



EXPLORING THE PSYCHOLOGICAL CORRELATES THAT AFFECT THE ATTITUDE TOWARDS THE USE OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE, AMONG DOCTORS.

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Abstract: Healthcare systems using Artificial Intelligence (AI) have the potential to aid Indian doctors to provide quick and accurate diagnoses, as well as, perform surgical operations. The present study is an attempt to explore various psychological correlates that can determine the attitude towards the use of AI in healthcare held by a doctor. The first objective of this study is to determine the attitude towards AI held by the doctors and the second is to explore how the Big 5 personality traits and Resistance to Change of the doctors are capable of predicting the attitude. Participants consisted of 68 doctors (47 males, 21 females). The age of the sample ranged from 22-66 years (mean = 44.38, SD = 18.579). A self-constructed attitude scale, NEO-FFI and Resistance to Change scale were used to collect data. Results revealed that 58.8% of the doctors held positive attitudes, while the rest were negative. Age, neuroticism, extraversion, openness and resistance to change are the significant correlates of attitude towards AI. Openness and Resistance to change are the most significant predictors of attitude towards the use of AI in healthcare among doctors. This information may be used to seek out doctors, who would be more likely to adopt AI healthcare systems, indirectly through their dispositional characteristics.

Index Terms - Attitude, Artificial Intelligence, Personality, Resistance to Change.

I. INTRODUCTION

Artificial intelligence (AI) and related technologies are increasingly prevalent in business and society, and are beginning to be applied to healthcare. These technologies have the potential to transform many aspects of patient care, as well as administrative processes within provider, payer and pharmaceutical organizations. Today, AI techniques have challenged traditional methods across healthcare, even fuelling an active discussion of whether AI doctors will eventually replace human physicians in the future. Though it is of public opinion that human physicians will not be replaced by machines in the foreseeable future, but AI can definitely assist physicians to make more accurate clinical decisions or even replace human judgement in some functional areas of healthcare (e.g., radiology).

Adoption of AI for healthcare applications is expected to see an exponential increase in next few years. The healthcare market globally driven by AI is expected to register an explosive CAGR of 40% through 2021, and what was a USD 600 million market in 2014 is expected to reach USD6.6 billion by 2021. The increased advances in technology, and interest and activity from innovators, provides opportunity for India to solve some of its long existing challenges in providing appropriate healthcare to a large section of its population.

The Central Mechanical Engineering Research Institute, a CSIR institute based out at Durgapur in Burdwan district of Bengal, has been relentlessly developing various medical innovations during the pandemic. Their latest innovation is the Hospital Care Assistive Robotic Device (HCARD). Despite all the innovations and efforts, there are still a number of barriers which stand in the way of widespread adoption and implementation, arising out of a lack of regulatory clarity on issues of data, design and certification and lack of resilient and ethical data collection and processing systems. From a psychological perspective, one of the biggest hindrances to the use of AI in Indian healthcare is the attitude towards the technology among the healthcare professionals.

PERSONALITY

Robert McCrae and Paul Costa (1985, 1987) conducted an extensive research that led to the identification of five personality factors (neuroticism, extraversion, openness, agreeableness, and conscientiousness) and the development of a personality test, the NEO Personality Inventory.

Morsunbul (2019) observed that out of the five personality factors, agreeableness, extraversion and openness were negatively related to negative attitudes towards robots. His findings also revealed that gender, extraversion and openness to experience were significant predictors of negative attitudes towards robots. Müller and Richert (2018) noted that neuroticism correlated with all dimensions of the NARS (Negative Attitudes toward Robots Scale) and extraversion correlated with the subscale Negative attitude towards the social influence of robots.

RESISTANCE TO CHANGE

It is simply human nature to counteract any changes and maintain the status quo. Resistance to change is an individual's tendency to resist or avoid making changes, to devalue change generally, and to find change aversive across diverse contexts and types of change.

Maier, Jussupow and Heinzl (2019) revealed that there was a significant negative correlation between resistance to change and positive attitude towards AI, and a significant positive correlation between resistance to change and negative attitude towards AI. Paloş and Gunaru (2017) discovered that dispositional resistance to change was a negative predictor to enjoyment of learning (affective component of the attitude), and conscientiousness played a moderating role in that relationship. Bhattacharjee and Hikmet (2007) confirmed that resistance to change has a biasing effect on physicians' perceptions of HIT usefulness.

II. RESEARCH METHODOLOGY

2.1 Objectives

1. To determine the current attitude that doctors hold towards the use of Artificial Intelligence in their work.
2. To check the influence of demographical variables like age and sex on their attitude.
3. To find out how personality traits of doctors are related to, and if they can predict, the positive/negative attitude towards AI.
4. To ascertain the relationship between Resistance to change and attitude towards AI in healthcare and to check the predictive power the former on the latter.

2.2 Description of the Tools

1. Scale to determine the attitude towards the use of Artificial Intelligence in healthcare: An attitude scale was prepared by the researcher under the supervision of the faculty guide. The items of the scale were face validated by two physicians who had thorough knowledge on the current and potential utility of Artificial Intelligence technology in the healthcare industry. The scale consisted of 13 items. Out of the 13 items, 6 items are positive statement towards the use of Artificial Intelligence in healthcare and the rest 7 items are negative statements. The scale used a 4-point forced Likert-type rating, viz., Strongly Agree, Agree, Disagree and Strongly Disagree. A forced Likert-type rating was chosen to avoid the occurrence of Neutral responses. For positive statements, a maximum score of 4 was given to "Strongly Agree" responses, a score of 3 to "Agree" responses, a score of 2 to "Disagree" responses and a minimum score of 1 to "Strongly Disagree" responses. Reverse scoring was done for the negative items. High scores indicated positive attitude towards the use of Artificial Intelligence in healthcare, whereas low scores indicated negative attitude. A cut-off of 32/33 was decided to categorize the two groups. Respondents scoring higher than 32 were considered to hold positive attitudes, and those scoring lower than 33 were considered to have negative attitudes.
2. NEO-Five Factor Inventory (NEO-FFI): The NEO-FFI was developed by Paul Costa and Robert McCrae in 1992. It is to be used with adult men and women (above 16 years). The NEO-FFI has 60 items, 12 items per domain. Responses are collected using a 5-point Likert scale, namely Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A) and Strongly Agree (SA). The scoring is done according to the scoring key where the scores for each item range from 0-4. The item scores of each domain are summed up to get a final score for that dimension. Higher the score, higher is the individual's tendency to behave in a manner as associated with the personality dimension. The reliability coefficients for the NEO-FFI are found to be as follows:

N:	E:	O:	A:	C:
0.85	0.8	0.68	0.75	0.72

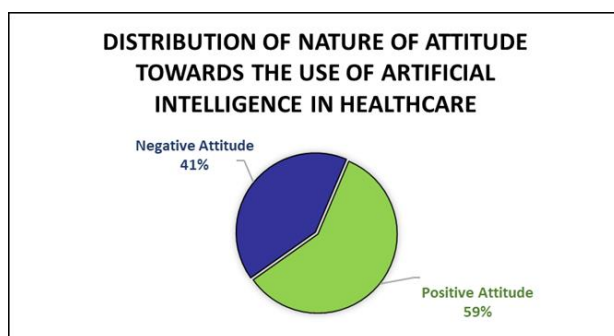
3. Resistance to Change Scale: The Resistance to Change scale was developed by Shaul Oreg in 2003 to measure an individual's dispositional inclination to resist changes. The scale consists of 17 items. The instrument uses a 6-point Likert scale viz. Strongly Disagree, Disagree, slightly Disagree, slightly Agree, Agree and Strongly Agree. The score for each item ranges from 1 to 6 with 1 being given to Strongly Disagree and 6 to Strongly Agree. There are two reverse items which are scored in the opposite manner. The total score is obtained by summing up all the item scores. Higher one's score, higher is their dispositional tendency to resist change. The alpha coefficient for the scale is .87.

2.3 Sample

The present sample comprised 68 doctors of various specialties residing and practicing in and around Kolkata. The age of the doctors varied from 22 to 66 years. The respondents consisted of 21 females (30.9%) and 47 males (69.1%).

III. RESULTS

Graph 3.1: Distribution of the Nature of Attitude towards the use of Artificial Intelligence in healthcare in the Sample.



Graph 3.1 illustrates that the majority of the selected sample (59%) held positive attitude towards the use of artificial intelligence in healthcare whereas 41% held negative attitudes.

Table 3.2: Mean, SD and t-value of Attitude scores between Male and Female Doctors.

	Sex	N	Mean	Std. Deviation	t-value	df	Sig. (2-tailed)
Attitude	Male	47	34.04	5.634	1.897	66	.062
	Female	21	31.43	4.238			

Table 3.2 reveals that male doctors and female doctors differed significantly in their attitudes towards artificial intelligence. Male doctors were found to hold more positive views than the females.

Table 3.3: Mean, SD and t-value of age of doctors between positive and negative attitude towards use of artificial intelligence in healthcare.

	Attitude	N	Mean	Std. Deviation	t-value	df	Sig. (2-tailed)
Age	Negative	28	34.07	16.339	-4.300	66	.000
	Positive	40	51.60	16.685			

Table 3.3 reveals that doctors with negative attitude and positive attitude differed significantly in their mean age. Doctors with negative attitude were of a younger age compared to doctors with positive attitude.

Table 3.4: Mean, SD and t-value of Resistance to Change scores between positive and negative attitude towards use of artificial intelligence in healthcare.

	Attitude	N	Mean	Std. Deviation	t-value	df	Sig. (2-tailed)
Resistance to Change	Negative	28	63.32	8.982	2.175	66	0.033
	Positive	40	59.03	7.273			

Table 3.4 reveals that doctors with negative attitude and positive attitude differed significantly in their mean Resistance to Change score. Doctors with negative attitude had obtained higher resistance to change scores than the ones with positive attitude.

Table 3.5: Correlations between Attitude Score and Sex, Age, Resistance to Change and Personality Traits.

		Sex	Age	N	E	O	A	C	RTC
Attitude Score	Correlation Coefficient	.227	.489**	-.337**	.319**	.422**	-.182	.041	-.404**
	Sig. (2-tailed)	.062	.000	.005	.008	.000	.137	.738	0.000
	Sig. (1-tailed)	0.031	0.000	0.002	0.004	0.000	0.068	0.369	0.001
	N	68	68	68	68	68	68	68	68

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 3.5 reveals the correlations between attitude scores and various variables. Attitude scores have been found to be significantly positively correlated to Age, Extraversion and Openness. The Attitude scores have been found to be significantly negatively correlated to Neuroticism and Resistance to Change.

Table 3.6: Linear Regression Coefficients.

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	35.385	7.857		4.504	.000
Neuroticism	-.158	.088	-.202	-1.786	.079
Extraversion	.089	.131	.080	.679	.500
Openness	.344	.125	.300	2.756	.008
Resistance to Change	-.181	.071	-.279	-2.565	.013

a. Dependent Variable: Attitude score

Table 3.6 shows that Openness to Experience is a positive predictor of attitude score of the doctors, whereas Resistance to Change is a negative predictor of attitude score of the doctors.

IV. DISCUSSION

It has been observed that a greater number of doctors (58.8% of the total participants) held positive views towards the use of Artificial Intelligence in healthcare. This implies that these doctors are more likely to adopt healthcare systems using AI technology in their daily work. The rest 41.2% of the doctors who held negative attitudes are less likely to be open to try out new AI machines on their own will and require to be persuaded to accept AI.

The male and female doctors' attitude scores were compared during the study and it was found that even though male doctors are more likely to hold positive attitudes than the female doctors, the difference between their mean attitude scores was only slightly significant. Research findings have supported this. Men, in general have been found to be more optimistic towards AI than females (Polesie et al, 2020; Zhang & Dafoe, 2019; Gherhes & Obrad, 2018; Hamlyn et al, 2017 and others). The Point Biserial correlation between the two sexes and Attitude towards AI was found to be low and insignificant. Thus, gender differences in attitude towards AI use in healthcare of the present sample is not significant.

The mean age of doctors with positive attitude towards the use of Artificial Intelligence in healthcare has been found to be significantly higher than the mean age of doctors with negative attitude. This implies that a greater number of older doctors held positive views about AI than the younger doctors. Previous literature has revealed mixed findings. While some researches (Sarwar et al, 2017) confirmed the present finding of older respondents having more positive attitude towards AI, whereas other studies (Oh et al, 2019; Zhang & Dafoe, 2019; Nordahl, 2019; and others) have found that younger people are more likely to hold positive attitudes towards Artificial Intelligence. But this disparity can be explained. As found by Heatley (2020), older people are less confident about their digital skills which leads to negative attitude towards AI, but the study by Polesie (2020) revealed positive attitude towards AI is linked with increased level of knowledge. Thus, it is possible that the older doctors had more knowledge about the AI systems than the younger doctors and therefore had more positive attitudes. The Pearson Product-Moment Correlation between age of the doctors and their attitude towards the use of AI in healthcare scores was found to be positively substantial and significant ($r = 0.489$, $p < 0.001$).

The mean Resistance to Change (RTC) scores has been found to be significantly different between doctors with positive attitude and negative attitude towards AI. Respondents with positive attitude had a lower mean RTC score and the ones with negative attitude had a higher mean RTC score. It is, thus, expected that high resistance to change of an individual will be linked to negative attitude. The correlation between Resistance to change scores and the attitude scores of the doctors has been found to be negative, marked and significant ($r = -0.404$, $p < 0.001$). Similar results have been found in a study conducted by Maier et al (2019). On conducting regression analysis, it was found that RTC is a significant negative predictor of attitude towards AI among doctors ($\beta = -0.279$, $p = 0.01$). Studies by Paloş and Gunaru (2017) and Bhattacharjee and Hikmet (2007) have revealed similar findings.

Neuroticism has a negative, low but significant association with the attitude scores of the doctors ($r = -0.337$, $p = 0.005$). Johnson and Verdicchio (2017) have introduced the term "AI Anxiety" referring to the fear and apprehension about AI technology going out of control. It can thus be expected that people who score high on neuroticism, will be more likely to experience anxiety or worry over the AI systems, which will ultimately lead to negative attitude. The results obtained in the studies by Müller-Abdelrazeq and Richert (2018) and Conti et al (2017) are consistent with the present finding. On conducting regression analysis, it was found that neuroticism is insignificant in predicting attitude towards the use of AI in healthcare among doctors ($\beta = -0.202$, $p = 0.079$).

It was found that Extraversion has a positive, low and significant association with the attitude towards AI scores ($r = 0.319$, $p = 0.008$). Regression analysis has revealed that extraversion is not a significant predictor of doctors' attitude towards Artificial Intelligence ($\beta = 0.08$, $p = 0.5$). Previous studies have shown that extraversion is a significant predictor of attitude towards AI (Morsunbul, 2019; Conti et al, 2017). In the present study, though the direction and magnitude of association is consistent with earlier literature, a significance of prediction could not be established.

It was found that Openness has a substantial positive and significant relationship with the attitude scores obtained by the doctors ($r = 0.422$, $p < 0.001$). The predictive strength of Openness, as found in the regression analysis, is positive and very significant ($\beta = 0.3$, $p = 0.008$). The findings have been supported by earlier researches related to this variable and attitude towards AI conducted by Morsunbul (2019) and Conti et al (2017). Doctors who score higher in openness are more likely to be open to new ideas and thus have a higher tendency to hold optimistic views about the adoption of AI systems.

The correlation between Agreeableness and attitude towards AI in healthcare among doctors has been found to be negative, negligible and insignificant ($r = -0.182$, $p = 0.137$). Previous literature presented by Morsunbul (2019) and Müller and Richert (2018) have also found no significant relationship.

Conscientiousness has a negligible, positive and insignificant relationship with the attitude scores ($r = 0.041$, $p = 0.738$). Earlier studies reveal similar results (Morsunbul, 2019; Müller-Abdelrazeq & Richert, 2018; Conti et al, 2017).

V. IMPLICATIONS

By identifying those psychological characteristics, that could distinguish a health professional with positive attitude towards AI from one with negative attitude, it will be possible for the hospital administrators to select those doctors who would be more likely to adopt the AI systems, and then with their help, can persuade the other less willing doctors to change their attitudes. It is always better to implement the change after fostering positive attitudes than imposing the change on people with preconceived negative connotations about the change. So, the Change Managers can use the findings to seek out spokespeople for the AI systems they want to implement and ensure a smooth and efficient transition. Such an approach will also reduce the drop in productivity experienced post change implementation and will ascertain consistent high productivity in the organization and better delivery of service.

VI. LIMITATIONS AND SUGGESTIONS

Due to the nature of study, snowball sampling method was used for convenience. Thus, it is impossible to determine the sampling error or make generalizations about the populations based on the present sample. Self-report inventories were used in the study which automatically included the self-reporting biases along with the possibility of some faking. The sample size is small, may reduce the power of the study and increase the margin of error, rendering the findings meaningless. The sex ratio in the sample was unequal. One of the scales used was self-constructed and face validated. The sample only consisted of doctors working in urban areas and thus restricted the sample heterogeneity.

A study with a larger and more heterogeneous sample can be conducted to increase the power of generalizability. Comparisons can be made among doctors of different specializations and working in either government or private practices. Comparisons can be made among doctors with varying knowledge about AI and exposure to AI healthcare systems. Comparisons can also be made among doctors working in the urban and rural areas of different parts of the country. A better, standardized attitude scale can be used to replicate the study. The study can also be conducted on other working professional groups that are having to cope with the implementation of AI technology in the workplace.

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