**Paper-Pencil to Tech-Age: The Evolving Psychometrics in the Present and Future**

**Introduction to the mind-reading psychometry**

Psychometric assessments are the scientific approach to evaluate one’s mental functions to understand the presence of deficiency, normalcy, and giftedness. The conventional way of evaluating these used to be the traditional face to face interviews, projective tests, objective tests etc. During the era of evolution from Neanderthal to Homo Sapiens when humans recognised their power in cooperation to deal the environmental resource-based challenges, they started living in community with fellow humans. The frequent and intensified social interactions due to the community living evoked the evolution of social intelligence to be a more complicated attribute.

 Human cognition can refer to own self called recursive thinking (thinking about thinking) which enables the human mind to perform ‘self-consciousness’ function where (s)he is able to distinguish his ‘self’ from other ‘selves’. Perception and cognition of ‘others’ in comparison to the ‘sense of self’ parallelly evolved in humans to deal fellow humans effectively. All these ‘Me vs You’ game to survive in the social world aided humans to constantly make theories of others’ mind in their day today social interactions. Cognitive psychologists call this phenomenon as Theory of Mind ability (ToM), that is the ability of a human mind to comprehend beliefs, desires, and intentions to predict future behaviour of another mind (Ian A. Apperly 2012). It is a developmental milestone achieved by all humans when they step into their age 3. Like the way you see the physical world with your eyes, your mental vision is determined by Theory of Mind. Hence, by the third year of life all humans become a born psychometrician who conduct psychological assessments of fellow humans via a method called ‘observation’. They sense, perceive, predict, and evaluate others intent and behaviour constantly in the social world. What really happens when the psychological evaluation takes place? One mind travel across to the other person’s mental dimension to comprehend the other’s mental functioning with a purpose. This need of our species later formally satisfied by the scientific community of psychology by contributing psychometry to the world.

 Psychometric tests were revolutionary in its approach through its symbolic and abstract nature to assess the mental faculties. They served their purpose in the fields of psychiatry, military, education, and industrial sectors. It started with Sir Francis Galton’s idea of measuring intelligence in 1800s. and in 1900s the French psychologist Alfred Binet created the first modern intelligence test, known as the Binet-Simon Scale. Later this got adapted as Stanford-Binet intelligence scale by Lewis Terman in the early 20th century. It turned into a popular test and became reference to many subsequently evolved intelligence tests. Wechsler Adult Intelligence Scale (WAIS) and Wechsler Intelligence Scale for Children (WISC) evolved from Wechsler-Bellevue Intelligence Scale by David Wechsler in 1930s. The very first personality test for identifying psychiatric diagnosis and personality attributes was Minnesota Multiphasic Personality Inventory (MMPI) developed by Starke R. Hathaway and J.C. McKinley in 1940s. Later in the same year, Katharine Cook Briggs and her daughter Isabel Briggs Myers developed the Myers-Briggs Type Indicator (MBTI). It became a popular personality assessment based on Carl Jung's theory of psychological types.

**Challenges in Measuring Psychological Attributes**

 The primary challenge in measuring psychological attributes is due to its existence in nonphysical dimension in abstract forms. In short, psychological attributes are not physically present and unit of measurement is not fixed. It varies during the process of measurement. In psychological measurement there is only an arbitrary zero point but no true zero point. Though quantitative measurements are being performed but it is validated or accepted in the context of a qualitative evaluation by the psychometrician. Hence, in the psychological measurement psychometrician is the real instrument. The validity and reliability of results or measured data depend to a great extent on the knowledge, training, skill, practice, and integrity of the psychometrician. Prediction on any psychological construct cannot be made with definite accuracy and the entire quantity also cannot be measured. The qualitative or quantitative approach while measuring any psychological attribute, is coupled with subjectivity in the measurement due to the non-physicality or abstract nature of attributes. Also, psychological constructs are often complex and multilayered. Any attempt or establishment to perform an absolute measurement will result in simplification error or overselling of the tool.

 Another intriguing and deep challenge while measuring psychological construct is the effect of social desirability especially in collectivistic cultures. Social desirability factor is very similar to the Heisenberg’s uncertainty principle in quantum mechanics, where it says that when we try to measure the position and momentum of a particle that effort of measurement itself will affect its position or momentum. Similarly, when we try to measure a psychological attribute using any tool, that effort or process can generate a separate force called social desirability which affects the absolute manifestation of that attribute. Social desirability is most visible in personality assessments where context-based data like nonverbal and paraverbal behaviors have more validity than content-based data like literal test responses of the individuals. Projective tests have an upper hand in this arena where individuals are barely aware of their response nature or get a chance to display their attributes unknowingly or unconsciously in abstract manner. To overcome these challenges are already in progress in the discipline with the advancement of technology especially in the psychophysiological measurements where researchers are constantly trying to identify the psychophysiological markers for the psychological attributes. That will be discussed in the upcoming part of the chapter.

**What is it called a ‘Good’ Test?**

 Any scientific tool whether in physical science or psychological science becomes ‘good’ only when it satisfies its intended purpose. That is achieved by defining the scientific properties of a test. The first one is, standardized and uniformed administration for the different test takers for ensuring the consistency and applicability of the tool. Second, the reliability where results should be consistent under different testing situations. For example, if a person named ‘A’ carrying out a test on the subject and later person named ‘B’ carried out the same test on the same subject, both the results should be similar. Next would be the validity of a test. It is the accuracy of the intent of measurement. That is, a test should perform what it claims. Establishment of norms during the test development from the larger representative sample will only give the generalizable reference which determines the target population. This process will ensure the standardized scores of a test objectively which will ensure the ease in interpretation of responses or performance of the test taker. Practicality and ethical nature are the other two essential properties where tests should be non-invasive to the test taker.

**Essential Ethical Principles**

 All the properties of a psychometric test mentioned above itself act as an essential ethical way to determine the readiness to use the test. In addition to that there are many principles that should be the heart and soul of a psychometrician. First, is the informed consent of the individual being assessed or the legal guardian by clearly mentioning all the information about the test which includes benefits and potential risks and the right to refuse or withdraw from without any consequences. Second, the confidentiality should be ensured in the identity information, accessing the personal information, test results since the psychological tests are deeply personal and vulnerable information about an individual. Psychometrician should put efforts to cause the benefits at its maximum and minimizing the harm. Non-invasive methods should be the major way to offset the risks. After test taking, the participants should be given adequate feedback regarding their testing and encourage them to ask questions if have any. Last but not least, the competence determined by the qualification and experience of the psychometrician is very crucial in this profession with the necessary knowledge, skills, training, and qualifications to administer and interpret the tests accurately. It is being discussed in detail in the next part of the chapter.

**Profile of a Psychometrician**

 It is a recursive scientific irony when we try to profile a psychometrician where that itself is a psychometrician’s job. There are very few or almost nil scientific studies available in the area of psychological attributes of psychologists or job profiling of a psychologist other than qualifications and experience. Unlike any other sciences, psychology is the only science which study the mind using another mind. Whereas all other disciplines, the mind is studying the fields whether it is economics or rocket science. When a mind studies another mind, it is bio-psycho-socially biased always. Hence, the desensitisation of such bias to an extent possible only through a deep reasoning recursive mind. So, profiling such minds are essential in the entire subdisciplines of psychology, especially the psychometrician. A psychometrician rigorously interacts with other minds in routine to understand the individual mind functioning where his own (psychometrician’s) mind also an evolutionary product just like any others except the knowledge and training in the science (s)he acquired. Therefore, letting the qualification and training required being the basic essential criteria for being a psychologist or psychometrician, let’s also shift our focus to this novel side of psychological profiling of a psychometrician.

Basic cognitive abilities like high functioning executive functions are general factors in all the jobs for being successful and efficient. But when the psychologists themselves discovered that beyond the cognitive factors, emotional intelligence and resilience are also some of the key factors for an individual to be successful or happy in his professional and personal life. So, is it just same for the psychologists or are there any other attributes which play vital in their profession?

 The very first one would be, Theory of Mind (ToM) that is the ability of a human mind to comprehend beliefs, desires, and intentions to predict future behaviour of another mind (Ian A. Apperly 2012). It is considered as a significant socio-cognitive attribute to function efficiently in the social world to understand and deal others’ mind. Psychologists are bound to serve in the social world by the nature of profession itself. No psychologist has a ‘lab’ without ‘humans.’ Theory of Mind is an umbrella term or mother quality for many other attributes. We call it social intelligence, affective and cognitive empathy, emotional intelligence, mentalizing, and even naively known as mind reading ability. Most often all psychologist face in their career a cliché question that “Can you read my mind by just looking at me?”. I rigidly believed it as an unscientific question by the naïve crowd where the majority do not even know or do ask why there is a ‘P’ in the spelling of ‘Psychology’. But later I had to change my stand while dealing a dissertation research question that why some people are really good at understanding and dealing others. Yes! Every Homo Sapiens in routine read others mind using this Theory of Mind (ToM) ability in their social world. Most often it is unconscious or involuntary due to evolutionary reasons. We started speaking language around just 10,000 years ago (Harari, Y. N, 2014) and before that all our communications were of nonverbal and paraverbal nature. The hand to mouth evolution desensitised the insight of the Homo Sapiens regarding their ability to read others nonverbally or para-verbally though the ability continued. We involuntarily grasp and interpret others facial expressions, body gestures, tone, and pitch of their voice in order to form the understanding of a second mind in a fraction of second. But in the complex social world those are bare minimum to have an accurate understanding about second person. That made us prone to mind reading errors which compelled us to believe that we are incapable of it. Presently, we invested this ability mostly in our sympathetic and parasympathetic responses like fight or flight to recognise the life threat stimuli for the purpose of self-preservation. And in communication we started believing blindly on the literal verbal transactions where it is the least reliable form to understand the second perspective.

 The second would be affective and cognitive empathy which are two parts of ToM but can function independently too. Affective empathy is the mirroring part of emotion from ‘other’ to ‘self’ whereas cognitive empathy is the perspective taking by wearing the second person shoe to get the greater picture how his mind functioning. Affective empathy is more of a zero-order cognitive function where mirror neurons in the prefrontal lobe facilitates the involuntary action. Cognitive empathy is an effortful first order and beyond cognitive function where your overall mental reasoning dominantly lead by prefrontal cortex and temporal parietal junction (TPJ). In the psychometric context, the listening and sensing part would be more efficient when your affective empathy has a high functionality whereas the perspective taking and understanding the symbolic social cues, believe system and strategizing the conversation is more connected to the cognitive empathy part.

 The third would be the enactment imagination. It is a dimension of vivid imagination where you can visualise different situations, simulate emotions and mental states, thinking creatively by divergent thinking for arriving at independent solutions. In the psychologist’s context, this applicable mostly to the social reasoning where you are obliged to travel mentally to others’ situations to simulate their mental state to understand the context accurately.

 The psychologist like attributes need more exploration through job analysis to include the psychological competence required along with the qualifications required.

**Types of Tests**

 Tests are mainly classified as cognitive and non-cognitive tests. Cognitive tests are generally performance tests where you measure the efficacy of particular cognitive functioning in its presence, intensity and frequency. Intelligence test, aptitude tests, achievement tests, memory tests, problem solving, language tests are few examples. They are mostly objective by nature and quantitative measurements are generally being followed. Non-cognitive tests majorly measure psychological attributes like personality, emotional intelligence, coping style, defense mechanism style etc. They are characterized as objective as well as projective tests. Objective tests are purely structured in its administration, scoring and interpretation where subjectivity is at its minimum. Projective tests are qualitative and subjective tests where the scoring and interpretation solely depends on the expertise of the trained interpreter. The social desirability factor earlier discussed is minimum in projective tests and maximum in objective tests.

 There are clinical and diagnostic tests and neuropsychological tests to understand mental health conditions and brain-behaviour connections. They are mostly accompanied by the clinical interviews and secondary data gatherings.

**New Emerging Trends**

 The landscape of psychological assessment has changed in the new era of technological advancements where the approach is becoming more objective basis to reduce the subjectivity in the process without affecting the social desirability factor. Most followed path in technology driven assessment paradigm is psychophysiological methods. Electrodermal activity (electrical potentials in the skin), electroencephalography (electrical activity in the brain), electrocardiography (electrical activity in the heart), electromyography (electrical activity in the muscles), eye tracking, facial expression analysis, visual stress analysis, voice analysis, automated polygraph are few examples for analysis of physiological responses in individuals to understand their psychological and emotional states. Recent research shows that customized AI based assessment platforms can identify the personality characteristics of an individual through facial recognition, nonverbal cues, and vocal analysis (Rupasinghe, A. T., 2016). Instruments like LVA (Layered Voice Analysis), a forensic tool as well as pre-employment integrity & personality assessment platform, incorporating unique voice analysis technology by processing the voice’s psychophysiological parameters. For the military purpose Chinese have developed fusion technology where it performs the integrated personality tests, eye movement techniques, EEG, soft neurological signs detection, and MRI (Xiao,Miao, & Gong, 2007).

 Considering the ontogeny and trends in this technology-based assessment paradigms it can be classified as Psychophysiological paradigm, Human assist paradigm, Automated Paradigm, and Autonomous Paradigm. Psychophysiological paradigm is the physiological and psychological correlates of psychological attributes as discussed above, the human assist paradigms are the technology-based platforms which assists the psychometrician in arriving at decisions as a corroboration method. Automated paradigm enables the automation of existing psychometric tools for the ease in administration, scoring and interpretation. Autonomous paradigms are the futuristic assessment interface which can independently take decisions without human intervention. Decision making agents and social robots are few examples of such paradigms.

 It is strongly evident that, present era is already being revolutionized by the artificial intelligence (AI) paradigm. Whatever we are seeing is just the rudimentary byproduct of the same and more developed and complex are yet to come and that is only possible by the contribution from psychology’s psychometric and cognitive science disciplines. AI is nothing but mimicking human abilities mainly the mental functions. For mimicking the complex mental functions, psychology science has a long way to go to explore the surface and deep of many psychological attributes. We are still answerless of nature of human consciousness, unconscious mind shaping our behaviours, origin of emotion and language etc. Unless we explore these attributes, we cannot reproduce or mimic these in AI paradigm. So, presently the fantasy of AI being the autonomous decision makers like self-driving cars, autonomous surgery robots and social robots like Sophia, all are still the rudimentary ones where we are still unreachable to the point like ToM-AI. Tom-AI refers to the hot cognition in AI. Autonomy to any AI machine without hot cognition will create danger in the human-machine interactions. Hot cognition mainly refers to the ToM(Theory of Mind) ability which includes the affective and cognitive component of taking others perspective whereas AI has mostly focused on ‘cold’ cognition, especially how to extract information from data.

**Conclusion**

 The psychometry is becoming most demanding day by day in all the fields wherever humans are present. It carries out the crucial role in mental health services, educational assessment, personnel selection and recruitment, forensic psychology and even in personal growth and self-understanding. More than a tool, it promotes the psychological wellbeing, conscious decision-making pertaining to human capital to achieve better outcomes in different areas of life.

 Advancements in technology have contributed a modern way to conduct psychological tests in a reliable and efficient manner. The challenge is to make it most valid system by converting the already existing theoretical knowledge into required platforms using the maximum data bank. Integration of these theoretical insights of psychological attributes with technology to produce modern psychometric assessment paradigms will be less burdened with human evaluation and minimized social desirability. Ease in administration, discrete nature, significant saving in time and human effort, accuracy and lack of biases are the core nature of such assessment paradigms in psychometrics.

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