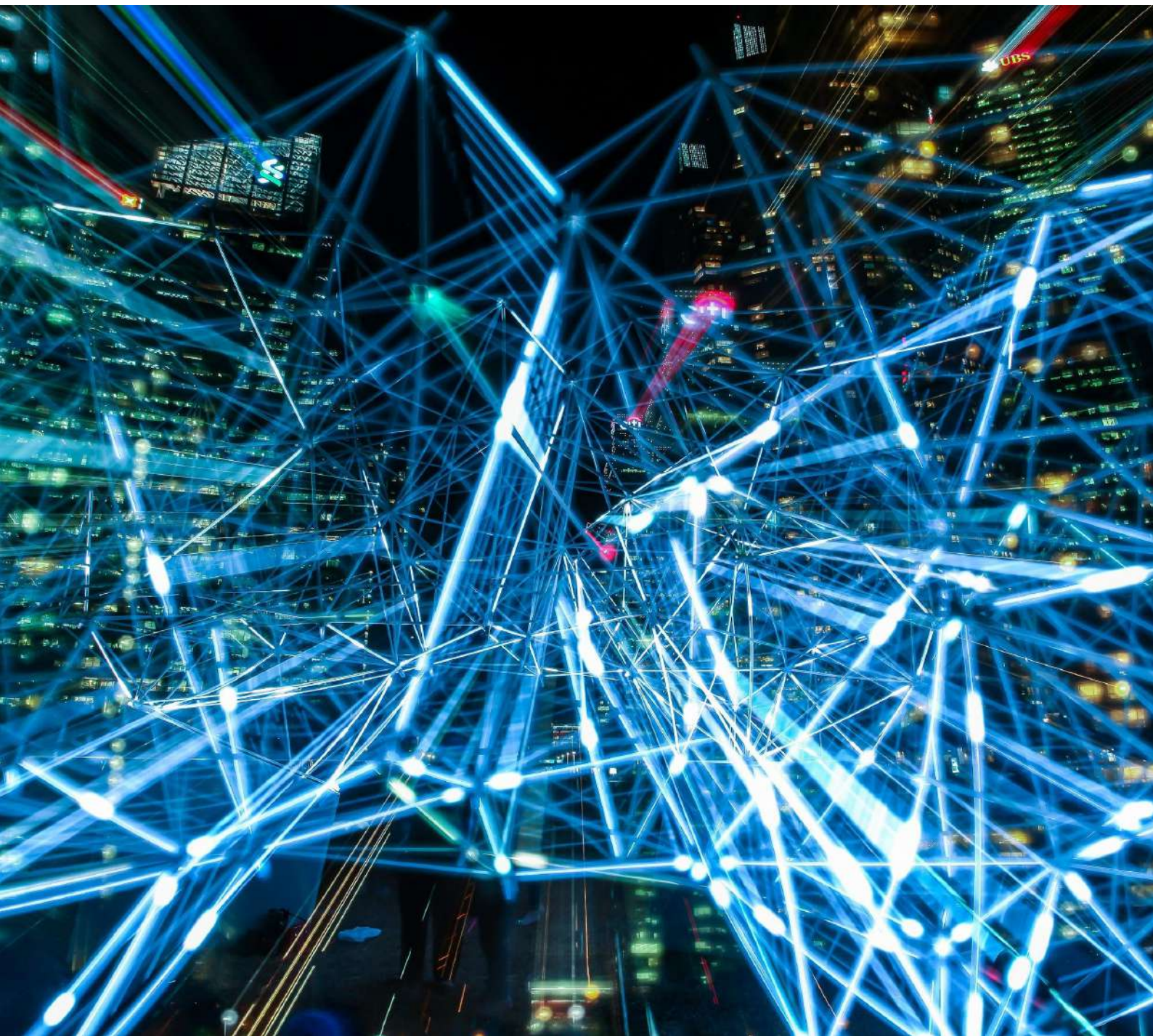# Using Artificial Intelligence (AI) to Modulate Happiness in Social Media Mental Health

Master of Arts | Psychology | Project 3 (January 2022) | Ze Ann Walter Ng

CONTENTS

"It is not if or when, but how we use social media that can influence our overall sense of happiness."

- Professor Derrick Wirtz, The University of British Columbia, Okanagan, Canada

Happiness

As human beings, we all strive for "the good life". How then could we utilize emotion-based approaches in modulating happiness, based on the linguistics in social media posts?

A study conducted by Professor Derrick Wirtz, Psychology Professor of UBC Okanagan revealed that the most frequently used function is passively scrolling through one's news feed without making contact with other users. The effects on happiness and well-being associated with this form of Facebook use were found to be consistently negative.[1]

"Social networks have the potential to improve our well-being and happiness if we use them to enable direct interactions," said Wirtz.[2]

"We live in a world where we have the option of living experiences through virtual reality with the aid of technology. Social media, even though virtual, is our reality," said Hewett Chiu, Adjunct Assistant Professor of Health Administration at New York University's Robert F. Wagner Graduate School.[3]

This paper aims to discover how using Artificial Intelligence (AI) can modulate happiness in social media mental health, preventing depression to escalate to serious concerns and suicide through secondary research.

A significant strength of AI in the mental health domain is its ability to convert new data sources and expand the ability to reach vulnerable populations, to detect people at risk of poor outcomes, to enable early interventions and identify personalised solutions.[4] Ultimately, leading to happiness.

Can we quantify the intensity of emotions, and specifically depression, based on written language or voice recognition, expressed through social media posts, which allows AI to recommend content, in ways highly relevant to well-being and happiness?

[1] C. Sexton, 'How you Use Social Media Affects your Sense of Happiness', *Earth.com*, Colorado, 2020, *https://www.earth.com/news/how-you-use-social-media-affects-your-sense-of-happiness/*, (accessed 6 December 2021).

[2] E. Dawber, 'Research Reveals that Social Media can Make you Happier', *Mind Cafe*, California, 2020, https://medium.com/mind-cafe/research-reveals-that-social-media-can-make-you-happier-63b6be3c1afb, (accessed 7 December 2021).

[3] P. Suciu, 'Why Quitting Social Media may not make you Happier', *Forbes*, New Jersey, 2019, https://www.forbes.com/sites/petersuciu/2019/12/06/why-quitting-social-media-may-not-make-you-happier/?sh=4910f3c637c5, (accessed 7 December 2021).

[4] M. D. Choudhury & E. Kiciman, 'Integrating Artificial and Human Intelligence in Complex, Sensitive Problem Domains: Experiences from Mental Health', *AI Magazine of AAAI*, California, 2018, https://ojs.aaai.org//index.php/aimagazine/article/view/2815, (accessed 8 December 2021).

Emotional Intelligence (EI) & Social Media

Emotional Intelligence (EI) is the ability to identify, assess and regulate one's own emotions, the emotions of others, and that of groups. They are emotionally aware enough to identify and name their emotions as well as channel those emotions to thinking and problem solving. Someone with high emotional intelligence is able to regulate their own emotions as well as others.[5]

In the 1990s, Peter Salovey and John D. Mayer introduced the theory of emotional intelligence and was further developed by Daniel Goldman. The concept, also known as Emotional Quotient (EQ) has gained wide acceptance though some psychologists argue that EQ cannot be captured via psychometric tests. Hence, lacking true explanatory power.[5]

A person with high EI is not impulsive and hasty with their actions. They think before they act and are able to regulate the intensity of an emotion. The emotionally intelligent individuals are able to shift gears and lighten mood, both internally and externally.

The term emotional intelligence is an instance of a standard intelligence that can enrich the discussion of human capacities (Mayer, Salovey, Caruso, & Sitarenios, 2001).[6]

Simply put, some individuals possess the ability to reason about and utilise emotions to enhance thoughts more effectively than others. They also have the ability to engage in sophisticated information processing about one's own and others' emotions and the ability to use this information as a guide to thinking and behaviour, leading to actions. Individuals high in EI is attentive to use, understand and manage emotions, and these skills serve as adaptive functions that could potentially benefit themselves and others (Mayer, Salovey, & Caruso, 2004; Salovey & Grewal, 2005).[6]

The fundamental skill is the capacity to perceive emotions accurately whereas higher level skills include the capacity to manage emotions properly. Whether or not people are sociable or emotional, they can be smart about emotions.

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[5] Psychology Today, 'Emotional Intelligence', Psychology Today, New York, 2021, https://www.psychologytoday.com/intl/basics/emotional-intelligence, (accessed 12 September 2021).

[6] J. D. Mayer, P. Salovey, D. R. Caruso, 'Emotional Intelligence – New Ability or Eclectic Traits?', *American Psychologist*, Washington, 2008, *https://cdn2.psychologytoday.com/assets/attachments/1575/rp2008-mayersaloveycarusob.pdf*, (accessed 29 September 2021).

In understanding social relationships, research on EI suggests that people with high EI tend to be more socially competent, to have better quality relationships and to be viewed as more interpersonally sensitive than those with lower EI (Brackett et al., 2006; Brackett, Warner, & Bosco, 2005; Lopes et al., 2004; Lopes, Salovey, Coˆteˊ, & Beers, 2005; Lopes, Salovey, & Straus, 2003).[6]

Rooting from the perspective that higher EI predicts better social outcomes, lower EI predicts interpersonal conflict and maladjustment. Teenagers with lower EI were rated as more aggressive than others and tended to participate in more conflictual behaviour as opposed to their peers with higher EI in two small-sample studies (Mayer, Perkins, Caruso, & Salovey, 2001; Rubin, 1999). Lower EI also predicted greater drug and alcohol abuse.[6]

Yet, relying on emotional characteristics or any single part of personality alone would leave the individual unbalanced. A truly healthy individual is a functional integration between his or her major psychological processes. All its parts must converge for personality to work. Mental energy – a combination of motives and emotions, coupled with adaptive thinking, leads to effective behaviours, while being guided by self-consciousness (Mayer, 2007).[6]

"People who are uncomfortable with their own and others' emotions may be more comfortable online," said Sara Konrath, PhD, of Indiana University. "We think that they may prefer text-based interactions that allow them more time to process social and emotional information."[7]

Konrath and her colleagues analysed data from four studies of more than 1,200 adult participants and used existing scales that assessed narcissism, empathy, emotional intelligence and emotion recognition. The study also posed questions about the frequency of participants who checked and posted on Facebook, Twitter and Instagram.[7]

According to the study, individuals with lower emotional intelligence, or rather those with difficulty identifying, describing and processing their emotions used social media more often than those who are more in touch with their feelings. This study built upon previous research that has shown that more narcissistic people use social media more often than less narcissistic people. Those who feel overwhelmed by the emotional experiences of others, also spent more time on all three social media sites.[7]

People who scored high on a test of reading others' emotions used Twitter and Facebook less often. More empathic people used Twitter less frequently than those who were not as caring and compassionate toward others. Another interesting finding was people who were more likely be able to see the world from another's perspective did not spend as much time on Facebook and Instagram.[7]

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[6] J. D. Mayer, P. Salovey, D. R. Caruso, 'Emotional Intelligence – New Ability or Eclectic Traits?', *American Psychologist*, Washington, 2008, *https://cdn2.psychologytoday.com/assets/attachments/1575/rp2008-mayersaloveycarusob.pdf*, (accessed 29 September 2021).

[7] Konrath et al. as cited in American Psychological Association, 'Dealing with Digital Distraction', *ScienceDaily*, Maryland, 2018, *https://www.sciencedaily.com/releases/2018/08/180810161553.htm*, (accessed 5 October 2021).

"Peak mental health is about not only avoiding active conditions but also looking after ongoing wellness and happiness." World Health Organisation (WHO)

Positive Mental Health

Mental health comprises of our cognitive, behavioural and emotional well-being. It shapes how we think, feel and behave. It relates to how we handle stress, relate to others and make choices in life. Factors in an individual's lives, interpersonal connections and physical factors can all contribute to mental health disruptions.[8]

According to the World Health Organisation (WHO), "mental health is a state of well-being in which an individual realises his or her own abilities can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community."[8]

WHO emphasise that mental health is "more than just the absence of mental disorders or disabilities."

In the United States, the National Alliance on Mental Illness estimates 1 in 5 adults experience mental health disruptions yearly.[8]

In the United Kingdom, 1 in 4 people will experience a mental health problem of some kind each year in England.[9]

In Malaysia, findings from local studies indicate that prior to the Covid-19 pandemic, 20% of the people in this country experienced symptoms of stress and has increased to 38%. This increase is largely due to the impact of the pandemic, abrupt changes to jobs and sudden loss of income, following the enforcement of the movement control order. According to psychiatrist, Dr Mohd Azhar Mohd Yasin, 2020 and 2021 would be the most emotionally and mentally-wracking years for many people.[10] A sudden decline in one's economic or financial status can be a psychologically unnerving affair.

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[8] T. J. Legg, 'What is Mental Health?', *Medical News Today*, UK, 2020, *https://www.medicalnewstoday.com/articles/154543*, (accessed 14 October 2021).

[9] Mind Infoline, 'Mental Health Facts and Statistics', *Mind Infoline*, UK, 2020, *https://www.mind.org.uk/information-support/types-of-mental-health-problems/statistics-and-facts-about-mental-health/how-common-are-mental-health-problems/*, (accessed 14 October 2021).

[10] D.M.A.M Yasin as cited in The Star, 'Analysis: Mental health issues growing more serious', *The Star*, Malaysia, 2021, *https://www.thestar.com.my/news/nation/2021/07/02/analysis-mental-health-issues-growing-more-serious*, (accessed 14 October 2021).

Jahoda (1958) identifies six conditions associated with ideal mental health, which includes positive view of the self, capability for growth and development, autonomy and independence, accurate perception of reality, positive friendships and relationships and environmental mastery – able to meet the varying demands of day-to-day situations. According to this approach, the more these criteria are satisfied, the healthier the individual is.[11]

However, the absence of this criterion of ideal mental health hardly indicates they are suffering from a mental disorder (Gross 2015) as it is practically impossible for individuals to achieve all the ideal characteristics all the time.[11]

Similar to real life, social media can reveal the onset of depression through alarming social media patterns, such as changes in language and intervals between status updates. The sudden surge of late-night Facebook posts, or uncharacteristic antagonistic comments for seemingly no reason and attention-seeking status updates may all be cues to depression. A Facebook wall can be a window into your mental health, research suggests. Even what users choose to conceal online provide insights into how their brain works.[12] Online activity shows how users express themselves naturally, with fewer filters, social cues and inhibitions. Therefore, it can oftentimes be the first indicator of an emerging mental health challenge, such as depression, anxiety or even dementia. Early warning signs include an excessive amount of time spent online, leaving extremely aggressive comments, late night activity, sudden de-friending or blocking, negative social interactions from others and an addiction to the Internet. It may be easy to conceal depression when you see someone only occasionally but social media patterns can offer indications long before they would have let on in person.

In the realm of the digital space, social media users have posted more frequently about the consequences of the pandemic towards their mental health, Dr. De Choudhury, Associate Professor in the School of Interactive Computing at Georgia Tech said. According to a 2020 article in the International Journal of Information Management, social media users have also posted more regularly regarding their health, particularly conditions relating to Covid-19, encouraging others to take the pandemic seriously.[13]

"There is more acceptance of negative disclosures," said Natalie Bazarova, an Associate Professor of Communication at Cornell University who studies public intimacy. Prior to the pandemic, social media users largely shared positive personal information but over the course of the past 15 months, things have drastically changed. "There is this common circumstance that we're going through, and so that shapes our perception of how we think about what's appropriate."[13]

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[11] Coventry University, 'What is Ideal Mental Health?', *Future Learn*, UK, 2020, *https://www.futurelearn.com/info/courses/defining-mental-health/0/steps/53695*, (accessed 14 October 2021).

[12] A. Heckel, 'Changes in Social Media Posts Can Be a Warning Sign', *Digital Media Treatment and Education Center*, Colorado, 2021, *https://digitalmediatreatment.com/changes-in-social-media-posts-can-be-warning-sign-depression-anxiety-suicidal-isolation-young-adults/*, (accessed 2 January 2022).

[13] K. Cusumano, 'Reset Your Boundaries, Online and Off', *The New York Times*, New York, 2021, *https://www.nytimes.com/2021/05/29/at-home/reassessing-intimacy.html*, (accessed 18 October 2021).

Decipher Moods in Social Media

Moods play a critical role in our daily lives by directing our attention and responses to environment, framing our attitudes and impacting our social relationships. They guide our life experience by directing our focus, influencing our perceptions of self, others and our interpretation and memory of events (Tellengen, 1985).[14]

Emotional states of individuals, also known as moods, are central to the expression of thoughts, ideas and opinions. Consequently, it has an impact towards one's attitudes and behaviour. Generally speaking, moods are complex patterns of cognitive processes, physiological arousal, and behavioural reactions (Kleinginna et al., 1981). Therefore, understanding the rich 'landscape' of moods will help us comprehend and make sense of the behaviour of individuals as they post their happenings on social media. While such shared content on social media may be objective, it can also reflect a user's emotional states (e.g., loneliness, depression).

This study focuses on collecting data on the rich ensemble of more than 200 moods from the popular social media Twitter. Since social media users utilise Twitter to share their opinions and feelings on various topics, it is plausible that the mood about some information needs to be of sufficiently low or high valence to be worth sharing to the audience. The observation that lower valence moods tend to be shared more often might be due to social media users seeking social support from their network in response to various circumstances.[14]

These results also indicate that positive moods appear to be correlated with one being more "social". Positive moods are also associated more frequently with active individuals, while negative (bored, lazy, annoyed, sad) and high arousal moods seem to be shared more frequently by individuals with low activity.

The findings also indicate a difference in the manner in which moods are shared in multiple participation contexts. For link sharing, moods tend to be both positive and of moderate to high activation. On the other hand, @-replies indicate very little in mood expression.

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[14] M. D. Choudhury, S. Counts, M. Gamon, 'Not All Moods Are Created Equal! Exploring Human Emotional States in Social Media', *Proceedings of the International AAAI Conference on Web and Social Media*, WA, 2021, *https://ojs.aaai.org/index.php/ICWSM/article/view/14279/14128*, (accessed 3 October 2021).

Impact of Social Media on Emotional Intelligence among Adolescents

What we consciously or unconsciously choose to consume on social media has a significant impact to our mind and emotions.

A study conducted among 1,200 students in Delhi explored the impact of social media usage on the emotional intelligence of an individual. The results demonstrate that there was so significant difference in internet usage as well as emotional intelligence between males & females.[15]

However, the impact of social media usage was seen to be significant within intrapersonal awareness among all other dimensions and overall emotional intelligence. This is because students who are spending more time on social media are more self-aware as they spend more time to spread awareness about their own thoughts, perspectives and lives, hence, they have higher awareness about their own self.

"With everyday advances in the field social media is no more a luxury, it has transformed into a necessity."
Payar Kanwar Chandel, Central University of Haryana.

Intrapersonal awareness is the ability to know and understand about one's own emotions. On the other hand, interpersonal awareness is knowing about other people's emotions.

Social media has become a platform where social media users portray their happiness, regardless of what is going on in their lives. However, despite attempts to conceal the negatives, we tend to reveal our depressive tendencies through our linguistics in social media and who we follow on social media. De Choudhury & Gamon (2013) postulated that decrease in social media activity and raised negative affect among others may be an indicative of the onset of depression among individuals.[15]

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[15] P. K. Chandel, 'The Impact of Time Spent on Social Media on Emotional Intelligence of Adolescents', *ResearchGate*, Berlin, 2018, *file:///C:/Users/irene/Downloads/SMEIPCNG2018.pdf*, (accessed 16 October 2021).

The Affordances of Social Media to Mental Health

A survey conducted among 101 students of a large public university in the southeast region of the United States revealed 70% had recently experienced some form of stress, anxiety or other mental health challenges correlated to college life. Out of which 50% have reported self-disclosure on social media platforms, indicating the pervasiveness of this expression.[16]

The survey results also revealed that individuals who practice self-disclosure on social media were already challenged by heightened mental health concerns.

The National Alliance on Mental Health revealed 50% of college students who left school due to mental health reasons did not access mental health services and support offered on campus. Similarly, National Survey of Counselling Center Directors reported that 87% of students, who committed suicide in 2010 never reached out for counselling or mental health services provided at their campuses.[16]

Our study reveals that social platforms gave students the ability to find support while still maintaining some level of informality, anonymity and privacy.

Hence, supportive interventions, coping strategies, social support and mitigation programs on social media might decrease the negative effects of mental health and prevent anxiety and depression from becoming a serious concern. Some may even fear that self-disclosure of mental health concerns may lead to biased or negative judgements about them or compromise their privacy.

Social media platforms, which are accessible without geographical boundaries, have begun to offer new opportunities to meet the mental health needs of college students and serve as a social support. A key aspect of web-based communities is access to other users with similar challenging conditions (Eysenbach et al, 2004).[16]

Students argued against complete anonymity in social media platforms for mental health concerns as they recognised the benefits of connecting informally with peers of similar challenges, yet advocate the importance of privacy and boundary regulation mechanisms.

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[16] P. Vornholt, M.D. Choudhury, 'Understanding the Role of Social Media-Based Mental Health Support Among College Students: Survey and Semistructured Interviews', *JMIR Publications,* Toronto, 2021, *https://mental.jmir.org/2021/7/e24512/,* (accessed 16 November 2021).

"I feel anonymity tends to lead to problems of lack of accountability and some people will use that to be funny in sort of a mean way," Freshmen, women, business major.[16]

The cohort of participants who is experiencing higher mental health issues, also used social media more extensively to disclose and obtain support as they seem to have lower access to social support. They seem to express lower self-esteem, higher homesickness, not receiving much empathy, advice or help from their existing support systems. Therefore, they choose to utilise web-based resources.

Participants who obtained value in using social media for mental health help also reported using social media more frequently to communicate with friends and family. Due to higher frequency and usage in social media, students in this cohort felt more encouraged to seek mental health help in a platform they already frequent, in contrast to other cohort who used social media for informational purposes.

For some, social media platform is a place to vent their frustrations with friends and just posting rants on Facebook to release their frustrations, made them feel better. "Friends on social media also help by reminding me of bigger picture things; I just feel like it makes me feel better," said female freshmen.[16]

Social media is also a form of companionship support, through simply liking or commenting on a post, as this helps with mitigating loneliness. The casual yet tangible support from social media family and friends are helpful in alleviating mental health challenges. The interviewed students prefer the informal respond as they view phone calls and texts as more pressing, as compared to a Facebook or WhatsApp message.

Students also expressed both enthusiasm and concerns regarding the anonymity on social media platforms. Some support this feature as it allows disclosure around stigmatised topics. At the same time, some felt anonymity would lower accountability, leading to counterproductive outcomes for mental health. In order to ensure emotional connection, a unique identifier such as academic year, area of study or hobbies may be able to provide context and create means for users to feel connected and engaged.

Trust is an important construct in encouraging mental health disclosures. Students advocated mechanisms to enhance trust, such as information to learn more about help providers to ensure privacy or inadvertent disclosure of personal information to social media users.

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[16] P. Vornholt, M.D. Choudhury, 'Understanding the Role of Social Media-Based Mental Health Support Among College Students: Survey and Semistructured Interviews', *JMIR Publications,* Toronto, 2021, *https://mental.jmir.org/2021/7/e24512/*, (accessed 16 November 2021).

Students also suggested customised and explicit interventions and provisions to support a variety of mental health concerns. For instance, a little "help me" button or suggestions on different levels of actions that could alleviate their mental health concerns. Having said that, students also recognised the need for security and privacy, while balancing the urgency to seek immediate help. Mechanisms can also be put in place to ensure these communities do not amplify negative feelings, but attenuate mental health challenges.

Essentially, social media could act as a catalyst for in-person support, extending a way for students to meet other students online in an informal, real-time setting without feeling stigmatised of their mental health concerns.

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[16] P. Vornholt, M.D. Choudhury, 'Understanding the Role of Social Media-Based Mental Health Support Among College Students: Survey and Semistructured Interviews', *JMIR Publications,* Toronto, 2021, *https://mental.jmir.org/2021/7/e24512/*, (accessed 16 November 2021).
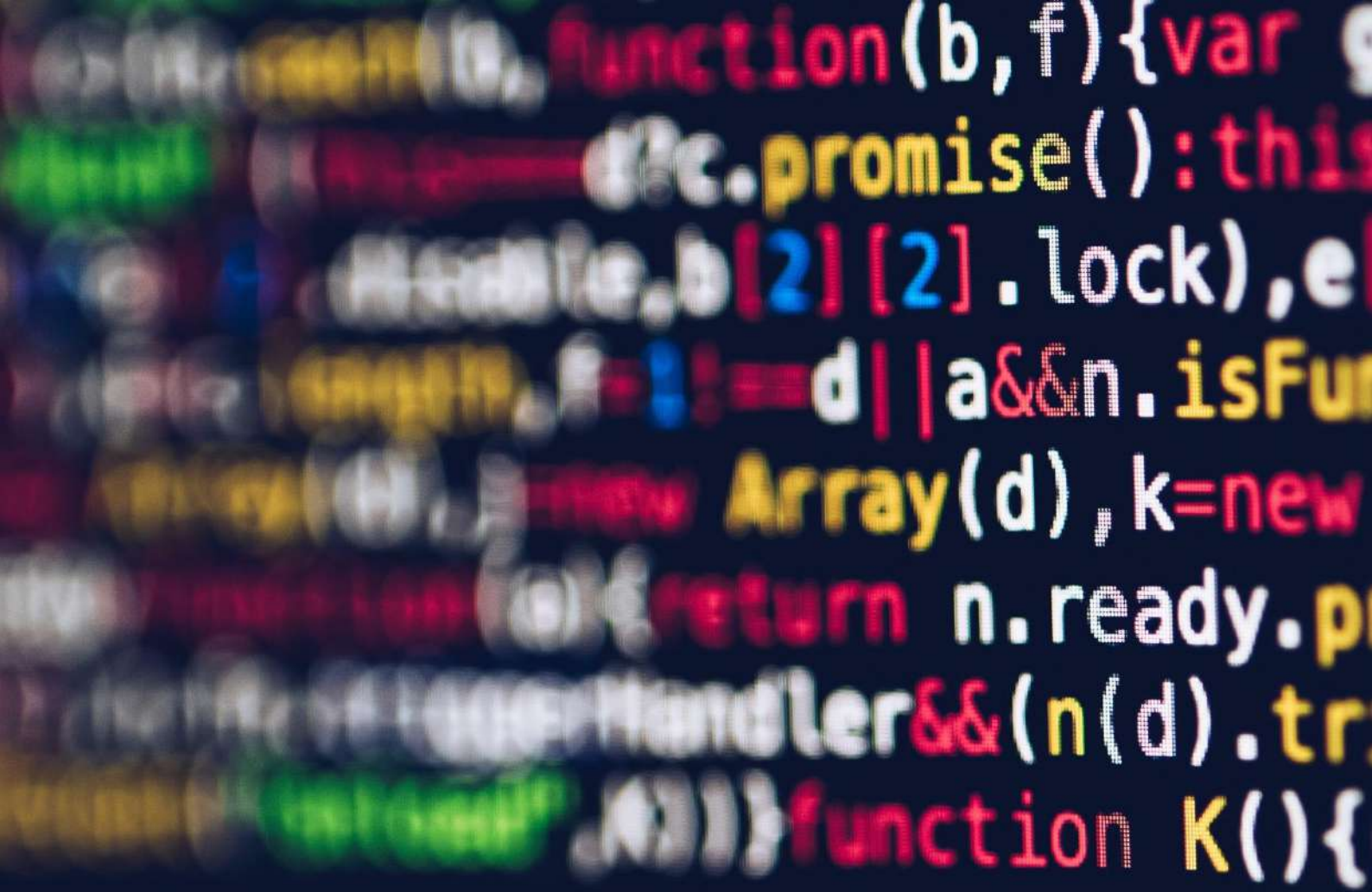
"Algorithms... will be so good at making decisions for us that it would be madness not to follow their advice."

- Yuval Noah Harari, author of "Homo Deus"

Algorithms, Artificial Intelligence (AI) and Machine Learning (ML) in Social Media

Algorithms are any form of automated instruction. An algorithm can either be sequential and predictive or a sequence of more complex mathematical equations. It can be simple and complex, depending on how many layers deep the initial algorithm goes.

Artificial Intelligence (AI) is a set of algorithms that is able to cope with unforeseen circumstances. It differs from Machine Learning (ML) in the sense that it can function with unstructured data. For example, AI robots that can physically navigate the world while avoiding obstacles. It can't predict what circumstances it will encounter, but it can function well with unstructured data. Although variables are unknown and it is very likely to encounter new situations, it does what it should do without any human interference.

ML is a set of algorithms that are fed with structured data in order to complete a task without being programmed how to do so. For example, a credit card fraud detection algorithm is a good illustration of machine learning. In this instance, the data that this particular algorithm receives is structured as banks store data in a fixed format. Hence, if there is a sudden deviation from its predictive variability, it will alert customers and stop the transaction from happening. This type of structured data defines machine learning.[17]

ML is a part of AI. The reason why AI is often used interchangeably with ML is with the data that serves as the input – structured vs unstructured data.

Instagram, a photo-sharing network has integrated an algorithm, called DeepText, whereby it uses AI to evaluate words for meaning and context to detect bullying in photos, captions and comments. Twitter, on the other hand, uses Natural Language Processing and tweet ranking algorithms to analyse a substantial number of tweets every second and predict the popular tweets to attract users. Twitter is also using algorithms to identify racist content and hate speech.[18]

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[17] Quinyx, 'What's The Difference Between AI, ML and Algorithms?', *Quinyx*, Stockholm, 2021, *https://www.quinyx.com/blog/difference-between-ai-ml-algorithms*, (accessed 9 September 2021).

[18] A. Emma, 'The Influence of AI on Social Media', *Media Update*, South Africa, 2020, *https://www.mediaupdate.co.za/social/148541/the-influence-of-ai-on-social-media*, (accessed 21 September 2021).

AI in Mental Health

AI technology for mental health was first discovered in the 1960s with ELIZA, a simple computer program for the study of natural language communication between humans and machine.

AI has since been developed in other areas of mental health, including assisting therapists with diagnosing depression and PTSD among the US armed forces. The integration of AI with smartphone technology has made mental health support more accessible, non-inferior and associated with less stigma.

AI systems such as AI Chatbots is an interactive program that can deliver structured therapies such as Cognitive Behavioural Therapies (CBT) or journaling therapy in a two-way text or voice conversation. These chatbots such as WoeBot or Tess, can establish a therapeutic bond with users as well as teach therapeutic skills that people can apply on their own, similar to actual in-person CBT sessions. In fact, these chatbots can text or email users daily journaling prompts, mood check-in diaries, mindfulness meditation and thought re-assessment.

"There is a shortage of human therapists and they're not available 24/7. They're also not available in remote places, and people are always hesitant to seek mental health treatment because of stigma. For these reasons, there are benefits to using AI because they're always available no matter where you are, and there is no stigma associated with them," said Gale Lucas, psychology researcher at the University of Southern California who studies human-computer interactions.[19]

Besides providing therapy, AI technology can even teach students self-care skills and offer mental health support by directing them to information and even social groups to help engage in campus life, as seen in AskAri, an AI Chatbot developed by Albert "Skip" Rizzo at the University of Southern California.

"Some of our darkest moments happen at 2am, when there's no one there. We designed Woebot to be there for you, to have a tiny conversation that can help you get back to living your life," Alison Darcy, PhD, Founder of Woebot Health.

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[19] L. H Vu, 'Is Artificial Intelligence the Future of Mental Health?', *Psychology Today*, New York, 2021, *https://www.psychologytoday.com/us/blog/talking-about-trauma/202103/is-artificial-intelligence-the-future-mental-health*, (accessed 7 October 2021).

Despite all the benefits, AI Chatbots is not a permanent solution for the in-born human need for social bonding, nor a substitute for the deep connection built between a therapist and client. These "social snacking" temporary fulfils a void for social contact but cannot be compared with in-person therapy.

Still, other concerns on implementation, frequency, responsibility, accountability, data and ethical implications need to be further researched.

Predictive Algorithms in Social Media

Let's dive into machine learning algorithms applied to large data sets, allowing for scalable, unobtrusive impact of well-being and other psychological constructs at the population level in the context of social media.

Predictive algorithms most frequently encountered as suggesting systems, for example Google Now and Netflix, may soon provide more general insight that resemble those of coaches. It may even make highly accurate predictions about major life decisions in highly personal domains like work and love, both of which have a tremendous influence on well-being.

One of the biggest advantage algorithms have over human cognition is in its ability to detect and learn to avoid a mistake based on a few occurrences, then, this new algorithmic insight will be added into its entire user base. For example, when a self-driving car have a new insight, all cars within the system learns the new insight, as opposed to human drivers who operates individually.

Likes on Facebook can now predict social orientation, ethnicity and political orientation (Kosinski et al, 2013).

Hence, algorithms are different than human decision-making as it compounds the ease of learning, sensitivity and specificity of decision making and generalizability of the learning.

Combining all the digital footprints, algorithms are able to predict various psychological traits of users with a high degree of accuracy. The linguistic content shared in Facebook posts (the platform will remain as Facebook, while the company is known as Meta) can be used to predict the Big Five personality traits (Park et al., 2015), gender (Park et al., 2016), and the linguistic features used for prediction may potentially reveal compelling features of constructs, such as for religious affiliations (Yaden et al., 2017a).[20]

Relating to this, a variety of papers have postulated the possibility of detecting mental health states from social media (Guntuku et al., 2017) as well as physical health issues of communities such as heart diseases (Eichstaedt et al. 2015).[20]

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[20] Yaden et al., 'The Future of Technology in Positive Psychology: Methodological Advances in the Science of Well-Being', *Frontiers in Psychology*, Switzerland, 2018, *http://wwbp.org/papers/advances_in_wellbeing2018.pdf*, (accessed 26 August 2021).

Perhaps in the near future, this increased capability for psychological measurement based on big data, predictive algorithms are able to suggest and tailor interventions.

When algorithms are ingesting text messages and social media messages, it is able to predict, detect and digest depression relapse or the potential onset of manic episodes, therapeutic interventions or targeted posts may be initiated immediately.

Health coaching algorithms may even personalised advice and recommendations on how to increase psychological well-being. For example, social media apps might recommend posts which suggest messages to users like "sleep more!" or "your interactions with Alice increases your stress level" or "Bob calms you down and lifts your mood".

[20] Yaden et al., 'The Future of Technology in Positive Psychology: Methodological Advances in the Science of Well-Being', *Frontiers in Psychology*, Switzerland, 2018, *http://wwbp.org/papers/advances_in_wellbeing2018.pdf*, (accessed 26 August 2021).

How Algorithms Determine How I Feel

"To hack human beings, you need two things. You require a lot of data, especially biometric data – what is happening inside your body and what is inside your brain. Second, you need computing power to make sense of all the data," Yuval Noah Harari, author of 'Homo Deus: A Brief History of Tomorrow'.[21]

"On the one hand, biologists are deciphering the mysteries of the human body and, in particular, of the brain and of human feelings. At the same time, computer scientists are giving us unprecedented data-processing power. When you put the two together, you get external systems that can monitor and understand my feelings much better than I can," Harari added.[21]

In Homo Deus, Harari (2016) also pointed specifically to the increasing capacity of technologies to modulate mental states and for algorithms to influence decision making in ways highly relevant to well-being. Harari believes that advances in biological and information technology may exert such substantial influence that individuals could fundamentally have a different experience of life.

The aspect of technological dystopia that grips him the most is losing mental autonomy to AI. Harari also refers to recent research suggesting the possibility to measure an individual's blood pressure by processing video of their faces.[23]

"Once Big Data systems know me better than I know myself, authority will shift from humans to algorithms," Yuval Noah Harari.[22]

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[21] The 2 Most Important Skills For the Rest Of Your Life, [online video], *Impact Theory*, 13 November 2018, < https://www.youtube.com/watch?v=x6tMLAjPVyo>, accessed August 25, 2021.

[22] Y. N. Harari, 'Yuval Noah Harari on big data, Google and the end of free will', Financial Times, UK, 2016, https://www.ft.com/content/50bb4830-6a4c-11e6-ae5b-a7cc5dd5a28c, (accessed 25 August 2021).

[23] I. Parker, 'Yuval Noah Harari's History of Everyone, Ever', *The New Yorker*, New York, 2020, https://www.newyorker.com/magazine/2020/02/17/yuval-noah-harari-gives-the-really-big-picture, (accessed 5 September 2021).

Sentiment Analysis

Simply put, sentiment analysis is the practice of defining whether a statement has a negative, positive or neutral sentiment.

Another use of AI and ML is sentiment analysis, as the algorithms can decipher through tons of data. The more data an algorithm deciphers, the higher the accuracy. Hence, sentiment analysis software is used to gather the mentions of a particular keyword online.

More advanced sentiment analysis can even discern whether the message is emotionally sad, happy or angry.

Based on certain words, sentiment analysis can discern the author's feelings towards something, by assigning a sentiment to the said views and opinions.

Sentiment analysis is based on Natural Language Processing (NLP), computational linguistics and text analysis. The study of meaning – semantics and the rules of a particular language – syntax are the two broad schools, which contributes to analytics.[24]

Sentiment analysis tools can recognise the emotions accurately around 85% of the time. There are three main components of sentiment analysis. First, the fine-grained method, which involves the classification of sentiment on a five-point scale – very negative, negative, neutral, positive and very positive. This demonstrates more accuracy as opposed to the regular two-way dichotomy.

Second, sentiment analysis for emotions to distinguish between the subtle feelings. Third, aspect-based where it captures the nuance in opinions about products or services within the context.

Sentiment analysis is widely used to keep track of competitor's social media efforts, to detect employee's concerns, customer's brand sentiments and even in politics.

On social media, humans are cognitively processing these sentiments, based on our experiences and understanding of social norm. With sentiment analysis algorithms, it merely speeds up this process to gather and categorize these emotions.

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[24] J. Suski, 'What is Sentiment Analysis? – AI in Social Media', *Inkbot Design*, UK, 2021, https://inkbotdesign.com/sentiment-analysis/, (accessed 25 September 2021).

"**We are now hackable animals. We have the technology to decipher.. what you think, what you want, to predict human choices, to manipulate human desires in ways which were never possible before.**"

- Yuval Noah Harari, New York Times bestselling author on Impact Theory

AI as suicide prediction among youth

A new study aims to better understand and detect the onset of self-harm or suicidal thinking and behaviour through their online experiences, leveraging on the power of AI. The data was collected by Bark, a parental and school monitoring app which is able to monitor a child's online activity.[25]

Like a Google search for suicide methods or harassment messages among peers, it flags concerns to the child's caregiver or school officials. A team of scientists drew data from a sample of more than 2,600 school districts and identified 227 youth whose online activity indicated they were contemplating or had completed either act.

Through these data, researchers found a correlation between suicide attempts and self-harm to the following types of content: cyberbullying, violence, drugs, hate speech, profanity, depression, low-severity self-harm and sexually suggestive language or image. Signs of ongoing depression, for instance expressions of hopelessness and negative self-esteem had the strongest association amongst the risk factors.

Cyberbullying was the most prevalent experience and often revealed in the form of name-calling, mean-spirited comments and threatening messages. When a student experienced five or more of those risk factors mentioned, they were 70 times more likely to commit a suicide attempt or self-harm alert.

"This research shows that red flags related to youth mental health can be spotted earlier." Said Dr. Steven Sumner, the study's lead author and senior advisor for data science and innovation at the CDC's National Center for Injury Prevention and Control.

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[25] R. Ruiz, '8 Online Experiences linked to Suicide in Kids and Teens', *Mashable*, UK, 2021, https://mashable.com/article/youth-suicidal-behavior-internet-risk-factors, (accessed 20 October 2021).

The study is thought to be the first of its kind to leverage on the power of AI to track specific types of internet activity and may even open up new opportunities to connect with and help youth.

The study shows promising results of AI monitoring as a suicide-prevention tool for youth, who may not share their deepest feelings or struggles with an adult.

Still, this tool is not a replacement of parents' or caregivers' eyes on the child, as illustrated by Dr. Nance Roy, Ed.D., chief clinical officer of the youth suicide-prevention non-profit, The Jed Foundation. The Foundation works with school and colleges to reach out to youth via developing life skills, promoting social connectedness and ensuring student have access to effective mental health treatment.[25]

Roy also cautioned parents should not deceive the child by monitoring their online activity without their knowledge. Instead, equip themselves with knowledge to be able to identify signs of suicidal thinking or behaviour, which included prolonged withdrawal from hobbies, friends, sudden changes in eating and sleeping patterns, as well as alcohol and drug abuse.

Similar to offline life, humans are governed by patterns of behaviour, which are highly influenced by moods and experiences in the physical and social environment. Building on this perspective, the subtle change in online patterns of behaviour in social media could indicate mental health status. Potentially, AI could be used to detect the nuance of online patterns of behaviour, which may prevent the onset of harmful behaviours. For instance, a user who mentioned or implied self-harm tendencies, followed by a sudden withdrawal of social media may lead to someone being notified.

As critics of AI in public health identify concerning trends, the work of building prediction algorithms to save lives must address the pitfalls and unintentional bias of AI.

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[25] R. Ruiz, '8 Online Experiences linked to Suicide in Kids and Teens', *Mashable*, UK, 2021, https://mashable.com/article/youth-suicidal-behavior-internet-risk-factors, (accessed 20 October 2021).

Introduction to Linguistics in Social Media

Linguistics is the scientific study of language. Through expanding our linguistics, we increase our knowledge and understanding of the world we live in. Language covers a broad area with multiple layers, from the sounds that speakers produce to the meanings that those sounds are expressed.

Some of the major Linguistics sub-fields are phonetics (the production of speech sounds by the human speech organs and the properties of sounds), phonology (the study of language sound systems), morphology (the study of word structure), syntax (the study of how linguistics units larger than the word are constructed) and semantics (the study of meanings in language).[26]

There are other sub-fields such as historical linguistics (the study of how languages change over time), sociolinguistics (the study of how language is being used in society), psycholinguistics (the study of how language is being processed in the mind), neurolinguistics (the study of actual encoding of language in the brain) and computational linguistics (the study of computing the properties of language that are described in phonology, syntax and semantics). Computational linguistics build systems that can perform tasks such as speech recognition (e.g., Siri), machine translation (e.g., Google Translate) and grammar checking.[26]

Social media posts contain expressions of positive emotion as they present a positive version of themselves through their posts (Liu et al. 2015). Computer scientists then use existing linguistics of human emotions such as joy, sadness or anger and build language-based predictive models of these emotions. "Joy" is considered the nearest proxy to a measurement of happiness (Mohammad, Kiritchenko, and Zhu 2013).[27]

Recent studies have criticised positive emotions linguistics on social media posts are insufficient to measure user's 'real' happiness (Kramer2010; Chen et al. 2017; Lin, Tov, and Qiu 2014).[27]

The expressions of happiness in writing also do not stem from the use of positive emotions alone. The findings suggest that the affordances of agency and social interaction are two very crucial elements in the language of happy moments and perhaps in the experience of happiness. These findings contribute to a growing body of work that postulated how social media posts indicate mental health and psychological well-being, similar to those that are captured through self-reported surveys (Guntuku et al. 2019; Jaidka et al. 2018).[27]

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[26] The Department of Linguistics, 'What is Linguistics?', *Humanities Division within UCLA College of Letters and Science, University of California*, California, 2021, https://linguistics.ucla.edu/undergraduate/what-is-linguistics/, (accessed 8 September 2021).

[27] Liu et al. as cited in Jaidka, K., Chhaya, N., Mumick, S., Killingsworth, M., Halevy, A., & Ungar, L., 'Beyond Positive Emotion: Deconstructing Happy Moments Based on Writing Prompts', *World Well-being Project, University of Pennsylvania*, Philadelphia, 2020, https://ojs.aaai.org/index.php/ICWSM/article/view/7300/7154, (accessed 23 August 2021).

Linguistics in Facebook predicts Depression

Depression, the most prevalent mental illness, can be detected using the language from Facebook posts of consenting individuals to predict depression recorded in electronic medical records.

Predictive language of depression includes references to typical symptoms, including sadness, loneliness, hostility, rumination and increased self-reference. Cognitively, depression is associated with perseveration and rumination, specifically on self pre-occupation information, which indicates anticipatory anxiety.

A study was done by accessing the history of Facebook statuses posted by 683 patients, out of which 114 of who had a diagnosis of depression in their medical records. For each 114 patients, 5 random control patients without a diagnosis of depression in the electronic medical record (EMR) was identified. This allowed comparison of control patients' data vs depressed patients data, across similar time span and to model the prevalence of depression across larger population.[28]

This study suggests, in the near future, the analysis of social media language could serve as a scalable front-line tool to identify the onset of depressed individuals.

This study demonstrates that the content shared by consenting social media users on Facebook can predict a future occurrence of depression in their medical records. It also suggests that an analysis of social media data could be useful to identify the potential onset of depression and may even point clinicians to specific symptoms of depression.

This present analysis postulates that social media-based prediction of future depression status may be feasible as initial as 3 months before the first documentation of depression in medical records. This study reveals the associations between social media content with mental health symptoms.

Therefore, unobtrusive assessment through social media of consenting individuals may be possible as a scalable complement to existing screening procedures to detect the onset of depression. This could reduce the total extent of functional impairment experienced during the depressive episode.

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[28] Eichstaedt et al., 'Facebook language predicts depression in medical records', *Positive Psychology Center*, University of Pennsylvania, Philadelphia, 2018, http://wwbp.org/papers/eichstaedt2018facebook.pdf, (accessed 29 August 2021).

Another study reviewed by Guntuku et al. (2017) aimed at predicting mental illness using social media suggest that depression and other mental illness are detectable on several online environments. However, the generalizability of these studies to broader samples and gold standard clinical criteria needs to be clearly identified.[29]

Automated analysis of social media is achieved through building predictive models, using an algorithm, which use 'features' or variables extracted from social media data. This includes language frequencies, time of posts, use of hashtags, mentioning depression-related terms throughout the year preceding depression onset etc. The prediction of depression among social media users were identified using self-report survey responses, self-declared mental health status on Twitter, or via online forum.

Few realised the amount of mental health related information that can be gleaned from one's digital footprint. Possibly, the greatest potential of social media analysis may be the detection of undiagnosed cases. Online social media data may be able to 'fill in the gaps' with ongoing in-the-moment gauge of a wide range of users' thoughts and feelings. Having said that, it is also plausible that depressed users may refrain from generating social media content; hence, uninterrupted information such as text messages and sensor data should also be deployed.

[29] Guntuku et al., 'Detecting depression and mental illness on social media: an integrative review', *ScienceDirect*, 2017, https://wwbp.org/papers/detecting_depression_twitter_2017.pdf, (accessed 2 September 2021).

Anticipate Depression via Social Media

The emotion and language in social media postings may even indicate feelings of worthlessness, guilt, helplessness and self-hatred which characterises MDD.

Another study conducted by Choudhury et al. (2013) reveals that social media contains beneficial cues for identifying the onset of depression among social media users prior to the reported onset. This can be done through analysing the decrease in social activity, increase in negative emotions, high self-attentional focus, heightened relational and medicinal concerns as well as greater expression of religious involvement.[30]

Nearly 300 million people suffer from depression worldwide (World Health Organization, 2001). However, there is insufficient laboratory test for diagnosing mental illness, in fact, most diagnosis is based on patient's self-reported experiences or behaviours reported by loved ones and a mental status examination.

This study explores the potential of utilising social media as a tool in detecting and predicting affective disorders in individuals, focusing on Major Depressive Disorder (MDD). MDD is identified as episodes of low mood, accompanied by low self-esteem, loss of interest or pleasure in normally enjoyable activities. Individuals experiencing MDD tend to focus on unhappy thoughts, interpret ambiguous information negatively and ruminate on pessimistic beliefs (Kessler et al., 2003; Rude et al., 2004).[30]

Social media is increasingly utilised as a platform to share one's deepest thoughts and opinions with their contacts. The nature of the platform is in its ability to capture the presence and absence of daily activities and happenings provides a means for capturing behavioural attitudes, which reflects an individual's thinking, feelings, communication and social milieus. Social media may even reflect changing social ties; hence, the nuance in social media language, activities and social ties may be used to construct, detect and predict MDD in ways that may complement and extend traditional approaches in diagnosis.

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[30] Choudhury et al., 'Predicting depression via social media', *Proceedings of the Seventh International AAAI Conference on Weblogs and Social Media*, 2013, file:///C:/Users/irene/Downloads/6124-30360-1-PB.pdf, (accessed 15 September 2021).

Leveraging on the multiple types of indicators obtained, this study demonstrated that it can predict ahead of MDD onset time, whether an individual is vulnerable to depression through an MDD classifier. The models revealed in predicting outcomes with an accuracy of 70%.

The study seeks responses to questions such as, "I thought my life was a failure", "I felt lonely", "I had crying spells".[31]

Diurnal pattern of posting is another key indicator to depression. For the non-depression class, most people are less active later in the night (i.e. post-midnight) and early in the morning. Evenings and early nights show peak, indicating that people are generally more likely to engage in social media after the end of work day.

On the other hand, for the depression class, most indicates peaks late in the night (post 8pm) with lower activity through the day (between 9am and 5pm). Lustberg & Reynolds (2000) posited that 8 out of 10 people suffering from depression symptoms tend to worsen during the night. In fact, night time online activity is a known characteristic of depressed individuals, which explains the increased levels of night time postings on Twitter.[31]

Using reviews from experts interpreting themes with sociocognitive model of suicide (Rudd 1990), it is possible to understand what risk marks or suicide are manifested through social media. To what extent the linguistic cue clusters align with what is known from existing theories in the psychology domain in order to alleviate the risk of suicidal ideation. For instance, a common theme sounds like "have nothing," "no real," "kill myself," "abandoned," and "die" which experts link the correlation to signals of hopelessness among social media users.[32]

According to Dieserud et al. (2001), the cognitive psychological integrative model of suicide has identified hopelessness as a mediating variable between mental illness and suicidal ideation and how hopelessness is an indicator for both current suicide intent and a predictor of future suicidal behaviour (Kashden et al. 1993; Glanz, Haas, and Sweeney 1995).[32]

Cognitive suicide model also suggests that impulsivity resulting from cognitive deficits (e.g. cognitive rigidity, dichotomous thinking, inability to generate or act on alternative solutions) are prominent markers of suicide ideation (Beck 1979; Kashden et al. 1993). Low self-esteem, self-efficacy (Schwarzer and Fuchs 1995), feelings of social isolation and loneliness, conceptualised as part of the cognitive vulnerability have been shown to be related to suicidal ideation, attempts and completions (Bonner and Rich 1998).[32]

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[31] M.D. Choudhury et al., 'Predicting depression via social media', *Proceedings of the Seventh International AAAI Conference on Weblogs and Social Media*, 2013, file:///C:/Users/irene/Downloads/6124-30360-1-PB.pdf, (accessed 15 September 2021).

[32] M. D. Choudhury & E. Kiciman, 'Integrating Artificial and Human Intelligence in Complex, Sensitive Problem Domains: Experiences from Mental Health', *AI Magazine of AAAI*, California, 2018, https://ojs.aaai.org//index.php/aimagazine/article/view/2815, (accessed 8 December 2021).

This research demonstrates that while AI approaches have made and continue to make significant impact in mental health domains, the involvement of natural intelligence in the form of human feedback is crucial to the success of these efforts. Human involvement will help translate and contextualise the potential benefits to real world mental health context, instead of automatic deployment of described AI approaches.[32]

With the human-machine mixed initiative approaches, technologies can be developed to allow clinicians to monitor patients' symptoms and identify patterns of adverse health effects in the future.

Inaccurate interpretation (e.g., what does mental health risk really mean), inappropriate use (e.g., using them directly in treatments), disregard of the underlying assumptions (e.g. every individual is different, and so is their social media use and mental health state) of the output may cause substantial consequences.

Therefore, the involvement of humans is critical to ensure that technologies such as AI function effectively in a way which is accountable, interpretable, actionable and transparent.

Social media users whose posted content may contain linguistic constructs relating to mental health concerns, as revealed by AI-based methods can be brought to the attention of community moderators and clinical experts, thereby involving a human "in the loop". Social media users forecasted by AI methods who could be prone to risk in the future, can be maintained in a "risk list", and would allow moderators and experts to connect them with mental health resources or private messages with relevant information.

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[32] M. D. Choudhury & E. Kiciman, 'Integrating Artificial and Human Intelligence in Complex, Sensitive Problem Domains: Experiences from Mental Health', *AI Magazine of AAAI*, California, 2018, https://ojs.aaai.org//index.php/aimagazine/article/view/2815, (accessed 8 December 2021).

Predicting Depression through Instagram Photos

A study conducted with Instagram data from 166 individuals, identified markers of depression through harnessing the wealth of psychological data encoded in visual social media, using machine learning tools.[33]

This research incorporated an ensemble of computational methods from machine learning, image processing and other data-scientific disciplines to process useful psychological indicators from Instagram users' posted photographs, without additional human input.

These results held even when the analysis was restricted to posts made before depressed individuals were first diagnosed, and even outperformed general practitioners' average unassisted diagnostic success rate for depression (42%).[33]

Depressed individuals were found to prefer darker (lower brightness), greyer colours (lower saturation) and bluer (higher hue) as opposed to mental health, healthy individuals who generally preferred brighter, more vivid colours.

Depressed individuals showed an aversion to artificially lightening photos, compared to non-depressed controls.

Barrick, Taylor and Correa also found a positive correlation between self-identification with depression and a tendency to perceive one's surroundings as grey or lacking in colour.[33]

As depression is strongly associated with reduced social activity, a face detection algorithm was used to analyse Instagram posts for the presence and number of human faces in posted photographs. Depressed participants were more likely to post photos with faces, but tended to post fewer faces per photo, in comparison to healthy participants.

Community engagement is also measured through number of counts of comments and likes each post received. User engagement is measured through posting frequency. The more comments Instagram posts received, the more likely they were posted by depressed users, but the opposite was true for likes received. Photos posted to Instagram by depressed individuals receive fewer likes, in line with findings from Epstein et al. who posited depressed individuals 'had difficulty reconciling a self-image as an 'outgoing likeable person', linking to likability.[33]

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[33] A. G. Reece & C. M. Danforth, 'Instagram photos reveal predictive markers of depression', *EPJ Data Science*, London, 2017, https://link.springer.com/content/pdf/10.1140/epjds/s13688-017-0110-z.pdf, (accessed 24 December 2021).

Higher posting frequency was also associated with depression. Depressed users were also more likely to post photos with faces but had a lower average face count per photography, as compared to healthy users. Depressed users were found to be less likely to apply Instagram filters to their posted photos. In fact, depressed users were less likely to use any filters at all. When they do employ filters, they most likely favour 'Inkwell' filter, which converts coloured to black and white images.

This study shows that markers of depressions are evident in Instagram user behaviour and that these depressive signals are detectable in posts made even before the date of first diagnosis. The findings also established that visual social media data are highly valuable to analysis of affect using scalable, computational methods.[33]

However, the findings reported here should not be taken as enduring facts, but rather as promising leads upon which to build and refine subsequent models for further research.

Given that mental health care is unavailable or underfunded in most countries, there are possibilities for mental health care, requiring only users' digital consent to share their social media histories.

In an increasingly digitalised society, these findings support the notion that major changes in the psychology of social media users are expressed through social media use, can be identified via computational methods to complement clinical diagnosis of depression.

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[33] A. G. Reece & C. M. Danforth, 'Instagram photos reveal predictive markers of depression', *EPJ Data Science*, London, 2017, https://link.springer.com/content/pdf/10.1140/epjds/s13688-017-0110-z.pdf, (accessed 24 December 2021).

> "If AI can be used for commercial benefits, what would the digital world look like if we leverage AI for mental health benefits?"

Emotion Artificial Intelligence (AI)

This Emotion AI technology could potentially be used to monitor the progress of depression, a condition that is extremely hard to monitor.

The potential of human emotion computing – devices that can detect, interpret and adjust to human emotions. This technology relies on data-centric techniques known as machine learning, algorithms that process data to learn how to make decisions in order to attain more accurate affect recognition.

"Using data, an app on a smart phone or smart watch could help someone suffering from depression to give their loved ones daily updates on their mood and how they're doing," says Daniel McDuff, a researcher at Microsoft.[34]

Emotion sensing technology can alter our human experience by helping to improve our wellness and well-being. These emotion aware devices can leverage on this emotion layers and improve the user experience.

Having said that, this emotion recognition technology should not be used in decision that may impact people's lives and access to opportunities, such as hiring decisions or pain assessments as it may lead to biased decisions.

Some limitations to these algorithms are in its inability to detect contextual cues, as emotions are expressed not only through a person's expression but also where they are and what they're doing. This technology may even draw upon fairness, accountability, transparency and ethical (FATE) into question. For example, one study demonstrated that facial recognition algorithms rated faces of black people as angrier than white faces, even when they are smiling.

Therefore, it is vital to have a combination of Emotion AI and human judgement, to ensure all aspects are carefully considered.

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[34] AI can now read emotions – should it?, [online video], *The Conversation*, 8 January 2020, <https://theconversation.com/ai-can-now-read-emotions-should-it-128988>, accessed September 19, 2021.

AI to Enhance Positive Emotions on Disclosed Life Events

Currently, algorithmic content recommendation on social media is largely content and interests driven, suggesting personalised content based on individual's interests and their interactions with social ties. More often, these interests-driven recommendations are intertwined with commercial content that are profit-driven.

The future possibilities of AI in social media could be tailored to positive, feel-good recommendations, curating personalised content, that are attuned to disclosed life events, which can enhance user's life experience. Supportive content may also enable social media users to be comforted during disclosed adverse times.

Social media platforms continue to provide an unprecedented, unobtrusive lens into behaviours and moods, especially for adolescents and young adults who are at the highest consumption bracket and at the greatest risk for the emergence of mental disorders. Examining the content, linguistics and consumption patterns of social media provide insights into communication and create new opportunities for intervention.[35]

AI may further complement clinical intuition by enhancing diagnostic accuracy and support the reasoning process and human assumptions, while advancing the mechanistic understanding of mental health. One study found that individuals were more forthcoming when disclosing sensitive information with a computer system than with a human.[35]

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[35] M. D. Choudhury, E. E. Lee & J. Torous, 'Artificial Intelligence for Mental Health Care: Clinical Applications, Barriers, Facilitators, and Artificial Wisdom', *UC San Diego*, California, 2021, https://escholarship.org/content/qt4z8917rj/qt4z8917rj.pdf?t=qt1sts, (accessed 20 December 2021).

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"Self-disclosure is a basic element in the attainment of mental health and sharing narratives, stories and experiences in written form can promote candid self-disclosure of difficult, stigmatised conditions."

- Jourard, Healthy personality and self-disclosure

"

Social Media Desirability

To disclose or not to disclose

From an individual's perspective, deciding to self-disclose something as sensitive as life event on social media can be compounded by various factors. Such factors include self-presentation, social desirability, audience, boundary regulation and stigma. Social media users have a desire to manage the impression on social media and may want to be viewed in certain ways, across different audiences.

Building from that perspective, social media users may not be comfortable to disclose some aspects of their lives to their social media audience. These disclosure decisions vary across social media users, circumstances and their self-belief.

Research conducted by Saha et.al (2021) reveals social media life event disclosures are generally expressive and emotional in nature and that negative events tend to be disclosed in the retrospective recall of individuals, prompted through survey responses by unfamiliar researchers.[36]

Additionally, the research shows significant findings in advancing the understanding of online life event disclosures. Positive and anticipated events, which are within the social norms of the platform are more likely to be disclosed online. On the flipside, significant, recent and intimate events bear a propensity to be self-disclosed in surveys.[36]

Social desirability is a known bias to face-to-face offline settings as well as in surveys. This factor could potentially modulate factors to social media disclosures. There were instances when individuals were comfortable to disclose positive events in social media, that were not recalled during the survey. This could relate to self-presentation goals propelled by social norm within the context of social media platform, a desire for selective "performance" as per Goffman's theory on impression management, or for exhibitionism, or for eliciting instant or short-term social approval and gratification.

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[36] Saha et al., 'What Life Events are Disclosed on Social Media, How, When and by Whom?', *CHI Conference on Human Factors in Computing Systems (CHI '21)*, NY, 2021, http://www.munmund.net/pubs/CHI21_LifeEvents.pdf, (accessed 3 November 2021).

Disclosure decisions may stem from a need to conform to underlying social norms around transitory or life's milestones, such as wedding or job transitions. A recent survey also revealed social media users "prefer sharing life's milestones with their social network than in person". This act of disclosure may not only revive dormant social connections but simultaneously elicit responses from passive social network, yet enhance the emotional tone and impact of the event.

Most importantly, positive life event disclosures are attributed to the "desire to use social media as a way of archiving life experiences and reflecting on identities," specifically if the life's milestones are associated with liminality.

Similarly, offline societal norms motivate people to conform in certain ways, social media platform's norms may also influence certain disclosure as well as self-impose non-disclosures around sensitive life events such as extra-marital relationship, family conflicts, pregnancy loss for fear of social stigma, shame or even disenfranchisement.

Building upon Disclosure-Decision Making framework posited by Andalibi, disclosure decisions may be driven by social media user's specific imagined or actual audiences, including mental representations, due to conflicting social spheres, surveillance, or the (semi-) public nature of the platforms. Hence, certain life events are self-filtered and may be deemed less appropriate or share-worthy compared to others.[36]

The technical architectures of Facebook platform in itself may be a hindrance for disclosures as it does not enable anonymity, a vital factor in determining intimate content sharing.

Drawing upon Newman et al.'s observations, social media users carefully navigate the tension between sharing vulnerability and the desire to curate positive images of themselves. There is an apparent dichotomy that the very same factors which encourage disclosure on Facebook (e.g., known audience), may also likely inhibit disclosure (e.g., family conflict).[36]

Significance and recency also negatively associate with social media disclosures. The immediate active attention needed for a pressing event may illustrate the lower likelihood of social media posting, as the situation demands immediate and important attention.

In retrospect, the significance of an event may only be realised after a period of time. For instance, a dinner outing becomes memorable after a friend's sudden demise.

This research emphasizes a need to understand the fundamental discrepancy of disclosure and non-disclosures from the lens of the socio-technical gap and how future social media platform designs could encourage genuine disclosures, to create eudaimonic happiness.

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[36] Saha et al., 'What Life Events are Disclosed on Social Media, How, When and by Whom?', *CHI Conference on Human Factors in Computing Systems (CHI '21)*, NY, 2021, http://www.munmund.net/pubs/CHI21_LifeEvents.pdf, (accessed 3 November 2021).

Emotional Language of Self-Disclosures on Social Media Posts

The research also reveals instances where negative events are disclosed in self-reported survey.[36]

Research conducted by Saha et.al (2021) compares the similarities and differences in linguistic descriptions of the events disclosed in social media posts vs self-reported surveys.[36]

Social media posts are more likely to bear an emotional tone about life events. It also tends to contain greater and richer detail about the event, for instance, a self-report survey may just have recorded a vacation. As opposed to a rich language description about their vacation and positive relationship event, *"Best date night with my husband! Love you to the moon and back dear husband #wefishtogether."*

In contrast, social media posts archives events from the past but were presumably recorded in the present moment. For instance, an individual posted about their ongoing vacation on social media but only revealed a breakup in self-reported survey on the same dates.

On another instance, an individual's social media post revealed them enjoying a vacation with friends; however, a car crash was only revealed in self-reported survey that might have happened then.

If social media posts tend to lean towards a positive self-disclosure in accommodating to the social norms of the platform, will AI be able to detect a shift in real emotions merely through social media postings?

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[36] Saha et al., 'What Life Events are Disclosed on Social Media, How, When and by Whom?', *CHI Conference on Human Factors in Computing Systems (CHI '21)*, NY, 2021, http://www.munmund.net/pubs/CHI21_LifeEvents.pdf, (accessed 3 November 2021).

Emotion Sensitive AI & Disinhibition Effect to Encourage Self-Disclosure

Currently, algorithmic content recommendation on social media is largely interests and commercial driven. Literature notes suggest that positive content can potentially inspire individuals to feel better in positive times and supportive algorithmic content may comfort individuals during adverse times.

Such positive use of social media can be considered in future technical modifications of the platform, by tailoring emotion sensitive algorithmic recommendations that are attuned to life event disclosures and emotional patterns.

Prior work reveals enormous therapeutic and positive benefits of expressive writing as a form of emotional release, self-acceptance and solidarity with other social media users with similar experiences.[36]

Building upon disinhibition effect as one of the main factors in self-disclosure, perhaps there could be options for anonymous post creations in order to encourage expressive writing.

This will encourage social media users to be more engaged with the platform, for the benefit of their emotional and mental health. It is possible to provide safe spaces for individuals to open up, with the objective of benefitting the mental health of social media users. This enables individuals to create anonymous "online trusted friend circles", replicating the offline experience.

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[36] Saha et al., 'What Life Events are Disclosed on Social Media, How, When and by Whom?', *CHI Conference on Human Factors in Computing Systems (CHI '21)*, NY, 2021, http://www.munmund.net/pubs/CHI21_LifeEvents.pdf, (accessed 3 November 2021).

"The next platform and medium will be even more immersive and embodied internet where you're in the experience, not just looking at it, and we call this the metaverse." Meta CEO Mark Zuckerberg.

Future Recommendations

Based on my research and other research, these are ideas moving forward and future recommendations for research on the psychological impact of social media and mental health, incorporating AI, augmented and virtual reality.

In line with Meta's vision of augmented and virtual reality, an area to be explored is leveraging on virtual reality for the benefit of mental health in the new Metaverse.

Metaverse is an online virtual world which incorporates augmented reality, virtual reality, 3D holographic avatars, video and other means of communication.

How do we then balance the humanity and agency of avatars? Could metaverse be a place to experience the inner awakening? Perhaps there isn't one or the other, rather a well-integrated self through synthesizing the multiple aspects of life. Similarly, in psychosynthesis, where there is an integration between the inner and outer world, the futuristic world of metaverse could be an integration between the physical and digital world. It is not if, but how do we integrate metaverse into our universe?

A truly immersive world, designed to evoke the individual's strengths and latent potential and express themselves meaningfully as the creator and avatar of their own life.

How do individuals co-exist with virtual reality? As the metaverse expands, perhaps social media users can see it as a valuable perspective in futuristic landscapes, rather than an alternative world. A place to enhance and integrate happiness, rather than an escapism. We can learn to embrace the positive psychological impact of metaverse and be a part of the evolution.

For some individuals, we are already living in an always-on online world, metaverse merely propels users to live, work, play and stay connected within an immersive digital universe. The direction towards an immersive world may serve as the basis for future research inquiries into the psychological impact of augmented and virtual reality on social media mental health.

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[37] M. Snider, B. Molina, 'Everyone wants to own the metaverse including Facebook and Microsoft. But what exactly is it?', *USA Today*, Virginia, 2021, *https://www.usatoday.com/story/tech/2021/11/10/metaverse-what-is-it-explained-facebook-microsoft-meta-vr/6337635001/*, (accessed 15 December 2021).

Conclusion

Social media, even though virtual, is and can be a happy reality.

Given the increasing prevalence of online social networks, learning how to balance life online and offline is key in modulating happiness.

AI has been widely used commercially and moving forward, it is possible to integrate augmented and virtual reality together with the power of AI to analyse social data at scale. Our future self is an integration of a virtual and physical self.

A deeper understanding on what modulates happiness in social media, coupled with the help of AI, VR and augmented reality would have benefited tremendously in the areas of social media mental health.

Seeing from the perspective of social media as a necessity, it is a platform to capture the nuances of depressive tendencies through visual social media data, linguistics, online patterns, heightened medicinal concerns, greater expression of religious involvement and social media activity. It provides a means for capturing behavioural attitudes, which reflects an individual's thinking, feelings, communication and social milieus.

With AI, signs of ongoing depression, for instance, expressions of hopelessness and negative self-esteem reveal cues to mental health. Unobtrusive assessment through social media is possible as a scalable complement to existing screening procedures to detect the onset of depression.

At the same time, the involvement of humans in understanding what's being said in social media, extracting insights to detect the nuance in the presence and absence of social media patterns are critical. Human involvement will help to contextualise the potential benefits, prior to deploying further recommendations and solutions to modulate happiness in social media mental health.

AI in social media could be tailored to positive, feel-good recommendations, curating personalised content, that are attuned to disclosed life events and mental health status, which can enhance user's life experience.

Again, how we utilise social media, integrated with emotion sensitive AI, can reshape the psychology of social media users, modulating happiness.

Over time, social media users may eventually refrain from offering cues that may indicate mental health challenges. How then, can social media continue to be platforms of authentic expression and a means to embody happiness?

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