

K-Means Clustering and Predictive Dependence of Personality Traits in Dark Triad Model

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Abstract— Machiavellianism, Narcissism and Psychopathy are the three traits expounded by the Dark Triad Model of Personality. These building blocks of personality cover a large and interconnected spectrum of personality. The use of Machine Learning can help in analysing large-sized databases to draw meaningful comparisons. In this paper, we have used K-Means Clustering to investigate dark personality clustering in a very large database comprising 18192 respondents. The data was normalised and then subjected to unsupervised machine learning to classify it into four separate clusters. The data was clustered evenly among the four clusters. To evaluate the interdependence of the personality traits intraclass (0.537) and Pearson's correlations were computed. Two of the SD3 traits were used to regress on the third and the process was used for all of them alternatively. Pearson's correlation between Machiavellianism and Psychopathy was highest at 0.721 and the same was corroborated by the regression equations between the two traits. Narcissism showed equal correlations with Machiavellianism (0.475) and Psychopathy (0.453). Regression equation revealed that Machiavellianism was most significantly affected by Psychopathy and vice versa. Regression results for Machiavellianism and Psychopathy indicated fair predictive capabilities with R^2 values of 0.547 and 0.535 respectively.

Index Terms— Dark Triad Model, DT, K-Means Clustering, Regression, Correlation

I. INTRODUCTION

The behavior of humans is a key factor in tracking the way they behave in day-to-day life and their manifestations in their interactions with others in social settings. The study of human behavior therefore has emerged as a key research area to enhance the user experience based on the behavior profiles. The Dark Triad is made up of three largely negative traits namely, Machiavellianism, Narcissism and Psychopathy. These dark triad traits are prevalent in the workplace, particularly in individuals in senior positions such as C-suite managers. Most of the literature on Dark Triad has focused on establishing the profiles of socially unfit individuals. Studies have revealed that all three traits relate to low honesty and low agreeableness suggesting the core of Dark Triad is rooted in dishonesty, coldness and manipulation of others. Psychopathy and Narcissism indicate high risk-taking and impulsive behaviour whereas Machiavellianism indicates a more cautious and coldly manipulative approach. Individuals can be classified into various personality types based on their responses to a set of questions. The Short Dark Triad (SD3) was developed [1] and contains 9 questions each for the three constituents. Compared to the individual scales the SD3 is quick and useful to apply and evaluate. Tracking human behaviour from identifying the pattern of clusters is a tedious task but years of research in

psychology has shown that it is always possible to have a coarse matrix of human behaviour based on the pattern recognition in the data. Even though no two people are likely to have the same identical behaviour, it is possible to reasonably albeit coarsely classify them into roughly three clusters as per the DT. As personality traits of DT define almost all the socially averse personality types sufficiently it might be interesting to investigate whether the individual traits can be estimated from the remaining two traits. This paper also attempts to see if a causal relationship exists between individual personality traits as a dependent variable and the remaining two variables as the dependent variables [2].

II. BACKGROUND AND RELATED WORK

Research in social psychology has long since concluded that the behaviours and preferences of people can be explained by underlying psychological constructs such as personality and emotions [3]. By definition, personality is a measure of individual differences in emotions, motivations, attitudes and interpersonal measures [4]. Prior work indicates that personality has a strong correlation with individual preferences and inclinations [5,6,7,8]. Researchers have successfully extracted personality information through activity profiles [9,10, 11,12 & 13]. The concept of Dark Triad comprises three socially averse personality traits. Personality can be thought of being placed between a normal and a sick personality under the SD3 approach [1]. Although the three constituents namely Machiavellianism, Narcissism and Psychopathy have different characteristics and origins, they possess a common thread among them [14,15]. Personality traits decide what kind of a person we would have and how he would exhibit his values and preferences. Individuals exhibiting high scores on Machiavellianism are more self-centered and opportunistic than others. They show no guilt, shame or remorse for manipulating others to advance their gains [16]. Such individuals believe that manipulating others and cheating for self-advancement is a normal means of achieving success [17]. Machiavellian individuals exhibit a lack of empathy and have a propensity to adopt a behaviours which would otherwise be considered immoral and selfish [18]. Individuals with narcissistic trait are characterized by their constant need for attention seeking and admiration drawing admiration from others around them to continuously boost their self-image and ego. Their behavior is always attuned to gaining additional esteem and status, even going to great lengths to take high stake steps to boost their image [19,20, 21]. Narcissists always believe that they possess higher intelligence than they actually do and always feel superior to their peers [22]. Like the Machiavellian individuals narcissists have no qualms in cheating or manipulating to exploit others for their self-image. Narcissists are not affected by regret or shame for using others to advance their self-image. Individuals exhibiting the psychopathic traits show scant regard for feeling or empathy for others and do as they please even at the cost of causing harm to others [23,24,25]. Psychopaths are ruthless, aggressive and selfish pursuing their own pleasures which might actually run counter to the socially accepted norms of behavior. All three dark triad personality traits are associated with risk taking behavior. Individuals with dark triad traits are generally more risk seeking than those devoid of these traits. Individuals showing high scores on the Dark Triad of personality traits are calculative, unethical and emotional coldness [23,26,27].

III. METHODOLOGY

The data used in the study is from the “Short Dark Triad Responses SD3” which consists of 27 questions equally divided into three dark traits of the DT Model. The end result is a five point Likert scale score in these traits. The dataset used in this study is SD3 (www.kaggle.com/datasets/lucasgreenwell/short-dark-triad-responses). This dataset contains responses from 18,192 respondents.

The data is compounded by the individual traits and then transformed into standard normal distribution ($\mu=0$, $\sigma=1$) data. This data is now amenable to cluster analysis. The machine learning algorithm of choice is the unsupervised clustering that segregates users into distinct clusters based on the Euclidean distance from the centroids of the traits. While the standard and commonly used methodology would be to use K-Means clustering but research does not support working with a predetermined number of clusters. Instead of a K mean clustering we can also have an X mean clustering where the clusters define the number of clusters based on the sufficient discrimination. We performed principal component analysis on the data to identify the latent factors in the dataset and we found four factors in the underlying dataset based on the scree plot of the eigenvalues. We, therefore, proceeded with the K Means clustering with four clusters.

After conducting the K means cluster analysis we investigated if individual personality trait can be predicted by the remaining two of the Dark Triad. The huge amount of data indicated that some meaningful insights on the interdependence can be had from the data of this size. We conducted correlation and regression. Regression

analysis is nothing but supervised machine learning. We calculated one way random intraclass correlations for the three dark personality traits and also the Pearson correlation coefficient among them.

Regression analysis is used as a supervised machine learning method. Three multivariate regressions were employed to investigate if the individual dark personality traits could be predicted by the other two. This process was repeated for the remaining two traits alternatively.

IV. DATA ANALYSIS

K-Means Clustering: after the principal component analysis the scree plot was generated which showed a clear elbow at 4 factors. These factors represented 52% variability of the sample. We conducted the K means clustering analysis with four clusters and the analysis terminated at 59 iterations. Table 1 shows a truncated iteration history. The four final cluster centres are shown in Figure 1.

One-way random Intra Class Correlation between the three normalized traits was carried out and the value of 0.537 was returned which is satisfactory. Bivariate Pearson correlations are presented in Table 2 and all three personality traits showed correlations significant at $\alpha=0.01$ % levels. The highest correlation of 0.408 was found between Conscientiousness and Openness followed by 0.399 between Agreeableness and Extroversion. The smallest bivariate correlation of 0.129 was found between Neuroticism and Extroversion.

Following the methodology adopted by Meuer (2021) we used regression to see whether any interdependence relationships existed between the five personality traits. Regression analysis is in effect an unsupervised machine learning process and based on the regression results one can predict the various traits of the DT. The regression analysis was run thrice with one DT trait as the dependent variable and the other two as the causal independent variables. The results are presented in Tables 4, 5 and 6.

The regression equations are given below:

$$1. \text{MACH} = 0.186 \cdot \text{NARS} + 0.636 \cdot \text{PSYC}$$

$$2. \text{NARS} = 0.232 \cdot \text{PSYC} + 0.308 \cdot \text{MACH}$$

$$3. \text{PSYC} = 0.652 \cdot \text{MACH} + 0.144 \cdot \text{NARS}$$

V. CONCLUSION

We conducted K-Means clustering on raw data sourced from a very large dark triad personality pool and identified four distinct clusters. Cluster 3 was most sparsely populated with cluster memberships of a meagre 2565. The remaining three clusters contained 6363, 5138 and 4126 members respectively.

The intraclass correlation coefficient of 0.537 between the personality traits was significant at $\alpha = 0.01$. Pearson's correlation between MACH and PSYC was highest at 0.721 which indicated that Machiavellianism and Psychopathy are most closely related. The regression equations also support this with the largest coefficients. Narcissism showed almost equal correlation coefficients with both Machiavellianism (0.475) and Psychopathy (0.453).

The regression equations revealed that Machiavellianism was most significantly affected by Psychopathy ($\beta = 0.636$) and vice versa ($\beta = 0.652$). Narcissism was mildly explained by Machiavellianism ($\beta = 0.308$) and vice versa ($\beta = 0.186$). Psychopathy was affected largely by Machiavellianism ($\beta = 0.652$) and Narcissism ($\beta = 0.144$). The regression results for Machiavellianism ($R^2=0.547$) and Psychopathy ($R^2=0.535$) were indicative of fair predictions with R^2 values of 0.547 and 0.535 respectively. Regression for Narcissism showed a poor result with $R^2=0.251$.

TABLE I: TRUNCATED ITERATION HISTORY

Iteration History ^a				
Iteration	Change in Cluster Centers			
	1	2	3	4
1	1.184	1.517	.949	1.599
2	.017	.258	.264	.361
3	.039	.080	.231	.134
4	.032	.019	.778	.058
5	.028	.027	.732	.037
6	.019	.067	.456	.026
7	.007	.073	.222	.001
8	.016	.074	.139	.001
26	.007	.009	.008	.004

27	.006	.006	.004	.004
28	.006	.006	.004	.004
29	.004	.005	.005	.003
41	.001	.002	.002	.000
42	.000	.001	.001	.000
43	.000	.000	.000	.000
44	.000	.000	.000	.000
45	.001	.001	.000	.000
46	.001	.000	.000	.002
47	.000	.000	.000	.001
48	.000	.000	.000	.000

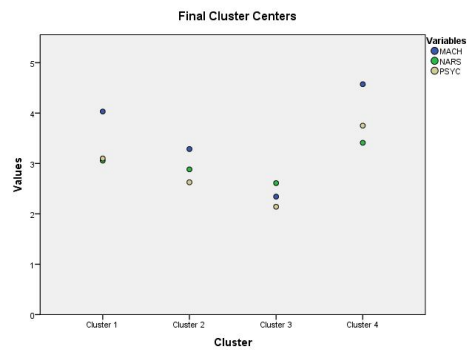


Figure 1: Final cluster centres

TABLE II: FINAL CLUSTER CENTROIDS

Final Cluster Centers				
	Cluster			
	1	2	3	4
MACH	4.03	3.29	2.34	4.57
NARS	3.06	2.88	2.61	3.41
PSYC	3.10	2.63	2.14	3.75

TABLE III: PEARSON BIVARIATE CORRELATION BETWEEN THE DT COMPONENTS

Correlations				
		MACH	NARS	PSYC
MACH	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	18192		
NARS	Pearson Correlation	.475**	1	
	Sig. (2-tailed)	.000		
	N	18192	18192	
PSYC	Pearson Correlation	.721**	.453**	1
	Sig. (2-tailed)	.000	.000	
	N	18192	18192	18192

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

TABLE IV: REGRESSION OF NARCISSISM AND PSYCHOPATHY ON MACHIAVELLIANISM

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1(Constant)	.332	.028		12.059	.000
NARS	.322	.010	.186	33.268	.000
PSYC	.806	.007	.636	113.599	.000

a. Dependent Variable: MACH

TABLE V: REGRESSION OF MACHIAVELLIANISM AND PSYCHOPATHY ON NARCISSISM

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1(Constant)	1.860	.015		121.935	.000
PSYC	.170	.007	.232	25.028	.000
MACH	.178	.005	.308	33.268	.000

a. Dependent Variable: NARS

TABLE VI: REGRESSION OF MACHIAVELLIANISM AND NARCISSISM ON PSYCHOPATHY

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1(Constant)	.476	.022		21.794	.000
MACH	.515	.005	.652	113.599	.000
NARS	.196	.008	.144	25.028	.000

a. Dependent Variable: PSYC

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