Assessing the clinical utility of the DSM-5 internet gaming disorder criteria by using supervised machine learning

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Coupled with traditional statistics, supervised machine learning represents an opportunity in the evaluation of diagnostic criteria. The combination of these two techniques could lead to more robust and varied analyzes

INTRODUCTION

The internet gaming disorder in the Diagnostic and Statistical Manual of mental disorders 5th edition (DSM-5) [1]

- **Section III :** Emerging measures and models
- **9 Criteria :** Substance use + gambling disorders
- **Diagnosis :** Presenting 5 or more criteria

DSM-5 criteria evaluated by experts [2]

- **Delphi study :** Structured method for gathering data from several experts in order to achieve a consensus
- **Experts :** Clinical experience (>5 years, *M* = 7.96) *and/or* research experience (>20 papers, *M* = 20.30) in gaming disorder
- **Clinical utility :** Normal / pathological distinction
- **Evaluation of criteria :** 5 points Likert scale
- **Validation :** Score of 4 or + for >80% of experts
- **Exclusion :** Score of 3 or - for >80% of experts

DSM-5 criteria	Example	Evaluation
Preoccupation	Spend a lot of time thinking about games	?
Withdrawal	Feeling restless, angry when unable to play	?
Tolerance	Need to play for increasing amounts of time	✗
Unsuccessful control	Unable to cut back on the amount of time	✓
Loss of interest	Lose interests in other hobbies	?
Continued use	Continue to play despite neg. consequences	✓
Deceiving	Lie to family, friends, about gaming time	✗
Escapism	Gaming to forget about personal problems	✗
Jeopardize	Risk or lose a job because of gaming	✓

AIM

Assessing the clinical utility of the DSM-5 criteria for the internet gaming disorder based on the predetermined diagnostic cut-off score and observe the contribution of supervised machine learning

METHOD

- 3 Datasets (online surveys) : N = 412
- Different video games and video game style
- Questionnaire : Dichotomous evaluation of each DSM-5 criterion [3]
- Diagnosis : Presenting 5 or more criteria

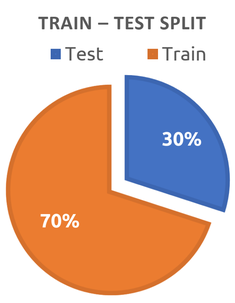
- Age : 18 – 43 years old (*M* = 21.89, *SD* = 3.42)
- Gaming hours per week : 1 – 70 hours (*M* = 12.36; *SD* = 9.06)
- 95 participants present an internet gaming disorder (DSM-5 diagnosis)

Traditional statistics

- Chi-squared
- Phi coefficient

Supervised machine learning

- Estimator : Random Forest Classifier
- Procedure :



i. Split data into train and test set (test set = 124)
ii. No tuning for the hyperparameters except for the numbers of estimators (n estimators = 150) [4]
iii. Several Random Forest Classifier are trained (n = 2500) to have more robust results
iv. Mean of : precisions, accuracies, F1, recalls, ROC AUC
v. Feature importance : mean for all criterion

RESULTS and DISCUSSION

Random Forest Classifier scores

- **Accuracy :** *M* = 0.956 ; *SD* = 0.018
- **Recall :** *M* = 0.867 ; *SD* = 0.071
- **Precision :** *M* = 0.941 ; *SD* = 0.046
- **F1 :** *M* = 0.955 ; *SD* = 0.019
- **ROC AUC :** *M* = 0.925 ; *SD* = 0.035

Phi and Chi-squared scores

- All $p < .001$

Both analyses complete the experts' evaluations that didn't reach a consensus

- **Preoccupation :** Irrelevant criterion
- **Withdrawal :** Relevant criterion (but caution is needed)
- **Loss of interest :** Relevant criterion

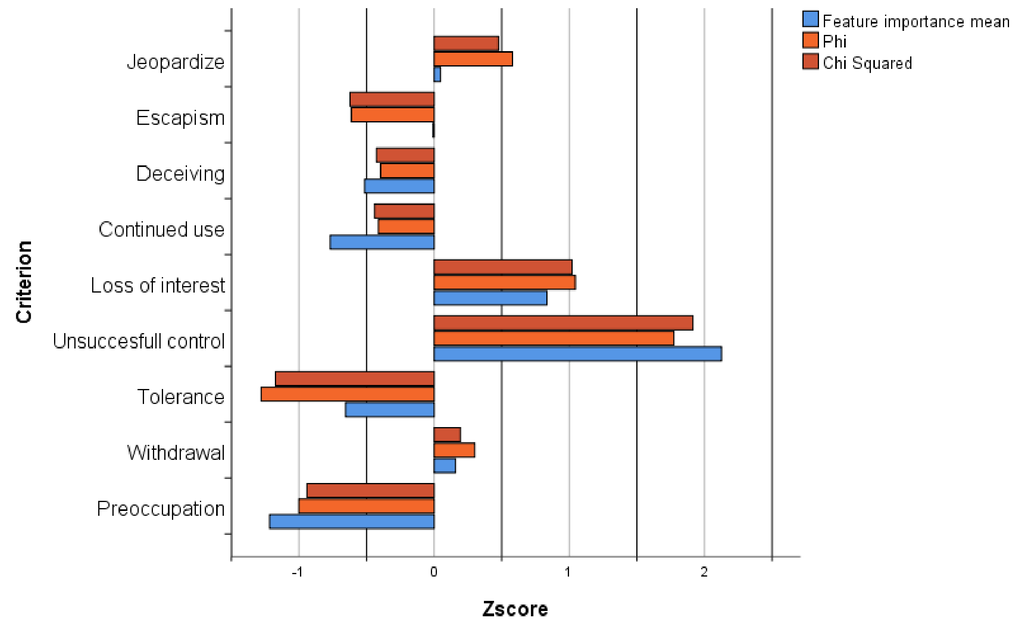
Highlight an important problem in the DSM-5 diagnosis

- **Continued use** criterion is <u>not correctly represented</u> and had more or less the same impact than irrelevant criteria (e.g. deceiving) in the DSM-5 diagnosis of the internet gaming disorder

Identification of core and peripheral criteria according to the literature [5, 6]

- **Withdrawal**, **unsuccessful control** and **loss of interest** are core criteria and are related to a <u>pathological involvement</u> in video games
- **Tolerance** and **preoccupation** are peripheral criteria and are related to a <u>high involvement</u> in video games

Feature importance mean, Phi and Chi-squared Z-scores for each criterion



Using multiple analytical methods to assess the criteria of a diagnostic tool provided robust results and more insights. In the future, using supervised machine learning in complement of traditional statistics could become a new standard in the psychopathology field

References
[1] American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders:* DSM-5 (5th ed.). Arlington, VA: American Psychiatric Association.
[2] Castro-Calvo, J., King, D. L., Stein, D. J., Brand, M., Carmi, L., Chamberlain, S. R., Demetrovics, Z., Fineberg, N. A., Rumpf, H. J., Yücel, M., Achab, S., Ambekar, A., Bahar, N., Blaszczynski, A., Bowden-Jones, H., Carbonell, X., Chan, E. M. Lo, Ko, C. H., de Timary, P., … Billieux, J. (2021). Expert appraisal of criteria for assessing gaming disorder: an international Delphi study. *Addiction*. https://doi.org/10.1111/add.15411
[3] Petry, N. M., Rehbein, F., Gentile, D. A., Lemmens, J. S., Rumpf, H. J., Mößle, T., Bischof, G., Tao, R., Fung, D. S. S., Borges, G., Auriacombe, M., González Ibáñez, A., Tam, P., & O'Brien, C. P. (2014). An international consensus for assessing internet gaming disorder using the new DSM-5 approach. *Addiction*, *109*(9), 1399–1406. https://doi.org/10.1111/add.12457
[4] Probst, P., & Boulesteix, A. L. (2018). To tune or not to tune the number of trees in random forest. *Journal of Machine Learning Research*, *18*(2001), 1–8.
[5] Charlton, J. P., & Danforth, I. D. W. (2007). Distinguishing addiction and high engagement in the context of online game playing. *Computers in Human Behavior*, *23*(3), 1531–1548. https://doi.org/10.1016/j.chb.2005.07.002
[6] Billieux, J., Flayelle, M., Rumpf, H.-J., & Stein, D. J. (2019). High Involvement Versus Pathological Involvement in Video Games: a Crucial Distinction for Ensuring the Validity and Utility of Gaming Disorder. *Current Addiction Reports*, *6*(3), 323–330. https://doi.org/10.1007/s40429-019-00259-x

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