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Beyond Artificial Intelligence (AI): Exploring Artificial Wisdom (AW)

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Abstract

The ultimate goal of artificial intelligence (AI) is the development of technology that is best able to serve humanity and this will require advancements that go beyond the basic components of general intelligence. The term “intelligence” does not best represent the technological needs of advancing society, because intelligence alone does not guarantee well-being either for individuals or societies. It is not intelligence, but wisdom, that is associated with greater well-being, happiness, health, and perhaps even longevity of the individual and the society. Thus, the future need in technology is for artificial wisdom (AW). In this overview we discuss the constructs of human intelligence, human wisdom, and AI, and we introduce and support the need for future AW. We propose three governing principles of AW that will enable humans to develop computers to operationally perform actions that utilize wise principles or result in wise acts and provide relevant examples of current efforts to develop such “wise” technologies. If we conceptualize future AI technologies as AW, we can ensure that these technologies are designed to emulate the qualities of wise humans and thus serve the greatest benefit to humanity.

Introduction

The current digital revolution is characterized by a fusion of technologies that are developing at unprecedented rates (Schwab, 2017). This fusion is best exemplified by artificial intelligence (AI), so labeled in 1950 by Turing, who defined AI as the science and engineering of making intelligent machines (Turing 1950). AI is already commonplace in modern life for accessing information, and is starting to be introduced in healthcare for

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been multiple theories of intelligence, from Spearman's *g* (general intelligence) factor to Thurstone's primary mental abilities, to Cattell's *Gf-Gc* (fluid-crystallized) theory and Cattell-Horn-Carroll's theory of cognitive abilities (Goldstein et al., 2015). Although slightly different, most of them agree that intelligence is a multifactorial construct comprised of several components, and integrates a number of cognitive domains and abilities, particularly sensory processing (including attention and working memory), language, acquired knowledge, memory consolidation and retrieval, processing and psychomotor speed, and reasoning.

Assessment:

Consistent with the evolution of intelligence theories, intelligence testing has evolved. Today, a number of different standardized intelligence tests exist such as the Stanford-Binet Intelligence Quotient (IQ) test (Terman & Merrill 1960) and the Wechsler Adult Intelligence Scale Fourth Edition (WAIS IV) (Wechsler 2008). These tests can reliably measure the various domains associated with intelligence. Many of these tests provide a single intelligence quotient (IQ) score and also subtest or factor scores that map onto and operationalize corresponding theories of intelligence (e.g., four-factor structure of the WAIS: verbal comprehension, perceptual reasoning, processing speed, and working memory).

Genetics:

Intelligence has been historically conceptualized as a highly heritable trait. Studies of twins provide strong evidence for heritability; the intelligence scores of identical twins reared apart are highly correlated (Deary & Penke, 2010).

Neurobiology:

The fronto-parietal network is implicated in facets of intelligence including perception, short-term memory storage, and language (Colom, et al., 2010).

Modifiability:

Cattell (Cattell, 1963) divided general intelligence into two types: *fluid intelligence* defined as the ability to use logic and solve problems in new situations without pre-existing knowledge and *crystallized intelligence* defined as the ability to use previously acquired knowledge. Fluid intelligence decreases with age, beginning in the 20s or 30s, but crystallized intelligence remains stable until the 70s when it may begin to decline. There is no evidence of increase in intelligence with aging. Some specific cognitive skills are malleable to training (Rebok, et al., 2014); yet, such interventions do not always generalize across domains (e.g., techniques to improve memory do not help spatial orientation or inductive reasoning) and may not improve overall intellectual functioning (Sala & Gobet, 2019; Butler, et al., 2018).

Public Health Significance:

IQ scores have been shown to predict health and healthcare, educational achievement, job performance, and income (Lloyd, 1978; Spengler, et al., 2015); yet, they also have major limitations. People with high IQs are not necessarily the happiest or most successful (Ali, et

al., 2013). While traditional intellectual reasoning and procedural knowledge have helped build productive communities, we need emotionally balanced and pro-social frameworks for coping with the uncertainties and complexities of life, and for addressing new challenges of the modern world - e.g., loneliness despite increased digital connections (Lee, et al., 2019). Given these considerations, there has been a rising interest in other components of general intelligence. Thus, emotional and social intelligence has been defined as, “an array of emotional and social abilities, competencies, and skills that enable individuals to cope with daily demands and be more effective in their personal and social life” (Bar-On, et al., 2003; Boyatzis & Gaskin, 2015); however, there are no consensus definitions or commonly used measures for these constructs. At least partly driven by the dissatisfaction with the excessive reliance on intelligence, the field of human wisdom has been attracting increasing attention in recent decades.

Human Wisdom

Wisdom has been discussed in religious and philosophical texts for centuries; however, scientific study of wisdom began in the 1970s. Since then, empirical research on wisdom, long considered the “pinnacle of human condition”, has been growing rapidly. The number of peer-reviewed publications on wisdom has increased by several folds during the last couple of decades (Jeste & Lee, 2019).

Definition:

Early wisdom researchers focused on high intelligence as the defining characteristic of human wisdom and stressed that wisdom was a rare quality. However, subsequent investigators emphasized the value of emotions, both in terms of control over negative emotions and of pro-social emotions and behaviors (e.g., empathy and compassion), as being essential for human wisdom. Wisdom is best defined as a uniquely human, complex trait that includes several specific components: *emotional regulation* (ability to control emotions), *pro-social behaviors* (e.g., empathy, compassion, and altruism), *self-reflection* (insight or looking inward), *a balance between decisiveness and acceptance of uncertainty and diversity of perspectives*, and *social advising* (Jeste, et al., 2019) (Table 1).

Assessment:

A number of rating scales have been developed to measure wisdom such as the 3-Dimensional Wisdom Scale (Thomas, et al., 2017). Like other personality traits, wisdom rating scales are based on subjective responses to a series of questions. Our group recently published the San Diego Wisdom Scale (SD-WISE; Thomas, et al., 2019), which assesses the components of wisdom listed above, and has been shown to be reliable and valid.

Genetics:

Wisdom is a personality trait, i.e., a relatively stable characteristic pattern of a person’s thinking, feeling, and behavior. Like resilience and optimism, which are moderately (33–52%) inherited, wisdom may also be partly inherited and partly influenced by cultural and other environmental factors (Boardman, et al., 2008; Amstadter, et al., 2016). Wisdom refers to an individual who displays wisdom steadily over time in both their internal processes

(e.g., rational thinking, positive emotions) and external activities (e.g., compassionate behavior). At the same time, there need not be a dichotomy between traits and states. The fact that a person's behavior is partly determined by social and other contexts does not negate its being a trait. For example, although intelligence is largely inherited, intelligent people may perform poorly when under duress or in different social contexts. Emotional and behavioral aspects of wisdom are as important as the cognitive ones.

Neurobiology:

The prefrontal cortex (dorsolateral and ventromedial prefrontal cortex as well as anterior cingulate) and limbic striatum (especially amygdala) are critical components of the putative neurocircuitry relevant to wisdom (Meeks & Jeste, 2009). Loss of wisdom without a reduction of IQ has been observed in people with damage to those areas, such as Phineas Gage, as well as in patients with diseases involving these specific brain regions, such as behavioral variants of fronto-temporal dementia. There are inevitable overlaps between wisdom and other positive constructs like resilience and social cognition, that share certain psychological attributes, including emotional regulation and social decision making, as well as neurobiological underpinnings such as parts of prefrontal cortex and limbic striatum.

Modifiability:

Wisdom is thought to be adaptive, and unlike intelligence, can increase with age and personal experience until the 80s when it may begin to decline due to cognitive impairment (Staudinger, 1999). Several components of wisdom have been shown to be present at higher levels in older than in younger adults (Worthy, et al., 2011). Additionally, wisdom is more modifiable than intelligence with interventions that can improve emotional regulation and pro-social behaviors (Lee, et al., in press; Treichler, et al., 2020).

Public Health Significance:

A distinct feature of wisdom is its reported usefulness for the well-being of the individual, society, and the species. Wisdom has been associated with positive personal outcomes including better overall physical health, mental well-being, happiness, life satisfaction, resilience, and perhaps longevity (Bergsma & Ardel, 2012; Ardel 1997). Recent studies show that the best correlate of loneliness (a growing global health concern), though in an inverse relationship, is wisdom – i.e., people who score highly in wisdom are significantly less likely to be lonely (Lee, et al., 2019). We view loneliness as having cognitive (negative perception of relationships and low self-efficacy), affective (distress due to perceived social isolation), and behavioral (social withdrawal) components. Wisdom can help address all those components through self-reflection (with appropriate perception of relationships and self-efficacy), emotional regulation with positivity (reducing distress, increasing distress tolerance), and greater empathy and compassion toward others as well as self (resulting in greater self-acceptance along with positive social engagement). Thus wisdom, rather than intelligence, may be the antidote for the behavioral toxin of loneliness (Jeste, et al., 2020).

Artificial Intelligence (AI)

Comparison with Human Intelligence:

AI systems include components of human intelligence such as reasoning, problem solving, planning, learning, acting, reacting, and understanding and generating language (Gil & Selman, 2019) (Table 2). Some AI systems exceed human intelligence, at least in processing speed and capacity to store information, e.g., GPS apps that provide updated turn-by-turn navigation information in almost any part of the world; the IBM Watson that has defeated Grand Masters of chess and champions of Jeopardy.

Assessment:

Since 1950, the Turing Test has been considered a test of a machine's (computer's) ability to exhibit intelligent behavior equivalent to or indistinguishable from a human's (Turing, 1950). There are ongoing efforts to establish new standards of AI including evaluation metrics (Baudoin, et al., 2019).

Benefits and Limitations:

A major strength of AI in healthcare applications is ultra-rapid analysis of large datasets. Today's AI uses rule-based systems to capture high-level articulable patterns and relationships, neural-network-based deep learning systems to capture low-level, non-articulable patterns and relationships, and also hybrid approaches by combining the two systems (Minsky, 1991). Patterns are useful for making predictions about future health (Graham & Depp, 2019) and efforts are underway to predict disease progression, such as the conversion of MCI to Alzheimer's disease, using objective clinical data (Grassi, et al., 2018). However, unlike humans, AI cannot yet create a mental model of others' emotions as well as intentions, beliefs, or desires, taking into account social, spatial, temporal and historical context, and using subjective rather than objective data.

The majority of current AI applications involve making logical decisions or drawing conclusions based on ontology (rules). However, clinical decision-making requires more than intelligent thinking – it requires wise thinking that incorporates ethical and moral considerations. Therefore, we are still far from routine adoption of AI in mental healthcare, especially psychogeriatrics, in view of its limitations and potential risks (Graham, et al., 2019a; Graham, et al., 2019b). The incredibly fast advances in computer science and related technologies that have outpaced the development of societal guidelines have raised serious questions about the ethics and morality of AI, and called for international oversight and regulations to ensure safety.

Artificial Wisdom (AW)

Human-Machine Interactions:

Although some futurists have contemplated artificial consciousness (Buttazzo, 2001), it is generally agreed that only humans can have consciousness, autonomy, will, and theory of mind (Leslie, 1987). Thus, only humans can truly be wise as these elements are key to developing/cultivating wisdom. While society/culture shapes many features of wisdom in

humans, the self-actualization of humans to achieve these components and develop wisdom is a core element of wisdom. However, humans can develop computers to operationally perform actions that utilize wise principles or result in wise acts (Sevilla, 2013). The key question is whether computers can be designed to adapt and become “wiser” in their algorithms. Unlike humans, computers have the ability to make assessments based on an entire array of data and weigh different inputs with equal or consistent importance every time (no matter what context). Technology can enhance moral, ethical, and pragmatic decision-making through facilitating instantaneous feedback from trusted advisers, or gathering input from, and disseminating data to, large numbers of people at once.

Delivery Tools for AI/AW:

Robots are examples of tools delivering AI/AW, interfacing with humans. If we think about consumer-level AW applications, most people will likely have a companion robot (similar to the current ubiquity of smartphones) in the future. Once AW agents are developed, they can be delivered by various other forms (e.g., walls of homes, eye glasses, hearing aids) to support human well-being. Social robots will be designed to interact with users and proactively communicate with them (for a recent review of behavioral models for social robots see Nocentini, et al., 2019).

Applying Components of Human Wisdom to Computers (AW):

In the field of robotics, Asimov’s three laws are considered central (Asimov, 1950). The first one that supersedes the others is that a robot may not injure a human directly or indirectly. Next in importance is the requirement that a robot must obey human’s orders. The last one in the hierarchy is the law that a robot should seek to protect its own existence. Salge and Polani (2017) have suggested replacing Asimov’s laws with those based on the principle of robot empowerment in the face of the complex and novel situations that robots will inevitably encounter when interacting with humans. We propose similar rules that would be characteristic of AW systems along with relevant examples of the components of wisdom. Additionally, in Table 2, we provide a comparison of all six main components of human wisdom, with each being followed by a summary of the corresponding characteristics of future AW envisioned.

Three Principles of AW Systems:

1. A wise system will learn from experience (self-reflection), integrating multiple perspectives (tolerance of diversity/divergent values) as well as past scenarios to make informed decisions and take supported actions.

Thus, AW-based systems will retain and organize memories that are lifelong and life-wide. They will learn from their mistakes and auto-correct to improve future performance (i.e., reinforcement learning) (François-Lavet, et al., 2018). Current work, e.g., Qureshi, et al., 2018, is focused on developing intrinsically motivated social robots that do not require an external reward system to learn from their mistakes, which will make the implementation of reinforcement learning more suitable for the “reward-sparse” real world.

2. A wise system will exhibit prosocial behaviors (empathy, compassion) in interacting with individuals and model social decision-making (social advising).

For example, AW could serve to facilitate social skill development. A small clinical trial found that in children with autism spectrum disorder, use of wearable technology employing Google Glass, which encourages facial engagement and provides cues about the emotions of their social partners during interactions, was associated with significant improvements in socialization skills (Voss, et al., 2019).

3. A wise system will be able to discern human emotions and help people to emotionally regulate and exercise good judgment or knowledge (act decisively).

Thus, AW can help promote emotional regulation in its users. A number of randomized controlled trials (RCTs) have shown that emotional regulation can be enhanced (Lee, et al., 2020). A wise system could act as a “wisdom coach” to provide a cognitive reappraisal of a stressful situation through appropriate role modeling and thus help the user to reinterpret the meaning of a distressing event and control negative emotions. For example, Hao, et al., 2019 used a robot to regulate a user’s emotional state from negative to positive emotions, or to maintain positive emotions, during a simulated “waiting” scenario (as in waiting in line, to be seated, etc.).

Assessment: Turing-like test for AW:

Based on the principles of the original Turing test for AI, we propose that the performance metrics for AW will involve a human evaluator who will compare her or his natural language conversations with a human versus those with an AW system in response to specific questions for assessing wisdom. The questions may come from moral dilemmas (e.g., the Trolley Problem) commonly used in the literature (Thomson, 1976; Christensen, et al., 2014). The evaluator will be blinded to which of the two partners in conversation is a machine. The conversation will be limited to a text-only channel, such as a computer keyboard and screen, so the result will not depend solely on the machine’s ability to render words as speech. If the evaluator cannot reliably discern the AW system from the human, the AW system will be said to have passed the AW test.

Public Health Benefit:

In a rapidly changing world, unexpected global crises may dramatically change the traditional norms of behavior in a very short time. How will machines handle these challenges that tax even human wisdom in unforeseen ways? This type of situation is exemplified by the novel Coronavirus pandemic, which has sowed high levels of uncertainty, confusion and emotional unease, given that humans had no previous exposure to this virus. Another challenge has resulted from the recommended steps to control the spread of the virus, through social distancing, which reduces social engagement, one of the most evidence-based strategies for health and longevity. There are also individual-level moral dilemmas for healthcare workers and others to weigh personal health risks against their work responsibilities and compassion toward others, and for allocation of scarce resources among

patients. A wise system would need to promote personalized wisdom for different users under different conditions and at different times.

Conclusions

If we conceptualize future AI technologies as AW, we can ensure that these technologies are designed to emulate the qualities of wise humans and thus serve the greatest benefit to humanity. In the area of psychogeriatrics, AI/AW will increasingly be a part of digital medicine and will contribute to mental health research and practice. As researchers and practitioners vested in improving mental healthcare, we must take an active role in informing the introduction of AI/AW into clinical care by lending our clinical expertise and collaborating with data and computational scientists, as well as other experts, to help transform mental health practice and improve care for patients.

Intelligence is necessary but not sufficient for wisdom. Intelligence is needed for the survival of *homo sapiens*, but wisdom is critical for thriving in the modern society. Wisdom is potentially more modifiable than IQ, and unlike IQ, may increase with age and experience. AI technologies of the future will require new conceptual and computational models based on human wisdom and not human intelligence, to produce AW. An AW agent can serve as an assistant, peer, or coach. It can help make humans wiser. A long-term transdisciplinary collaboration is essential for development of AW, which will have far greater positive impact on human well-being than any technology developed to date.

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Table 1:

Comparison of Human Intelligence and Human Wisdom

	Human Intelligence	Human Wisdom
Definition	A general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly, and learn from experience.	A uniquely human complex trait including emotional regulation, pro-social behaviors, self-reflection, balance between decisiveness and acceptance of uncertainty, and social advising.
Assessment	Standardized tests, e.g., Stanford-Binet Intelligence Quotient (IQ) test; Wechsler Adult Intelligence Scale (WAIS).	Rating scales, e.g., San Diego Wisdom Scale (SD-WISE); 3-Dimensional Wisdom Scale (3D-WS)
Genetics	Strong evidence for heritability.	Moderately inherited.
Neurobiology	Fronto-parietal network for facets like perception, short-term memory storage, and language.	Prefrontal cortex and limbic striatum for facets like decision-making, problem-solving, self-control, and emotional regulation.
Modifiability	Fluid intelligence decreases with age; crystallized intelligence remains stable until the 70s. Intelligence does not increase with aging.	Wisdom is adaptive and may increase with age and personal experience until the 80s, when it begins to decline due to cognitive impairment.
Public Health Significance	IQ predicts health and healthcare, educational achievement, job performance, and income, but alone is insufficient for the well-being of the individual or the society.	Wisdom is associated with better overall physical health, mental well-being, happiness, life satisfaction, resilience, and perhaps longevity; it is useful for the well-being of the individual and the society.

Table 2.

Current (Weak) AI versus Future AW: Goals and Component Areas

	Current (Narrow or Specific) AI	Future AW
Goal	Accomplish complex human tasks quickly.	Serve as personal assistants to humans to create a better world.
Component Areas	<ol style="list-style-type: none"> 1 Comprehension-Knowledge 2 Processing Speed 3 Quantitative Reasoning 4 Memory 5 Visuospatial Ability 6 Auditory Processing 	<ol style="list-style-type: none"> 1 Pro-social Behaviors (empathy, compassion) 2 Self-reflection 3 Emotional Regulation * 4 Accepting Diversity of Perspectives 5 Decisiveness 6 Social Advising
Assessment	Turing Test	Turing-Like Test for AW
Examples of Potential Benefits for Healthcare	<ol style="list-style-type: none"> 1 Re-defining diagnoses 2 Biomarker-based subtypes 3 Early disease detection 4 Personalized treatment 5 Better monitoring 6 Scalable interventions 7 Efficient operation of systems (e.g., electronic health records) 	<ol style="list-style-type: none"> 1 Deliver Psychotherapy 2 Facilitate social skill development 3 Personal assistant for lifestyle support 4 Companionship to reduce loneliness 5 Treatment adherence 6 Real-time assessment of symptoms/emotions 7 Facilitate prognosis or treatment expectations

Note:

* Computers would not possess this trait but could help a user to improve his/her emotional regulation.

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