



CONTEMPORARY MENTAL HEALTH

**The use of Artificial Intelligence
(AI) in Counselling and Mental
Health Care**

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SESSION STRUCTURE

- Brief introduction to Artificial Intelligence
 - Background and definition of key terms
- The use of AI in mental health care
- Break
- Activity: Technological, Practical, and Ethical considerations debate



What is AI?



- Field of science concerned with the study and design of intelligent machines
 - Goal: to build machines capable of performing tasks we define as intelligent
 - E.g., reasoning, learning, planning, problem-solving, remembering, and perception
- Divided into:
 - **Strong:** build machines with General Intelligence leading to consciousness (Searle, 1980).
 - **Weak:** focus on specific specialised intelligent tasks
 - e.g., speech processing (Velik, 2012).

Key terms

- **Machine learning (ML)** = core branch of AI that aims to give computers the ability to learn without explicit programming (Samuel, 2000)
 - Capability of a machine to improve performance through exposure to data and experience
- **Artificial neural networks (ANN)** = type of ML technique that simulates structure and function of neuronal networks in the brain (Alonso & Mondragón, 2011)
- **Natural Language Processing (NLP)** = capability of machines to interpret and process human language (Manning & Schütze, 1999).



Key terms

- **Machine Perception and Sensing** = computer systems with hardware and software to recognise images, sounds, touch, and smell in manner that enhances interactivity with humans



- **Affective computing** = emotion recognition by machines, emotion modelling, and expression of emotions by robots and virtual agents (Picard, 1997)

- **Virtual reality (VR)** = allows the user to become immersed within and interact with computer-generated simulated environments (Rizzo et al., 1997)



Key terms

- **Augmented reality (AR)** = combines virtual reality with the real world by superimposing computer-generated graphics with live video imagery (Craig, 2013).



- **Brain-Computer Interfaces (BCIs) & Implants:** devices that provide direct communication between the brain and external hardware (i.e., a computer).

- **Robotics** = machines that move around in the real world.



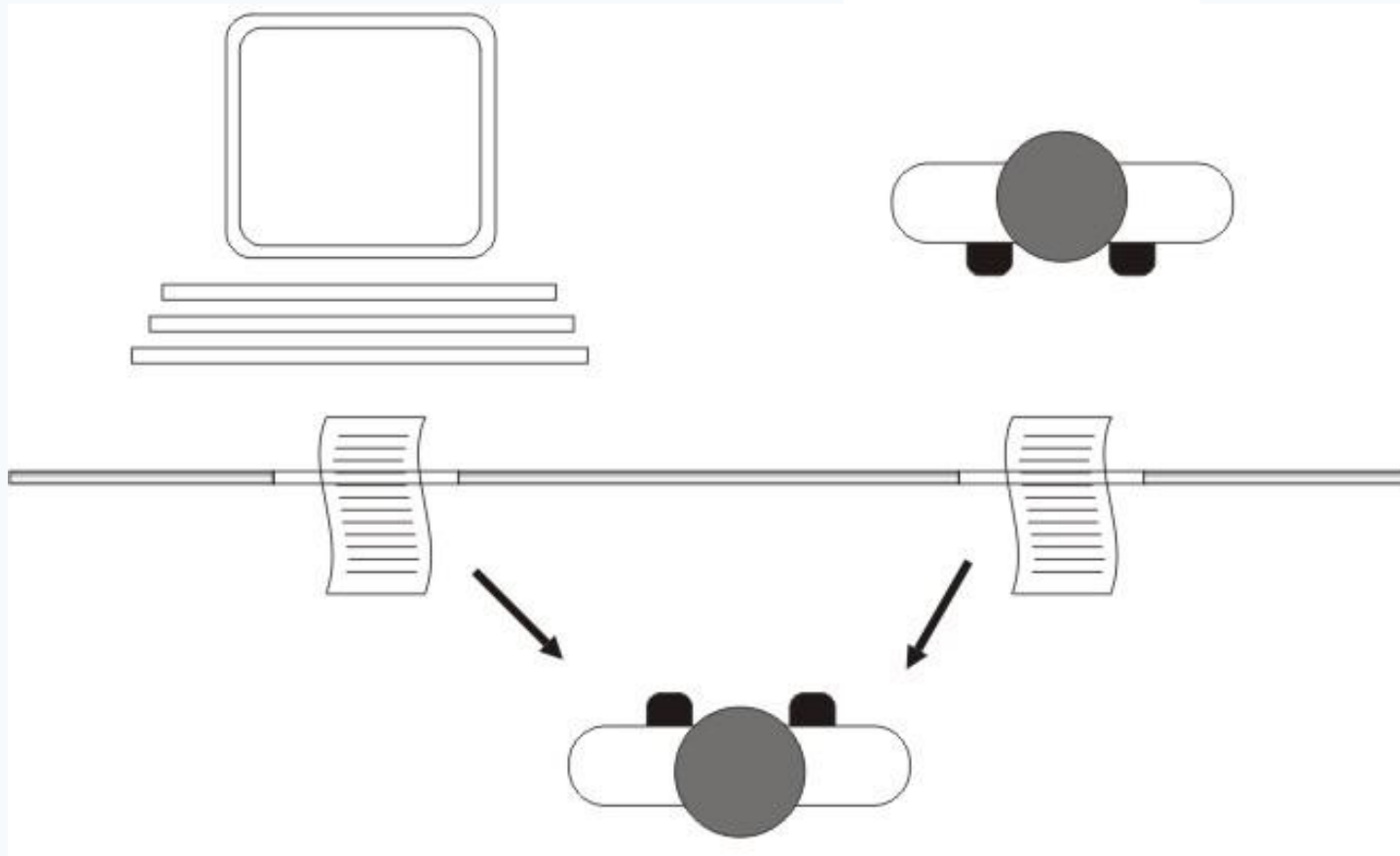
AI – Brief Background

Alan Turing (1950)

- Mathematical and computer scientist.
 - The way we carry out a computation (i.e., work something out), a computer could also do in the same way by following a series of rules in a step-by-step manner and manipulate symbols according to these rules.
- To examine this he devised the imitation game:
 - Method for judging intelligence of machines and whether machines are capable of “thinking.”



AI – Brief Background



- Thinking defined in terms of output (verbal behaviour)
- If human and machine perform the same in the Imitation Game then the material is irrelevant; only function matters

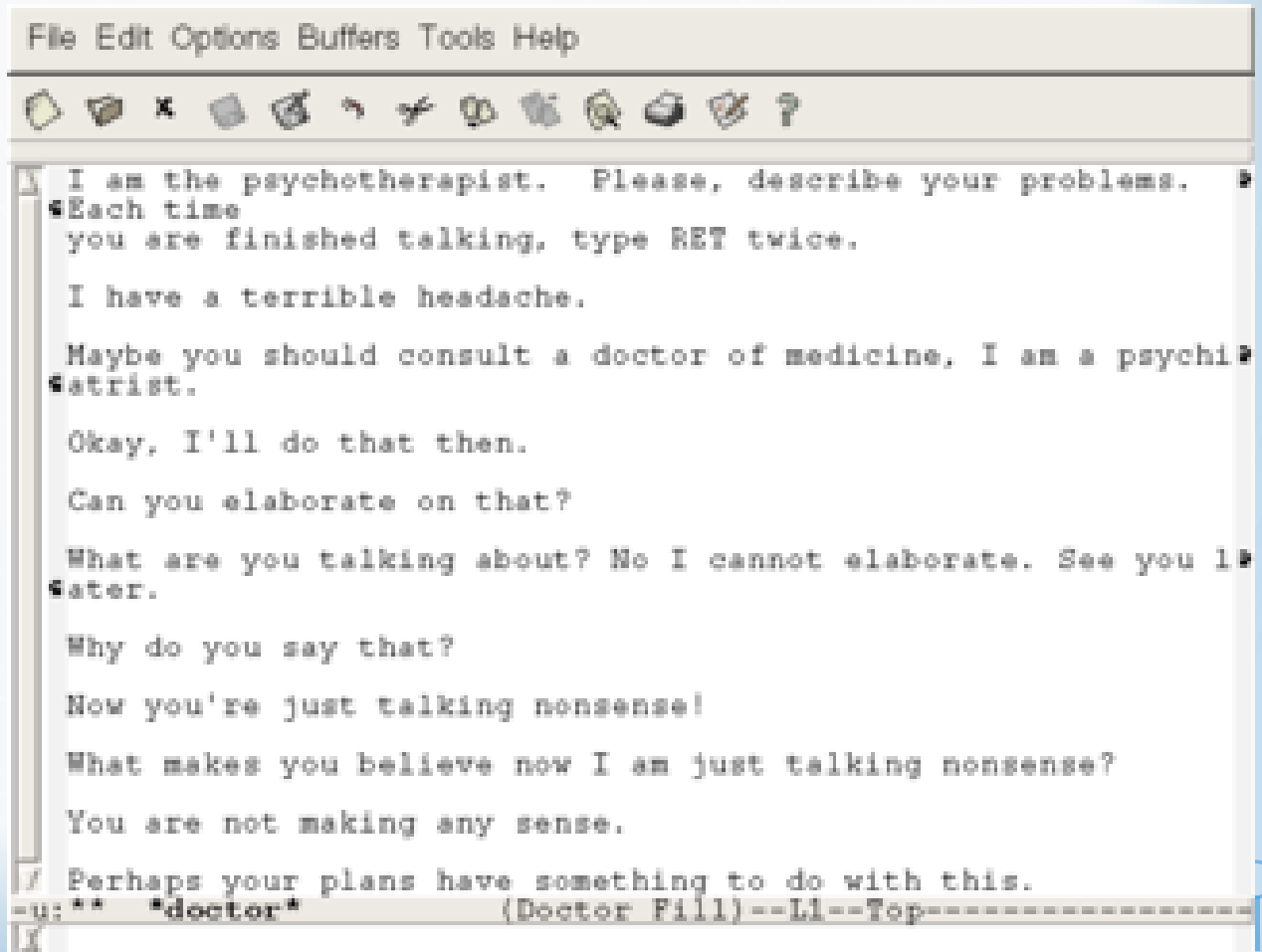
First AI use in Psychiatry

- **ELIZA** programme: created by Weizenbaum (1966) at MIT
 - Simulated conversation by using pattern matching and substitution methodology that gave an illusion of understanding, but had no built in framework for understanding the context of events
 - ELIZA would process user inputs and engage in discourse following rules and directions of a pre-programmed script
 - Modelled to imitate the empathic communication style of psychologist Carl Rogers (Rogers, 1959).

First AI use in Psychiatry

- Most famous script, called **DOCTOR**, simulated psychotherapist: used rules, dictated in the script to respond with non-directional questions to user inputs.

- ELIZA considered one of the first chatterbots



The screenshot shows a window titled "File Edit Options Buffers Tools Help". Below the menu bar is a toolbar with various icons. The main text area contains a simulated conversation between a user and a program named "DOCTOR".

```
I am the psychotherapist. Please, describe your problems.
Each time
you are finished talking, type RET twice.

I have a terrible headache.

Maybe you should consult a doctor of medicine, I am a psychiatrist.

Okay, I'll do that then.

Can you elaborate on that?

What are you talking about? No I cannot elaborate. See you later.

Why do you say that?

Now you're just talking nonsense!

What makes you believe now I am just talking nonsense?

You are not making any sense.

Perhaps your plans have something to do with this.
-u: ** *doctor* (Doctor Fill)--Li--Top-----
```

First AI use in Psychiatry

- Some believed it would positively influence people's lives, particularly those with psychological issues and that it could aid doctors with treatment.
- Colby (1970s) developed a program called **PARRY** that simulated a person with paranoid schizophrenia.
 - It could converse with others via text interface
 - Tests showed that expert psychiatrists were unable to distinguish between PARRY and real patients with paranoid schizophrenia (Teuscher & Hofstadter, 2006).

Why is AI being considered in Mental Health Care?

- Globally, around 264 million people are affected by depression
- Bipolar disorder affects about 45 million people worldwide
- Schizophrenia affects over 20 million people worldwide
- Worldwide, approximately 50 million people have dementia.
- The number of licenced clinicians is not sufficient to deal with these demands required for safe and timely mental health care.
- Therefore, a range of methods employing various AI technologies have been proposed to help alleviate these demands....

Source: James et al. (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*, 392(10159), 1789-1858.

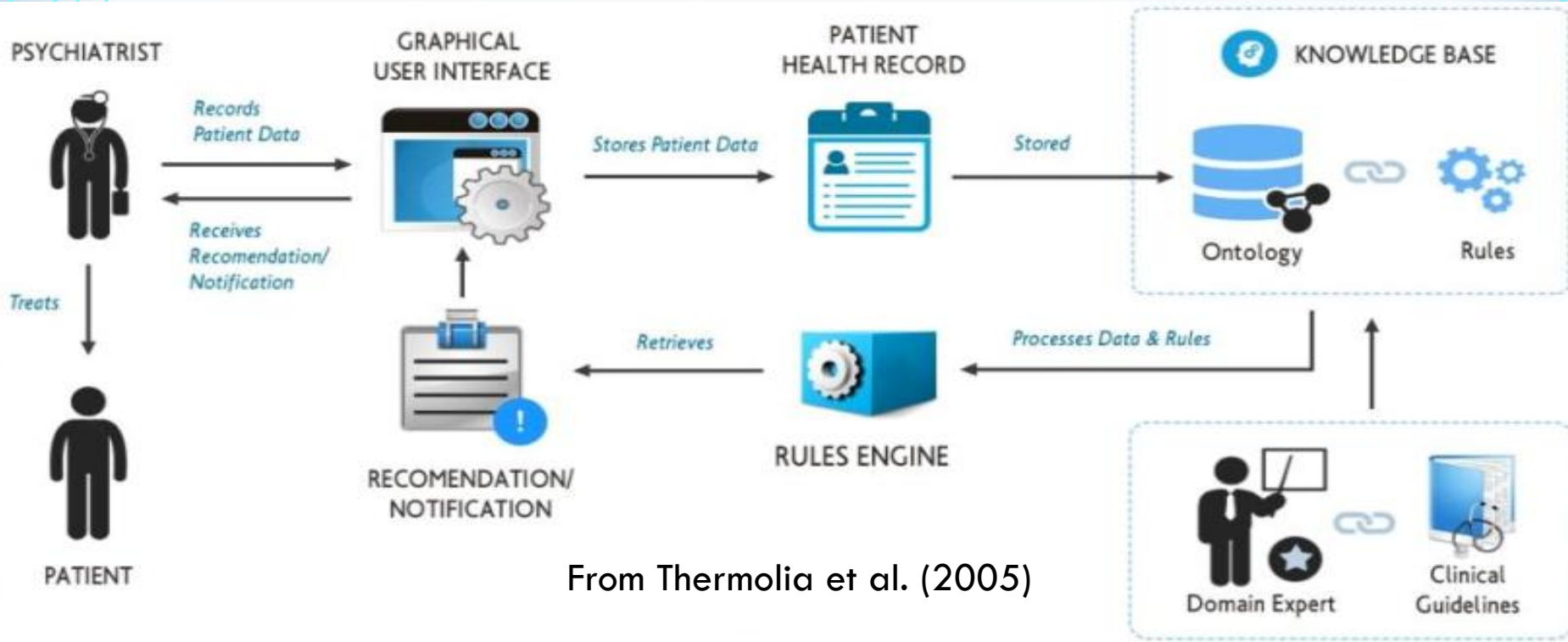
AI use in Mental Health Care

- **Expert systems:** designed to emulate decision making capabilities and performance of human experts – e.g., psychologist, Counsellor.
- They elicit a knowledge base of rules from experts, from which inference about the present state or future could be performed by an end-user via a user interface.
- Uses IF $\rightarrow$ THEN rules
- A multitude of such rules is then used to calculate probabilistic recommendations.

AI use in Mental Health Care

- **Expert systems:** Became implemented in Clinical Decision Support Systems (CDSS):
 - “Any electronic system designed to aid directly in clinical decision making, in which characteristics of individual patients are used to generate patient specific assessments or recommendations that are then presented to clinicians for consideration” (Kawamoto et al., 2005).
- They make use of imputed information from domain experts, clinical guidelines, and data from and about the patient from a variety of sources.

Example CDSS



Kurian et al. (2009): Patients with major depressive disorder treated by physicians employing CDSS had significantly greater symptom reduction, based on the Hamilton Depression Rating Scale than patients treated with usual care

Expert Systems and CDSS: Evaluation

- Use evidence-based guidelines prescribing one-size-fits-all or standardised sequence of options
 - But patients in the real-world show individualised characteristics
 - Not all elements of persons life considered
 - Sometimes based on out-of-date guidelines
 - Suffer from *Knowledge Engineering* problem
 - No matter how many rules, there are always exceptions



Virtual Reality (VR)



- Advances in technology now enable realistic and sophisticated context-relevant environments.
- In an online environment a person can interact with a Virtual Human (VH) who can answer questions about clinical issues, discuss treatment options, guide through self-assessment questionnaires, etc.
- A VH could also be situated at a clinic to conduct an initial interview to start creating a treatment plan followed by a live clinician.



Virtual Reality (VR)



- Can be used in exposure therapy to help patients deal with specific phobias (e.g., social anxiety)
- Patients are exposed to situation using immersive simulations inhabited by “still-life” graphics-based characters (Anderson, et al., 2005; Klinger, 2005)
- Amount and location of simulation is adapted, so intensity of anxiety provoking contexts can be modulated systematically



Virtual Reality (VR)



- Aim = gradually habituate phobic patient to their fear, leading to improved functioning in real world
- Has been used to support and train social and safety skills in those with high-functioning autism (Padgett et al., 2006; Parsons et al., 2012; Rutten et al., 2003)
- And as distracter stimuli for attention assessments conducted in a virtual classroom (Parsons et al., 2007; Rizzo et al., 2006).



AI in Emotion Recognition



- **Is there a link between non-verbal and clinical conditions?**
- Depressed patients usually maintain less mutual gaze (Waxer, 1974), show nonspecific gaze (Schelde, 1998), and avert gaze (Perez & Riggio, 2003)
- Pattern for PTSD is similar, with patients avoiding direct eye contact with the clinician.
- Emotional expressivity, such as the frequency or duration of smiles also diagnostic of clinical state (Bylsam et al., 2008; Fairbanks et al., 1982; Perez & Riggio, 2003; Schelde, 1998).

Link between behaviour and clinical conditions

What do these happy looking smiling people have in common?

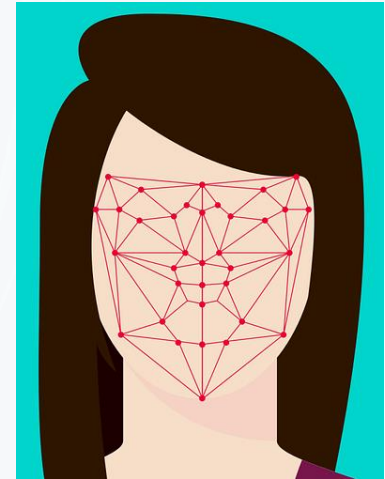


Link between behaviour and clinical conditions

- Total quantity of expression is not important
- Instead the dynamics are key
 - E.g., depressed patients may frequently smile, but these are often shorter in duration and seen as less genuine (Kirsch & Brunnhuber, 2007) than in nonclinical populations.
- Social anxiety and PTSD also have heightened emotional sensitivity and more energetic responses, including hypersensitivity to stimuli (e.g., more startle responses and greater tendency to display anger) (Kirsch & Brunnhuber, 2007)

AI in Emotion Recognition

- Multi-modal approaches now used, usually combining visual (facial expression) and audio (speech content and prosody) channels.
- Physiological signals also incorporated to increase recognition accuracy, primarily signals reflecting activity of the autonomic nervous systems (arousal).

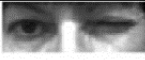
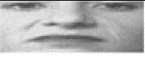
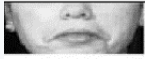
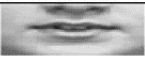


AI in Emotion Recognition

1. Diagnostic information

(Features) extracted from signals recorded by sensors

- If sensor is a webcam, signal is a video.
- Features are the activity of specific facial muscles or Action Units (AUs) (Ekman & Friesen, 1978), such as inner brow raise (AU 1) or the lip pucker (AU 18).

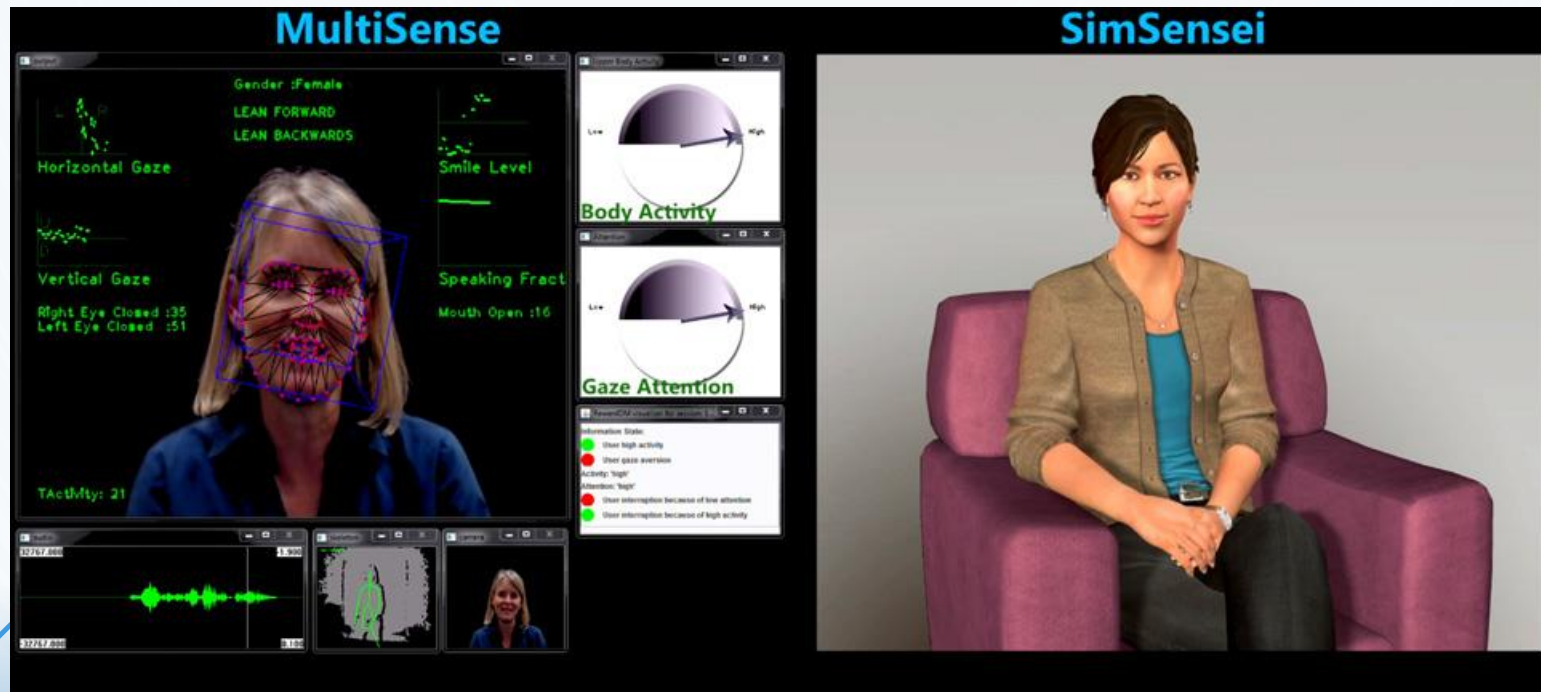
Upper Face Action Units					
AU 1	AU 2	AU 4	AU 5	AU 6	AU 7
					
Inner Brow Raiser *AU 41	Outer Brow Raiser *AU 42	Brow Lowerer *AU 43	Upper Lid Raiser AU 44	Cheek Raiser AU 45	Lid Tightener AU 46
					
Lid Droop	Slit	Eyes Closed	Squint	Blink	Wink
Lower Face Action Units					
AU 9	AU 10	AU 11	AU 12	AU 13	AU 14
					
Nose Wrinkler AU 15	Upper Lip Raiser AU 16	Nasolabial Deepener AU 17	Lip Corner Puller AU 18	Cheek Puffer AU 20	Dimpler AU 22
					
Lip Corner Depressor AU 23	Lower Lip Depressor AU 24	Chin Raiser *AU 25	Lip Pucker *AU 26	Lip Stretcher *AU 27	Lip Funneler AU 28
					
Lip Tightener	Lip Pressor	Lips Part	Jaw Drop	Mouth Stretch	Lip Suck

AI in Emotion Recognition

2. Inferences of mental state from features extracted from signals are conducted.
 - Metrics of AI performance:
 - **Accuracy:** extent to which automated mental state estimates align with objective standard, typically self or observer-reports of the mental states.
 - **Generalizability:** robustness of detectors when applied to data beyond what was used to train supervised classifiers.

Case Example

- **SimSensei:** VH interaction platform capable of sensing and interpreting real-time audio-visual behavioural signals
- Reacts to inferred state of user through analysis of behavioural signals from facial expressions, body gestures, and vocal parameters
 - Through this, it aims to identify behaviours associated with anxiety, depression, or PTSD.



Case Example

- **SimSensei**
- Some research found participants reported willingness to disclose, willingness to recommend and general satisfaction with the system (Lucas et al., 2014; Morency et al., 2015)
- Other research found no significant difference in felt rapport (as reported by the users) between face-to-face interactions with another human and the final AI system (DeVault et al., 2014; Morency et al., 2015)

Robotics in Mental Health Care

- Socially interactive companion robots to assist those with mental health concerns both in clinical and home settings (known as socially assistive robots).
- They have many sensors to perform certain tasks, which can be used to provide data for clinical decision-making in the same way as smart homes.
- E.g., PARO an interactive robotic seal intended as a socially assistive robot (SAR) (Shibata & Wada, 2011).

Picture sourced from PARO Robots website:
<http://www.parorobots.com/index.asp>



Robotics in Mental Health Care

- For those with autism (Scassellati et al., 2012), various studies have utilised interactive robots to explore aspects such as sensory overload (Dautenhahn et al., 2009) and social engagement deficits (Pioggia et al., 2007).
- Marino et al. (2019): Used a RCT to test the role of a human-assisted social robot as an intervention mediator in a socio-emotional understanding protocol for children with ASDs.
 - Children randomly assigned to ten sessions of CBT intervention in a group setting either with or without the assistance of a social robot.
 - Pre- and post-intervention assessments were conducted using the Test of Emotional Comprehension (TEC) and the Emotional Lexicon Test (ELT).
 - Substantial improvements were found through the use of the human-assisted social robots.



Gaming in Mental Health Care

- Computer games developed for training and learning purposes
- Games have the ability to engage players, and provide immersive learning, training and therapeutic environments customised to the user's specific learning needs or therapy goals
- Games used to help children/teens on the autism spectrum learn social skills and manage anxiety (Beaumont & Sofronoff, 2008)
- Schuurmans et al. (2018): RCT to examine effectiveness of a videogame (*Dojo*) for youths in residential care with clinical levels of anxiety and externalizing problems.
 - Results = decreases in self-reported anxiety and externalising problems for those in the *Dojo* condition compared to control
- Games also exist to help treat OCD (Brezinka, 2008)

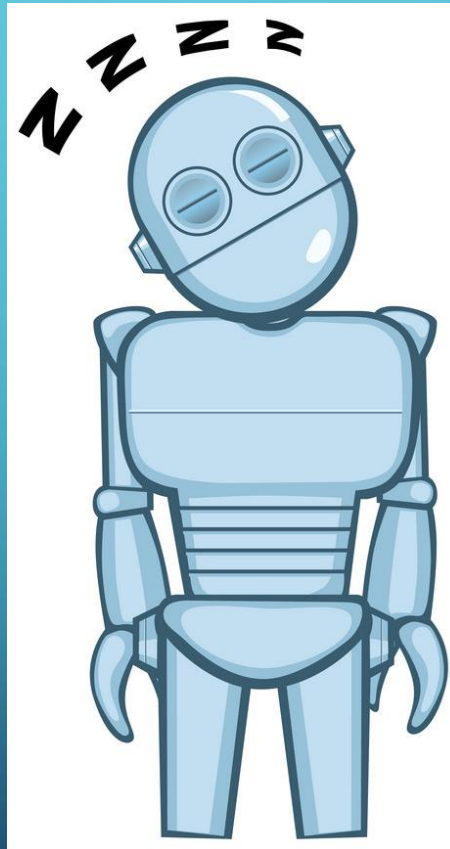


Gaming in Mental Health Care

- They do not work at the level of an experienced, empathic human therapist, and likely never will.
- Instead have a unique role in the delivery of behavioural health care, both supportive of, and distinct from, the roles of human therapists.
- These include....
 - Enhance dissemination of evidence-based treatment
 - Make treatment more accessible (anytime/anywhere)
 - Support treatment between sessions (facilitate homework and skills practice)
 - Adapt to individual needs and cultural preferences
 - Promote engagement and support motivation.



BREAK



DEBATE ACTIVITY

- In groups, prepare a discussion of the positive and negative aspects of using AI in mental health care for both **diagnosis** and **treatment** in relation to the following:
 - Technological/Practical issues
 - Ethical considerations
- Use evidence from empirical literature and research to support your arguments.

Practical considerations

- Is the process user-friendly for clinician and patient?
- Is there a sufficiently large and reliable data set on which to work from?
- Small mental health organisations may not be able to generate significant levels of data
- May need to engage in aggregation and data sharing
- Could be costly and time consuming to set-up
- Transferring paper data into electronic format



Practical considerations

- How can we design and input knowledge into a system when there is disagreement on definitions, classifications and treatments of various mental health disorders?
- Technological ability
- Willingness to engage with technology – both clinicians and patients
- Design
- Cultural considerations

Practical considerations

- Interaction with AI agents (VR, avatars, etc.) can be personalised on physical characteristics (e.g., to age, race, gender, etc.) and personality characteristics.
- For example, an agent interacting with a teen might address the user informally
 - “Hey, are you ok?”
- Whereas an agent interacting with an elderly user would be more formal
 - “How are you doing today, Mrs. Smith?”.

Practical Considerations

Embodied Cognition

- A disembodied brain could not ride a bike.
 - The same can be said for AI.
 - If it does not experience the world in the same way as us, how can it understand our interactions?
-
- Many VH agents are designed to look like humans, but this may interfere with affective realism and believability - a phenomenon known as uncanny valley (MacDorman, 2005; Mori, 1970).
 - A drop in perceived believability due to evaluative criteria shift
 - Cartoonish characters lead to low expectations, while those resembling human appearance, are evaluated more critically
 - When expectations are not met, we feel they are not believable, or, worse, even disturbing.



Philosophical Consideration

Searle's (1980) – Chinese room argument



Influence on Cognition

- Can be positive, as AI offloads cognitive tasks into our environment to allow our minds to focus on more complex issues, and the bigger picture (Clark, 2004).
- However, can also be negative as they can lead to cognitive overload – may be too much information presented or too many different elements to focus on
 - Making it difficult to know what to focus on and what to ignore
- Continuous alerts from an AI system can also lead to alert fatigue

Ethical considerations

- Must ensure key clinical standards are embedded
- Must be seen as decision assistants not makers
- Loss or theft of data collected via AI
- Hackers potentially infiltrating AI systems instructing patients inappropriately or causing further harm
- Who is in charge of regulation?
- Danger of exposing a patient to something traumatic with no human clinician available to deal with negative outcomes
- Potential for misapplication of therapeutic technique
- Could lead to development of inappropriate relationship with AI system (potentially considered as a disorder in itself)

Ethical considerations

- DSM-5 already acknowledges Internet Addiction and Internet Gaming Disorder – could using AI in treatment of certain mental health disorders perpetuate or lead to the development of these or related conditions?
- The area as a whole is severely lacking in RTCs
- Professional healthcare and regulatory bodies (e.g., the BACP, BPS) must stay current with technological developments
- Legal consideration: Relevant laws and regulations
- Privacy