Artificial Intelligence (AI): a tool in clinical practise and ADHD research

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Artificial intelligence (AI) is a buzzword that often conjures up images of driverless cars and lost jobs. However, it can also be a powerful tool to support clinical research and practise in psychiatry, in a plethora of ways. As discussed by Winter et al., "*In both psychiatry and medicine in general, expectations to move beyond classical group-level statistics and enter the promising future of personalized medicine are high. Although AI has not yet fully hit mainstream psychiatric research, the availability and advancement of technology and methods have indeed led to a growing adoption of AI methods…"*.[1]

At its core, AI is a vast field that combines computer science and large datasets, to help solve specific problems. Alan Turing, the founding father, defined AI as "*the science and engineering of making intelligent machines, especially intelligent computer programs*".[2] It is an umbrella term that encapsulates many different methods schematically represented (Figure). AI methods have started to make in-roads both in research and commercial products. A recent review[3], describes the exponential rise in the number of publications, particularly with autism. We quote from a review by Winter et al. as they share their lived experience: "*A decade ago, at a major international conference, we vividly remember a symposium on psychiatric Artificial Intelligence (AI) drawing a crowd of seven people-including the four speakers. Today one might get the impression that every other funding proposal is required to include at least some degree of AI-based analyses*". [1]

In the ADHD space, on the research front, most recent publications discuss the use of machine learning (ML) for analyzing large imaging and genetic datasets. Machine learning is itself a vast field, that includes different classes of techniques (represented in

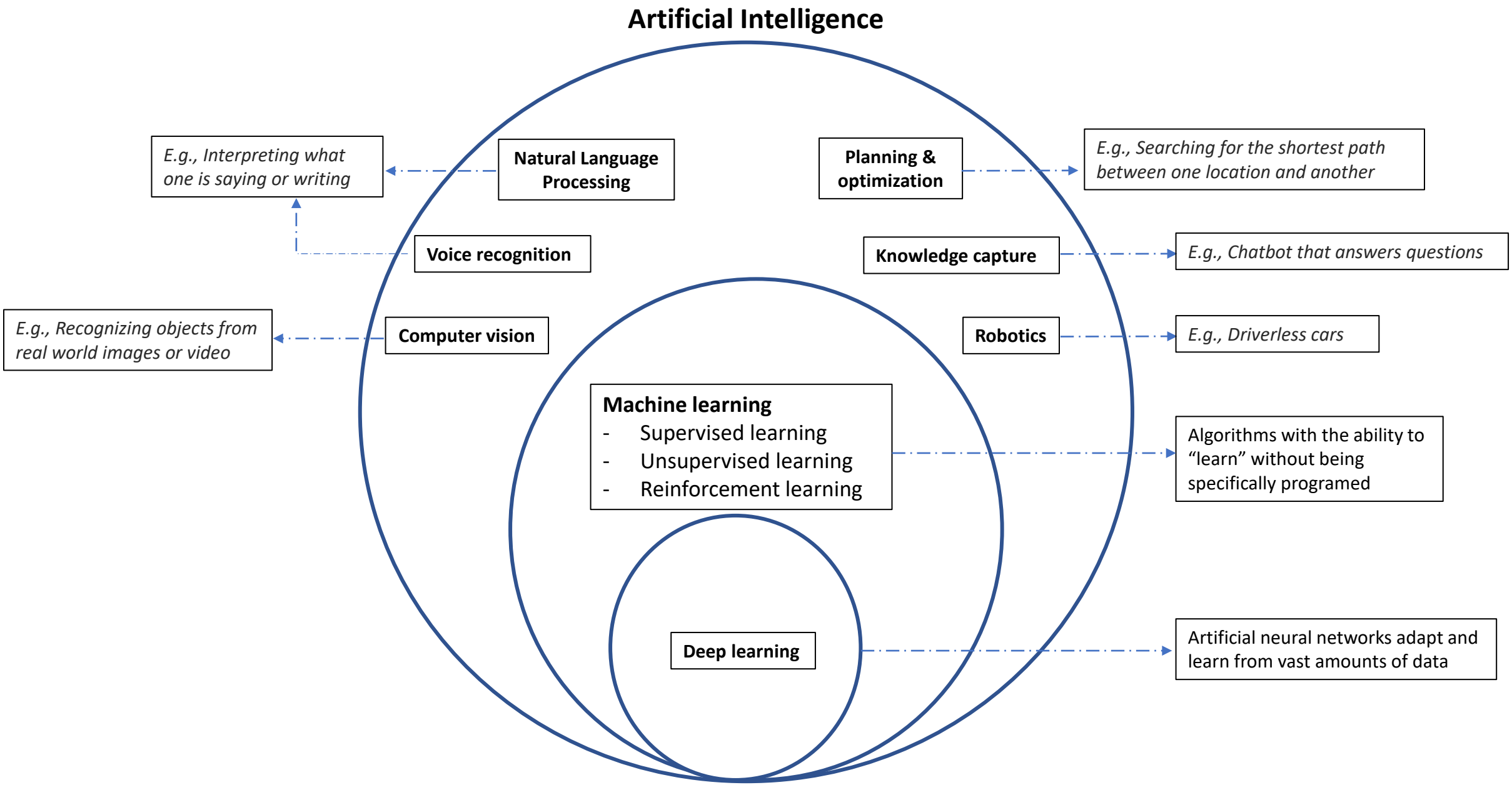
the schematic figure). Recent updates on the use of ML techniques with large MRI/genetic datasets, to develop diagnostic classifiers, have been reviewed[3], and were discussed at the APSARD 2022 conference [Symposium: How Should We Think about Genetics and Neuroimaging in ADHD?]. The general summary has been encapsulated[3]: *"…ML studies of MRI-based ADHD diagnostic classifiers has important implications for methods development, but these studies have not yet led to clinically useful classifiers. Our review shows that the variability of results across studies is due, in part, to differences in methodology. Future work should use the largest samples possible and should rely on a heldout test set, rather than cross-validation for estimating prediction accuracy. Future studies should not rely on percent correct as a measure of accuracy in unbalanced samples. Our analysis also highlighted the need of data from underrepresented groups, particularly females and adults…the initial results from the ENIGMA ADHD consortium should encourage more sites to participate. The lack of a very large multimodal dataset that include sufficient data from both sex and all ages may be the biggest impediment to developing a clinically useful classifier for diagnosing ADHD."*

The surge in interest was similarly echoed in a recent review:[4] there are "*increasing attempts to assist with diagnoses, prognoses, and treatment selection with new approaches and data sources. While traditional data types are used most widely, such as questionnaires and neuroimaging, the field demonstrates emerging use of a variety of increasingly available data types that harness multilevel clinical information (e.g., data from sensors now commonly available on smartphones, video, and audio)."* This review also summarizes the concerns and limitations that are being widely

discussed. "*The prospect of these tools being clinically used highlights the need…to acknowledge limitations*". There are four main limitations to these methods - *Sample size and representativeness; Internal and external validation considerations; Clinical utility; Ethical concerns*.

In terms of commercial products, diverse AI-powered tools are being tested as an aide to clinical practise. In particular, Digital Mental Health Interventions have been making inroads, improving access to services and delivery. A similar picture is emerging for digital gaming interventions: "*Based on the principles of gamification, they target psychosocial and cognitive domains, according to the deficits in various psychiatric disorders. They have been used to deliver cognitive behaviour therapy, cognitive training and rehabilitation, behavioural modification, social motivation, attention enhancement, and biofeedback"*.[5] Many of these products are at diverse stages of pre-clinical and clinical trials, while one (EndeavorRx) has received FDA approval for use in conjunction with medication management for the treatment of ADHD.

Summarized by Dwyer and Koutsouleris, "*When combined with the exponential rise in publications in the field…such regulatory applications suggest that implementation might be closer than once thought".*[4] There is much potential that needs to be fully explored, but *"there is no shortage of promises"*.[1] It is imperative to proceed with caution, cognisant of each important limitation.


Artificial Intelligence
Natural Language Processing
E.g., Interpreting what one is saying or writing
Voice recognition
Computer vision
E.g., Recognizing objects from real world images or video
Planning & optimization
E.g., Searching for the shortest path between one location and another
Knowledge capture
E.g., Chatbot that answers questions
Robotics
E.g., Driverless cars
Machine learning
- Supervised learning
- Unsupervised learning
- Reinforcement learning
Algorithms with the ability to "learn" without being specifically programed
Deep learning
Artificial neural networks adapt and learn from vast amounts of data

References

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