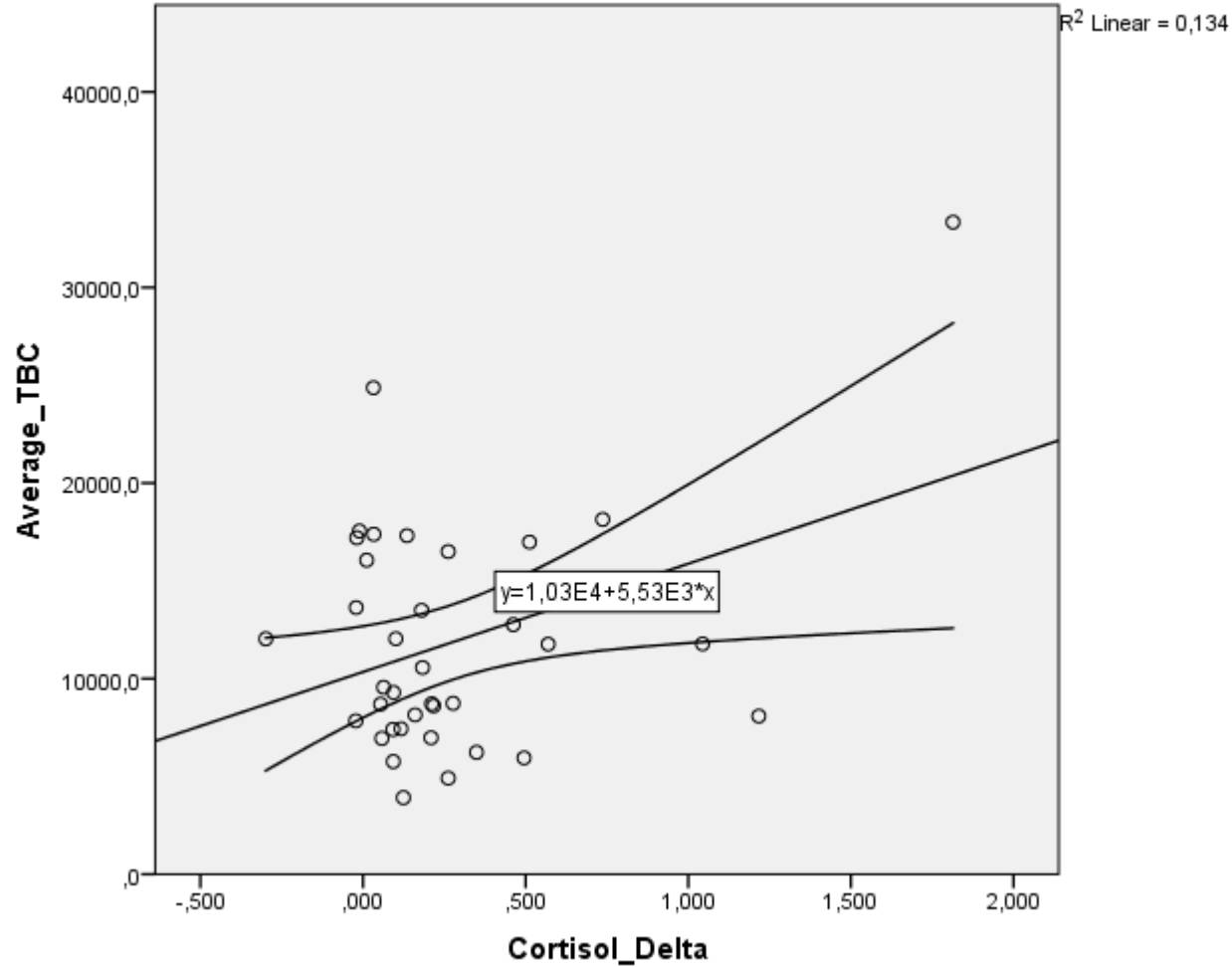
R = 0.707; p= 0.007



R = 0.566; p= 0.044



# Results

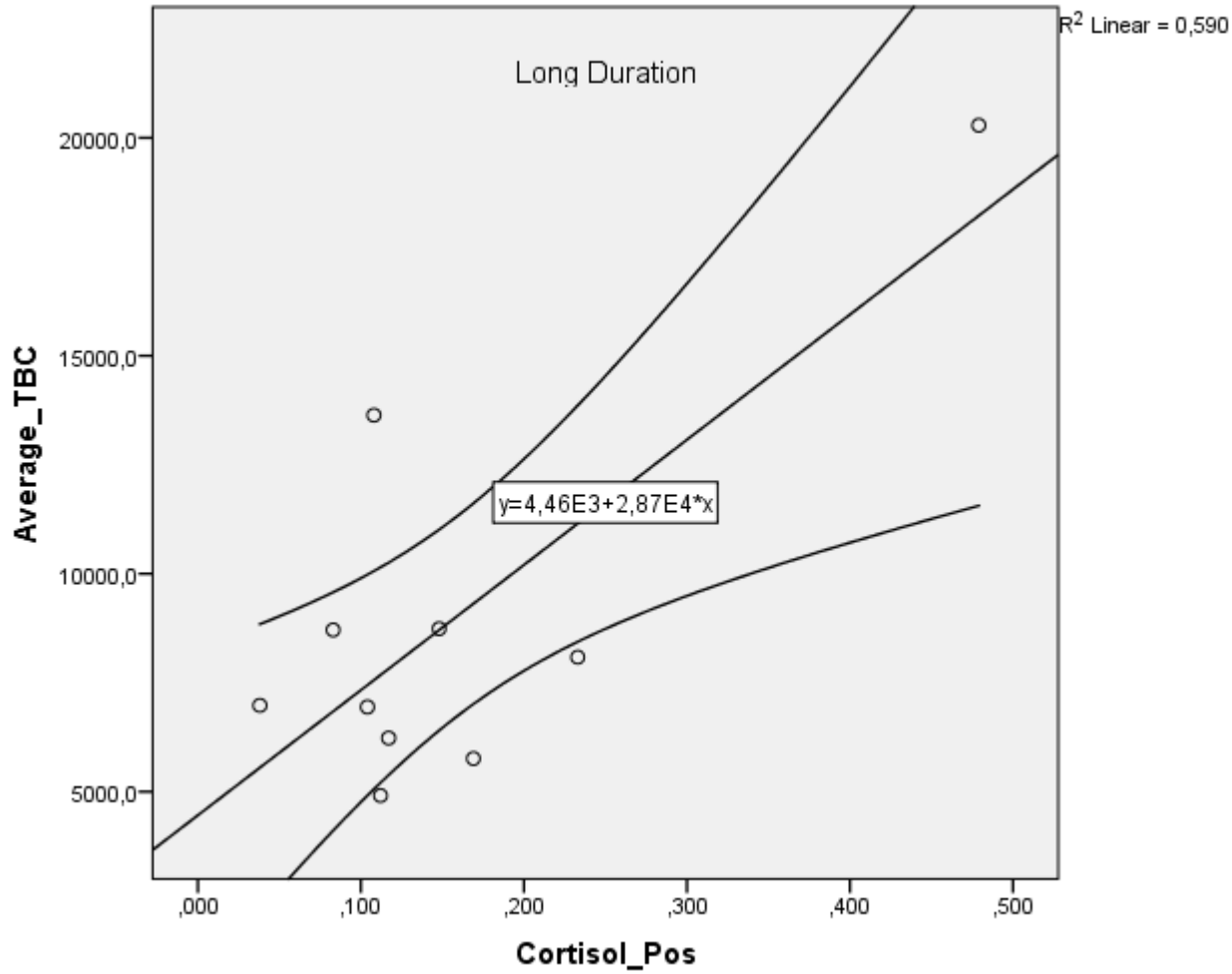


N = 62

R = 0.366; p = 0.028

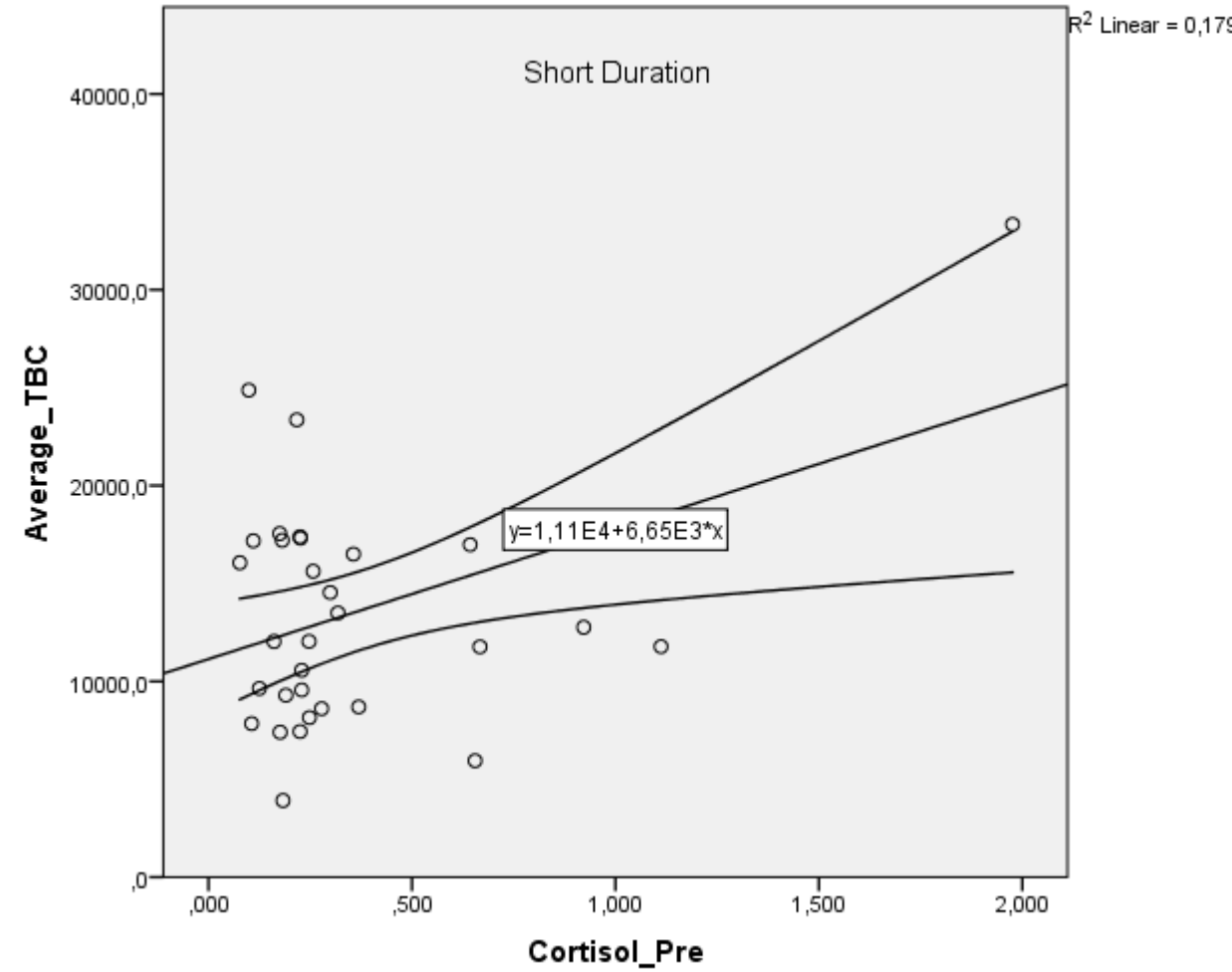
R = 0.414; p = 0.012

# Results



N = 24

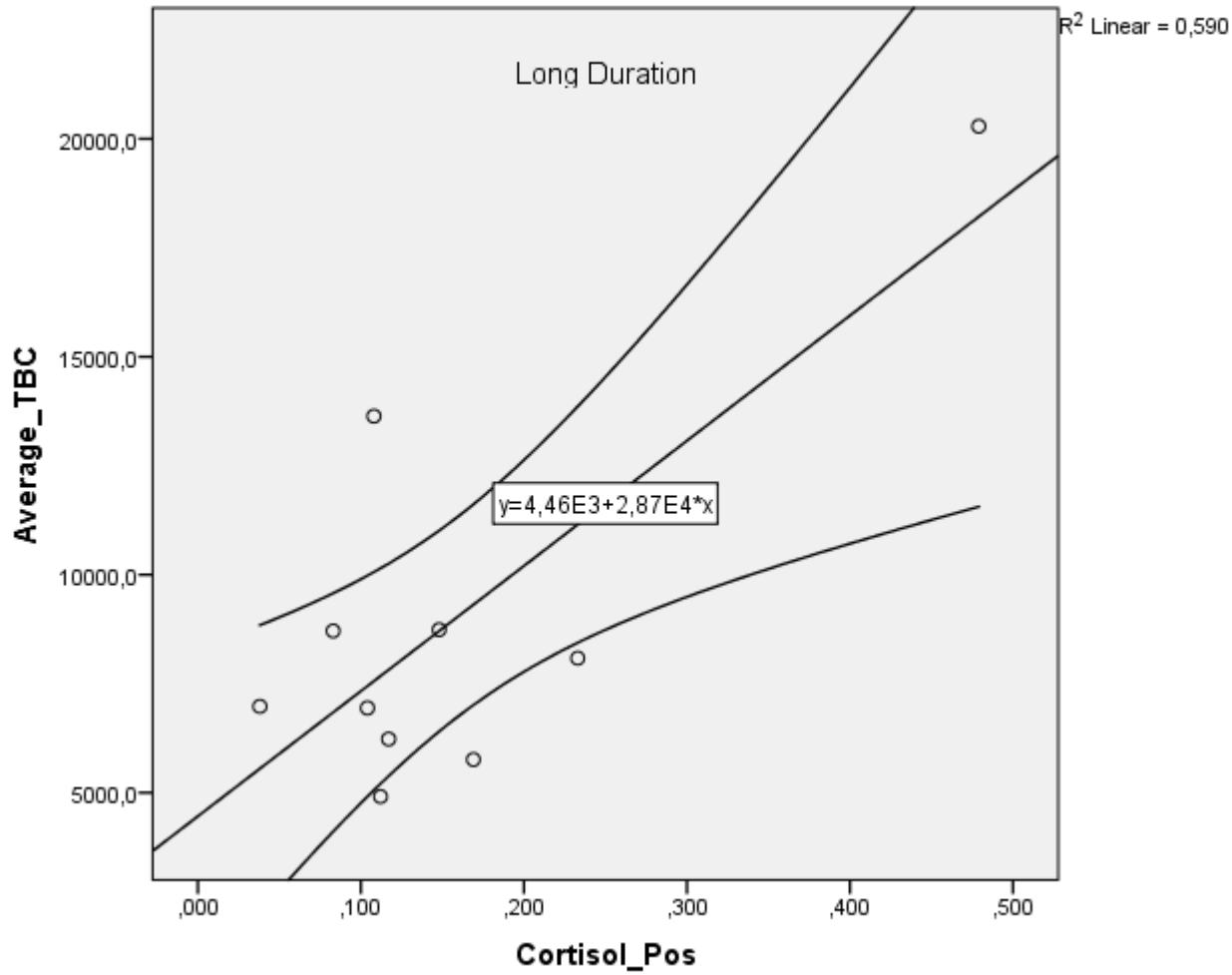
R = 0.768; p = 0.009



N = 38

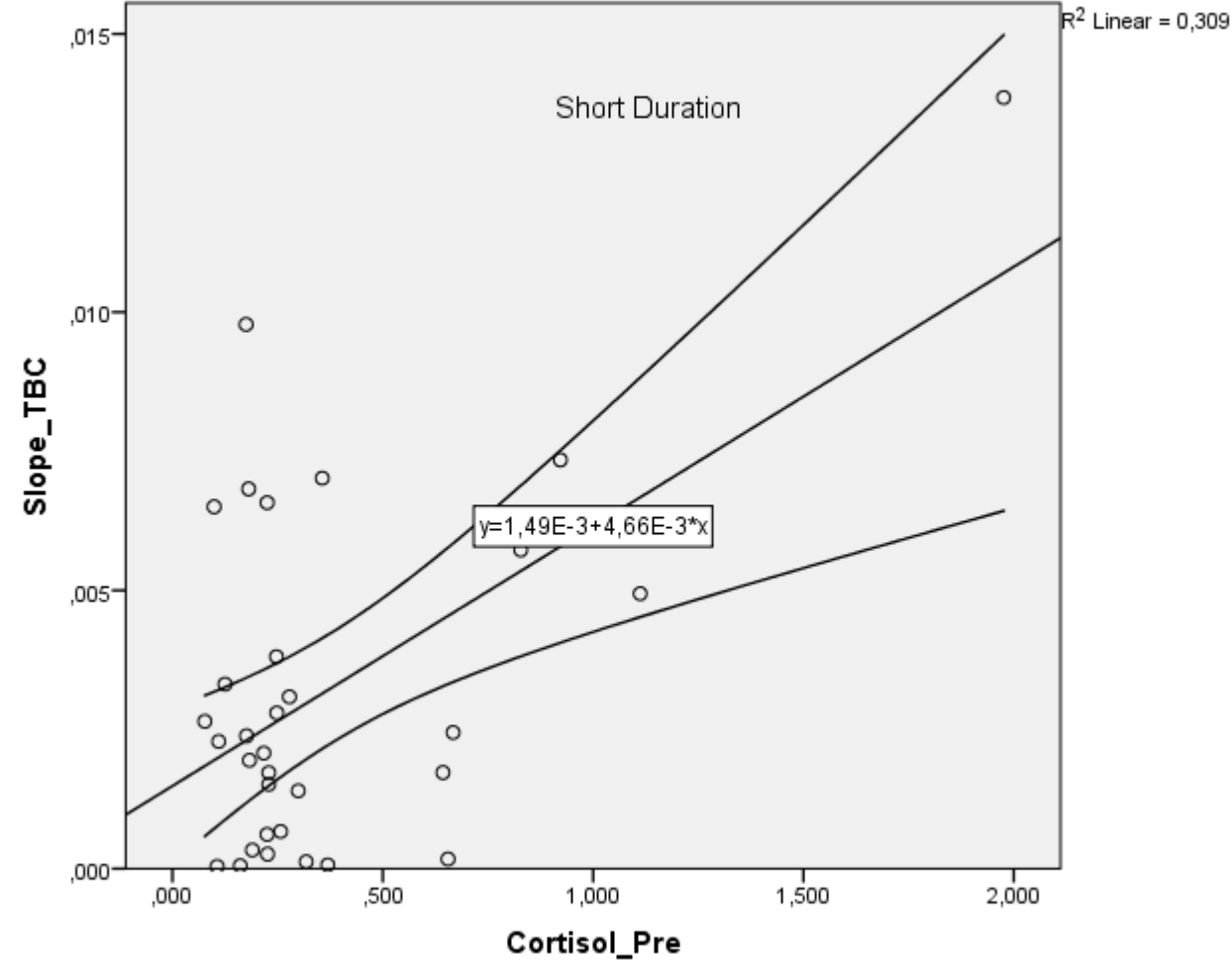
R = 0.423; p = 0.016

# Results



N = 24

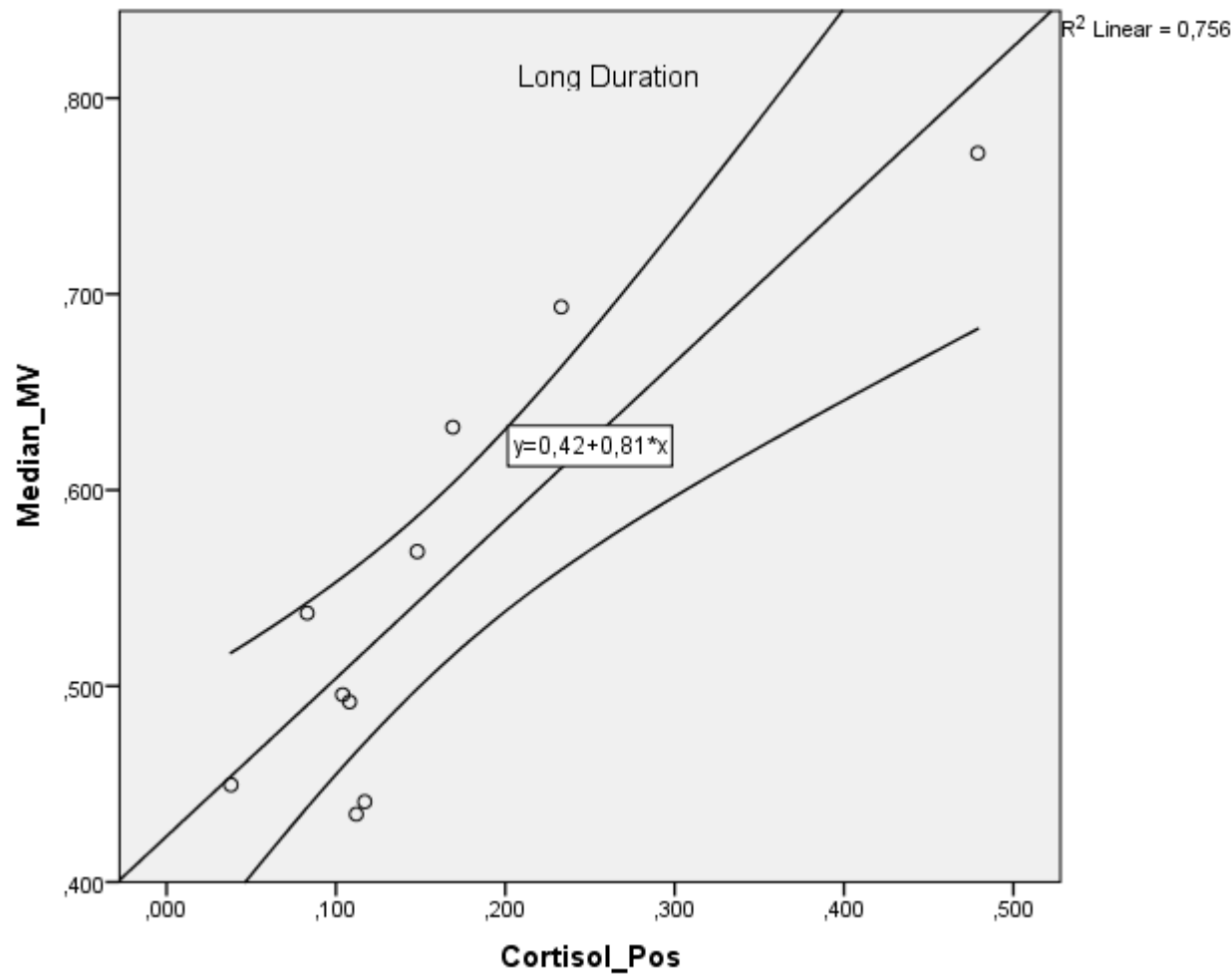
R = 0.768; p = 0.009



N = 38

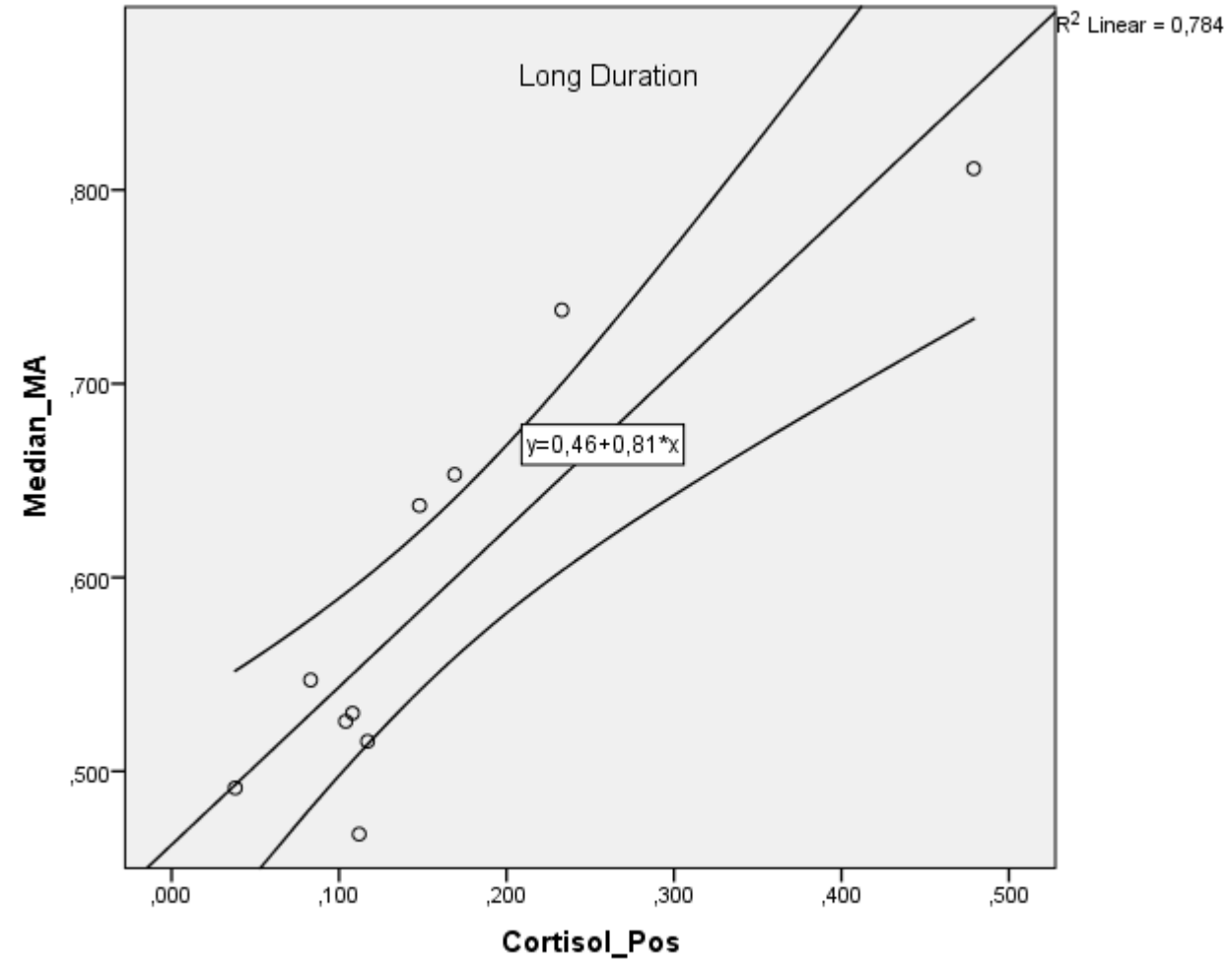
R = 0.556; p = 0.001

# Results



N = 24

R = 0.870; p = 0.001



N = 38

R = 0.886; p = 0.001

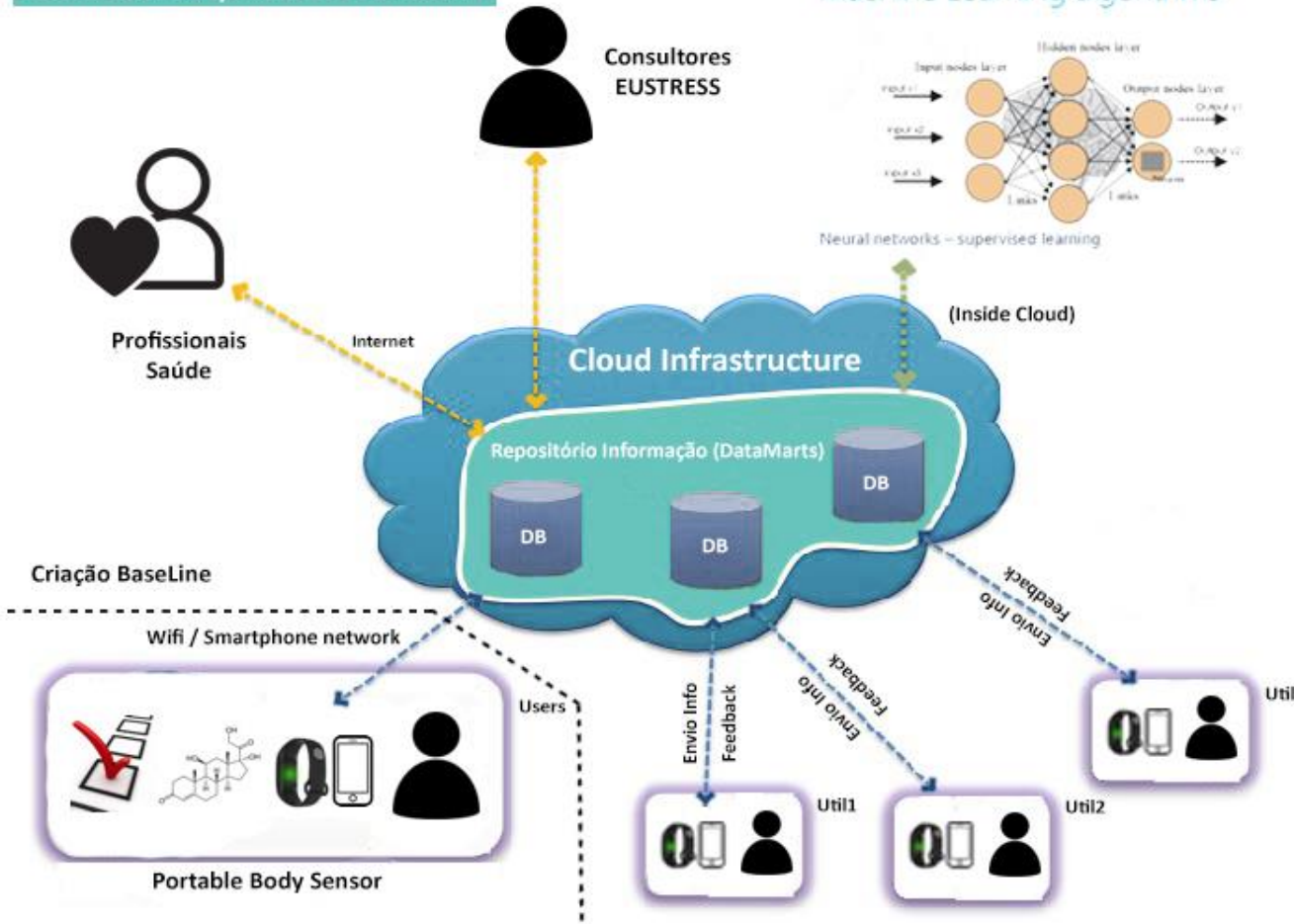


**Mouse dynamics** correlates with students' perceived stress, anxiety and cortisol levels.

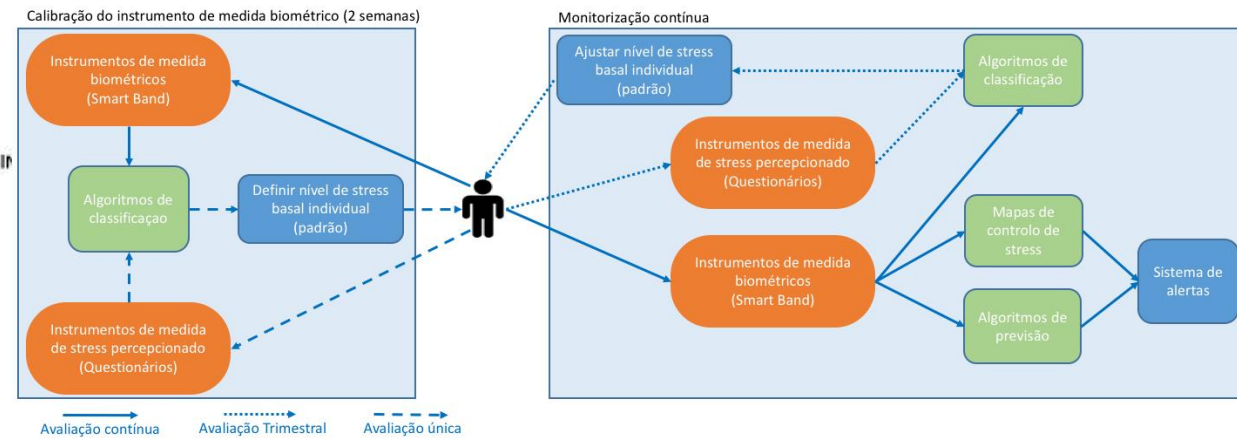
Measures depend on the student's **use of time.**

# Future work

## EUSTRESS - Arquitectura Funcional



## EUSTRESS



# Mouse dynamics as a surrogate of assessment related stress and anxiety

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Pólo de Competitividade da Saúde

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