

## Explainable AI Modeling of Academic Burnout in High School Students Using Cognitive Flexibility, School Climate, and Online Learning Engagement

Yara. Mahfouz<sup>1</sup> , Zhang. Minyi<sup>2\*</sup> 

<sup>1</sup> Department of Counseling Psychology, Ain Shams University, Cairo, Egypt

<sup>2</sup> Department of Cognitive Psychology, Zhejiang University, Hangzhou, China

\* Corresponding author email address: [minyi.zhang@zju.edu.cn](mailto:minyi.zhang@zju.edu.cn)

### Editor

Trevor Archer   
Professor Department of Psychology University of Gothenburg, Sweden  
trevorcsarcher49@gmail.com

### Reviewers

**Reviewer 1:** Zahra Yousefi   
Assistant Professor, Department of Psychology, Khorasan Branch, Islamic Azad University, Isfahan, Iran.

Email: [yousefi1393@khusif.ac.ir](mailto:yousefi1393@khusif.ac.ir)

**Reviewer 2:** Mehdi Rostami   
Department of Psychology and Counseling, KMAN Research Institute, Richmond Hill, Ontario, Canada.  
Email: [dr.mrostami@kmanresce.ca](mailto:dr.mrostami@kmanresce.ca)

### 1. Round 1

#### 1.1. Reviewer 1

Reviewer:

In the statement “Contemporary cognitive science research demonstrates that flexibility supports self-regulation...”, the manuscript cites Mendl et al. (2024) and Ari (2025) but does not clearly distinguish cognitive flexibility from executive functioning. Please clarify the theoretical boundary between these constructs to avoid conceptual overlap with later references to executive functioning.

While subgroup stability is impressive, the manuscript does not report whether performance differences between subgroups are statistically significant. Please include appropriate comparative tests.

The paragraph links cognitive flexibility strongly to burnout reduction; however, potential bidirectionality is not addressed. Please acknowledge the possibility that lower burnout may itself enhance cognitive flexibility.

The claim “the current model not only achieved superior predictive accuracy but also provided transparent interpretability” would benefit from a short comparison with at least one prior burnout prediction study (e.g., Ye et al., 2023) to contextualize the improvement.

The sentence “psychological mechanisms underlying burnout operate consistently across demographic categories” overgeneralizes from the presented subgroup analysis. Please soften the claim or provide additional justification.

Authors uploaded the revised manuscript.

#### 1.2. *Reviewer 2*

Reviewer:

The claim “academic burnout emerges from a dynamic interaction between individual cognitive resources, environmental conditions, and learning behavior patterns” is theoretically strong; however, the manuscript would benefit from explicitly stating a conceptual model or framework (e.g., ecological or systems-based) to anchor this interaction before introducing AI modeling.

The sentence “Traditional regression-based approaches assume linearity and independence among predictors” is accurate but incomplete. Please briefly acknowledge existing non-linear statistical alternatives (e.g., SEM with interaction effects) to strengthen the justification for AI adoption.

While the multi-stage cluster sampling is well described, the rationale for selecting Shanghai, Hangzhou, and Nanjing is not articulated. Please explain why these regions were chosen and how this affects generalizability.

The sentence “predictor variables were also significantly and positively correlated with one another” suggests possible multicollinearity. Please explicitly report tolerance/VIF results here to reassure readers that multicollinearity did not distort the AI model.

Although the ensemble model’s performance is strong, the manuscript does not report confidence intervals or variance across folds. Please add cross-validation variance or standard deviation metrics.

The interpretation of SHAP values as “relative importance (%)” is potentially misleading. Please clarify how SHAP values were normalized into percentage contributions.

Authors uploaded the revised manuscript.

## 2. Revised

Editor’s decision after revisions: Accepted.

Editor in Chief’s decision: Accepted.