

School of Computer Science

Scientific Research & Literature

in Fulfilment of

SPEC9997

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Topic - Data Science Stream: **Application of Machine Learning to mental health illneses such as Scitzophrenia.**

# Paper 1

**Topic:** Pattern recognition of brain biomarkers for dissociative identity disorder

**Reference:** Reinders, A., Marquand, A. F., Schlumpf, Y. R., Chalavi, S., Vissia, E. M., Nijenhuis, E., Dazzan, P., Jäncke, L., & Veltman, D. J. (2019). Aiding the diagnosis of dissociative identity disorder: pattern recognition study of brain biomarkers. *The British journal of psychiatry : the journal of mental science*, *215*(3), 536–544. https://doi.org/10.1192/bjp.2018.255

**Aim:** To investigate whether pattern recognition can help identifying biomarkers for DID diagnosis.

**Methods:** Brain images/MRI were compared using probabilistic pattern classifiers. Survey for healthy patients were used for screening.

**Conclusions:** Classification model yielded an accuracy of 72.84%, found significant proof that individuals with D.I.D can be distinguished from healthy ones via spatially dependant patterns in white and grey brain matter. Patients with D.I.D can be identified at an accuracy of 71.88% through the studying of underlying effects. This can be considered a limitation or solution due to a lack of data.

**Gaps in the Research:** Due to limited data research can potentially be more rigid. Researchers suggested that a control group for PTSD would be advisable to see its effect not the classification, similar can be said about other comorbid symptoms.

**Critique:** The paper acknowledges the inferences are made at a group level and a limited ability to provide insight at an individual level this could be used for a future project. It's used as a proof of concept that differences in biomarkers can be extracted to provide use.

# Paper 2

**Topic:** Application and limitation of machine learning in predicting mental health diagnosis

**Reference:** Tiffin, P. A., & Paton, L. W. (2018). Rise of the machines? Machine learning approaches and mental health: opportunities and challenges. *The British Journal of Psychiatry*, *213*(3), 509–510. http://doi.org/10.1192/bjp.2018.105

**Aim:** Identifying strengths and weaknesses of machine learning in mental health

**Methods**: Content analysis

**Conclusions:** Risk of overfitting models to the data used, since in some conditions data is very limited. Machine learning uses “brute force” of ensemble models and lack of interpretability of deep learning techniques.

**Gaps in the Research:** Statements aren’t really explored in more detail such as pointing out issues that could come from streamlining an automated diagnosis system and how it would be implemented.

**Critique:** The author didn’t include/review many papers, it almost reads like an opinion piece, claiming that models can’t adapt to a potential change in the use of language when trained on scraped web data to detect depression or suicidal behavior is in my opinion not accurate, if such a change did occur then sensitivity analysis or outlier detection could be used to accommodate such an occurrence in the advent of a slang term being invented, it feels like a devil’s advocate argument. Another point is that in such cases one would not relay on one model but multiple preforming different functions such as looking for new slang and analyzing if it relates to existing topologies etc.

# Paper 3

**Topic:** Application of deep learning to mental health, a scoping review

**Reference:** Su, C., Xu, Z., Pathak, J., & Wang, F. (2020). Deep learning in mental health outcome research: a scoping review. *Translational psychiatry*, *10*(1), 116. https://doi.org/10.1038/s41398-020-0780-3

**Aim:** Review existing research on the application of deep learning techniques to mental health problems.

**Methods:** Thematic analysis, Content analysis, Meta-analysis, Systematic review

**Conclusions:** Deep Learning is gaining more traction in healthcare despite not being as interpretable as statistical or white box models, although it’s still not as popular as the latter. In accompanying tables, you can see the findings of all papers in which deep learning was used. This is a very short conclusion as there are many papers compared in accompanying tables.

**Gaps in the Research:** As this paper evaluated the state of the art it’s difficult to address potential gapswithout having significant knowledge/experience in the area. One thing worth mentioning is that it seems like their process for collecting said papers could have been a better rather than what it felt like “randomly” searching for papers. Doesn’t specify details on techniques used or how something was implemented.

**Critique:** A more advanced audience/reader would find some of the material too elementary, it was a good mix for someone like myself starting research in the area. I didn’t find anything worth critiquing as this paper was reviewing use cases from a plethora of papers, I’ve covered it to gain insight on state-of-the-art application of machine learning in mental health.

The paper itself mentions uses cases of deep learning with genetic data for studying mental health, social networks for finding patterns of depression and suicidal behavior. Already known use of deep learning for analyzing neuroimages which can then be reviewed by clinicians.

Limitation via a lack of quantitative tests such as blood chemistry tests etc Data for mental health is largely collected through self-reported surveys. This could be a future project that could aid the collection of more concrete data.

# Paper 4

**Topic:** Classifying and predicting the onset of mental health disorders using functional connectivity

**Reference:** Yuhui Du1, Z. F. (06 August 2018). Classification and Prediction of Brain Disorders Using Functional Connectivity: Promising but Challenging. frontiers in Neuroscience.

**Aim:** Compare and review state-of-the-art of functional connectivity analysis methods, static vs dynamic connectivity.

**Methods:** Thematic analysis, Content analysis, Meta-analysis, Systematic review

**Conclusions:** Accuracy, sensitivity and specificity do not provide a realistic measure of positive or negative outcomes/probabilities that someone has an illness or not. More studies now focus on using continuous variables such as personal cognitive scores and behavioral performance using fMRI data. There seems to be a lot of emphasis on what variables/techniques and methods should be used rather than there being a set standard, it seems it was more a thematic/content analysis of where the state-of-the-art is. There is a need for the development of disease categories built on biological data to ease the segregation of said disorders.

**Gaps in the Research:** Couldn’t identify any. I found it to be an informative paper.

**Critique:** Difficult to parse, this is probably a result of my inexperience rather than the paper, it was very detailed and covered a lot of ground. I would need more time, probably after this semester to look thoroughly into functional connectivity.

SVM seems to be a popular classifier for mental health classification

# Paper 5

**Topic:** Machine learning in mental health

**Reference:** Shatte, A., Hutchinson, D. M., & Teague, S. J. (2019). Machine learning in mental health: a scoping review of methods and applications. *Psychological medicine*, *49*(9), 1426–1448. https://doi.org/10.1017/S0033291719000151

**Aim:** Synthesize and review current literature on the application of machine learning to mental health in order to highlight current findings and applications in practice.

**Methods:** Thematic analysis, Content analysis, Meta-analysis, Systematic review, Scoping review

**Conclusions:** Majority of research is done on MRIs with fMRI being more common in diagnosing schizophrenia. Overall, the use of other mediums is also being explored such as video and audio for Alzheimer’s disease. Found three themes, one of which is the use of sensor and mobile data to detect changes in behavior indicative of mental health conditions. Social media data and electronic health records allow monitoring of large pools of people in a cost-efficient manner. The over all consensus is that machine learning is being more commonly used as a tool in research and clinical settings.

**Gaps in the Research:** Lack of research in personality disorders and schizophrenia due to availability.

**Critique:** Highlights the issue that there is a lack of consistency in accuracy of techniques and datasets used. Potential for bettering the collection of data from clinicians as machine learning models are only as good as the data it can consume.

Closing thoughts

PCA and SVM seem to be the most dominant forms of classifying disorders from MRI images post 70% accuracy.

# References

Adrian B R Shatte, D. M. (2019 July). Machine learning in mental health: a scoping review of methods and applications. *Psychological Medicine*, https://doi.org/10.1017/S0033291719000151.

Chang Su, Z. X. (2020). Deep learning in mental health outcome research: a scoping review. *Translational Psychiatry*, 10(1), 116. https://doi.org/10.1038/s41398-020-0780-3.

Paul A. Tiffin, L. W. (2018). Rise of the machines? Machine learning approaches and mental health: opportunities and challenges. *The British Journal of Psychology* , 213, 509–510. http://doi.org/10.1192/bjp.2018.105.

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Yuhui Du1, Z. F. (06 August 2018). Classification and Prediction of Brain Disorders Using Functional Connectivity: Promising but Challenging. *frontiers in Neuroscience*.