the interaction between Data Science Innovation and psychological research

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Words: 1836

# Introduction

The field of psychology is a broad field, which involves a scientific process of studying, analysing, predicting and understanding mental processes, brain functions and behavioural patterns. While the branches of psychologists are extremely broad and they work in different environment and condition, they have commonly been established and developed through a variety of psychological research and experiments. Particularly, psychologists, in their research, conduct psychological experiments, along with statistics and produce a hypothesis with findings. Many psychological findings have improved the quality of people’s lives and as well as potentially contributing to organisational and societal benefits in many sectors. For example, clinical psychological research have improved the workers’ well-being and enabled to treat a variety of mental disorders in specific conditions (Lobban, Barrowclough & Jones, 2003). Furthermore, organisational psychological research have elevated the group and individual performances and productivity of many organisations (Taris & Schreurs, 2009). Consequently, the continuous development of psychological research is vital in understanding, analysing and predicting a variety of psychological phenomena and mental illness.

# Challenges

## CRISIS WITH REPLICABILITY OF PSYCHOLOGICAL SCIENCE

One of the most important elements in psychological research is the process of obtaining consistent and reliable results. In other words, replicability and generalizability of the experiment is very crucial in determining the validity of the experiment. Psychologists typically collect data and evidence and produce a hypothesis by conducting multiple research methods, which include self-report, direct observation, interview, survey and questionnaires. On the other hand, those self-report procedures have been criticised due to low statistical power, their inconsistent results and biases, such as participants’ memory limitations, reporter bias and lack of ecological validity (Nelson & Allen, 2018). Moreover, those procedures are extremely time-consuming and can potentially create uncontrolled variables (Francis, 2012). Along with those critical procedures, many psychologists have also been criticised for their lack of knowledge and procedures in employing statistics skills and a range of other techniques in the process of obtaining sufficient data (Thayer, 2022). Potential limitation of collecting data methods can negatively influence replicability of psychological research. In terms of those issues, it seems that the more advanced scientific methods of obtaining data would be mandatory to obtain more statistic data, improve the precision of measurement and in turn increase the validity of psychological research.

## CRITICISMS OF SCIENTIFIC FINDINGS AND PUBLIC TRUST

Psychology is an interdisciplinary field, which requires expertise and lots of efforts and trainings to understand, analyse and refer to complex scientific findings and phenomena. Despite continuous publications of many psychological findings, there have been still high proportion of people, who do not trust or refer to psychological literature and scientific findings in psychological research. That is, some people do not recognise the importance of psychological findings regardless of research’s validity and credibility. First, people typically do not try to search and understand deeply for complicated psychological findings and solutions. Hence, psychological research is likely to be rejected by general public and other disciplines because of its nature of complexity. According to APS Fellow Delphine Dahan, who is a cognitive psychologist, claimed that general public is likely to require a simple explanation of psychological phenomena. Furthermore, because of the consistent failures of replicability of past findings in many science disciplines including psychological science, public criticisms of psychological research are an increasing challenge within psychology field and those continuous public criticisms can in turn influence detrimentally on the trust in psychological science among wider public community and other disciplines (Anvari & Lakens, 2018). Therefore, it is vital that psychological science should engage more actively with public and provide more effective way to communicate with wider public community, in order to gain trusts and credibility of psychological research field.

## GLOBALISATION: LACK OF DIVERSITY AND CULTURAL VARIATION IN PSYCHOLOGICAL RESEARCH

While our contemporary society is increasingly becoming multicultural, diverse and globalised within a variety of domains, sectors and constructs, the availability of tools, and data and different perspectives in the field of psychological research is yet narrow and extremely screwed across the world. Typically, it has been shown that many psychological literatures are continuously being dominated by cross-cultural studies, which are primarily biased by western-based research data and interest (Thayer, 2022). Furthermore, Crookes and Warren (2022) showed that many of current research literature have been reliant on etic approach and are less likely to consider emic approaches to a particular culture, local community or perspective. For example, experimental research on indigenous contexts is highly influenced by universal theories and data, deteriorating the representation of indigenous values and contexts (Gelfand, Lyons & Lun, 2011). This, in turn, can potentially worsen the validity of research. The lack of external and internal validity is likely to lead to a conclusion that is potentially irrelevant contexts. Therefore, it is very crucial to extend and collect data and tools in terms of larger subsets of local variables and consider cultural variation in our research.

# Opportunities for Innovations from Data Science

The continuous development of big data and data science-based technologies, tools and methods would potentially provide the opportunity for psychological science to tackle those challenges and further contribute to the development of the field of psychological science in terms of its replicability, globalisation and public trust.

## SMARTPHONE AND SMART-HOME TECHNOLOGY TO COLLECT ENORMOUS DATA IN PSYCHOLOGICAL SCIENCE

Smartphone and other smart-home devices are now widely used to monitor and record individuals’ daily activities, health conditions, social interactions, mobility patterns and particular interests (Harari et al., 2016). Using the advanced functions of smartphone may enable researchers to collect enormous amount of data and records very rapidly, efficiently and objectively. In terms of collecting data, smartphone sensing method has more advantages over traditional self-reporting methods of psychological science. First, traditional self-reporting methods have consistently had limitations with generalizability and statistical power of the samples. On the other hand, smartphone sensing method allows researchers to obtain more representative samples and generalised data about people’s activity or behavioural patterns and as well as considerably reducing many limitations of traditional methods, including experimental biases and memory limitations (Harari et al., 2016). Furthermore, smartphone and smart-home technology enable the researchers to collect sufficient data of individuals’ daily activity and social interactions without time consuming and dedication of participants and researchers (Nelson & Allen, 2018). Representatively, there have been recent psychological research showing the opportunity for psychological researchers to use smartphone sensing methods to examine many psychological phenomena and behavioural patterns, including daily emotional variation, sleeping patterns and interpersonal behaviours in group processes (Rachuri et al., 2010; Wrzus et al., 2012; Mast, Gatica-Perez, Frauendorfer, Nguyen & Choudhury, 2015).

## BIG DATA AND OPEN SOURCE FOR PSYCHOLOGICAL RESEARCH

The advancements of data science and big data have enabled many organisations to collect enormous data in the world. According to Huss and Westerberg (2014), Google company is estimated to have 15 billion gigabytes and Facebook is estimated to own 150 petabytes of data (Cheung & Jak, 2016). The expansion of big datasets has also led to free access of enormous data available to the public over the internet. The open source of big datasets would potentially provide the opportunity to tackle current limitations of psychological research. Primarily, the big datasets in open source are very simple to read and interpret, hence providing more convenient and easier access to connect with the public. For example, American Psychological Association (APA) provides links to datasets and repositories, in which those databases clearly show a variety of topics regarding psychological science research. In particular, each database provides a current trend of particular psychological research topic, along with simple graph, pictures and new information. Hence, the expansion of those open data source may continuously help the field of psychological research to communicate and connect more efficiently with the public, in turn lead to higher credibility in psychological research. Simultaneously, big data open source would also be useful in addressing existing theories, variables and findings in the process of obtaining data (Cheung & Jak, 2016).

## DATA-DRIVEN METHODS

Data-driven approach is a process of collecting an amount of data and analysing an array of data with statistical techniques and tools, such as R, factor analysis and simple graph. Data-driven methods would be also very effective in tackling challenges in psychological research. First, compared to theory-driven approach, data-driven approach provides highly effective predictive analyses with accurate and precise measurements, in turn increasing the replicability of psychological research. Moreover, data-driven methods would considerably reduce cultural biases, which have been one of potential limitations in psychological research and be able to provide a huge subset of cultural variations and diversity. For example, the opportunity is presented in the research by Jack, Crivelli & Wheatley (2018), showing that using data-driven methods researchers were able to examine facial expressions of emotions across various cultures and races, hence reducing a cultural bias in research. Finally, data-driven methods can be especially effective in emic approaches to particular culture or local contexts in psychological research, as they are easily accessible to relevant contexts (Jack, Crivelli & Wheatley, 2018).

# Implementation Considerations

While smartphone sensing methods and big data open source are very effective in obtaining sufficient data, they would still require high levels of computational and technical skills, including using R or Python for data analysis and other statistical techniques (Cheung & Jak, 2016; Harari et al., 2016). Hence, Psychological researchers are likely to struggle in the process of obtaining data without expertise in computational skills. Smartphone sensing and smart-home technology are also likely to be considered with privacy, ethical and data security issues. When researchers collect data via smartphone sensing methods or smart-home technologies, they should carefully consider privacy of participants, confidentiality and transparency between researchers and participants (Nelson & Allen, 2018). Data collected via smart devices can be sensitive so researchers should ensure to provide participants with maximum control over their personal records or data (Harari et al., 2016). Furthermore, researchers should also ensure participants to be aware of what and how the data are collected, along with clear instructions of the sensing application and the data storage practices (Harari et al., 2016). Finally, ensuring data security is very crucial to protect participants’ privacy. Researchers should ensure data being secure in the process of collection, storage and sharing. One of good strategies of data security would be using secure-sockets-layer (SSL) encryption when transferring and sharing data (Harari et al., 2016).

Furthermore, big data analyses mainly focus on business settings and other sectors, but they are not yet commonly and extensively applied to psychological science (Cheung & Jak, 2016). Thus, the quality of data in open source for psychological science can detrimentally influence the validity and reliability of psychological research. Data-driven methods are indeed effective in terms of providing an enormous and various amount of data contexts and reducing cultural bias in psychological research. On the other hand, this approach still lacks applying in different subdisciplines of psychology, including neuroscience and cognitive science. One of good strategies would be using some technological devices, such as wearable devices or smartphones when conducting data-driven methods (Jack, Crivelli & Wheatley, 2018).

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