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

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Abstract: *In this paper, we have used K-Means Clustering to investigate dark personality clustering in a very large database comprising 18,192 respondents. The data was normalized and then subjected to unsupervised machine learning to classify it into four separate clusters. We also evaluated the interdependence of the three dark traits using bivariate correlations. To investigate the predictive dependence of the three dark traits each pair was regressed on the third dark trait.The four clusters showed marked values of dark traits ranging from the most modestly dark personality with medium to low values of Machiavellianism, Narcissism and Psychopathy to the extreme dark personality with highest values of the three dark traits. These cluster are plotted in three dimensions using python software. To evaluate the interdependence of the personality traits intraclass (0.537) and Pearson's correlations were computed. 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.*

Keywords: *Dark Triad Model, DT, K-Means Clustering, Regression, Correlation*

Introduction

The behaviour 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 behaviour therefore has emerged as a key research area to enhance the user experience based on the behaviour 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 (Paulus & Jones, 2012) 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 course 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 (Mereu, 2021).

Literature Review

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 (Protogerou & Hagger, 2020)[24]. By definition, personality is a measure of individual differences in emotions, motivations, attitudes and interpersonal measures (Johnson,2021). Prior work indicates that personality has a strong correlation with individual preferences and inclination (Correa et al., 2010[6]; Mark and Ganzach, (2014)[17]; Barrick & Mount, 1991[2]; Kraaykamp and Eijck, 2005)[16]. Researchers have successfully extracted personality information through activity profiles (Carlisle, 2017; Kosinki et al., 2013, Shen et al., 2013; Dieris-Hirche et al., 2020; John & Srivastava, 1999)[28,7,11]. The concept of Dark Triad comprises three socially averse personality traits. Personality can be thought of being places between a normal and a sick personality under the SD3 approach (Paulus & Jones, 2012). Although the three constituents namely Machiavellianism, Narcissism and Psychopathy have different characteristics and origins, they possess a common thread among them (Mereu, 2021; Parks-Leduc et al. 2015)[18,19,21]. 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 (Murphy, 2012)[20]. Such individuals believe that manipulating others and cheating for self-advancement is a normal means of achieving success (Sahai & Rath, 2021)[27]. Machiavellianism individuals exhibit a lack of empathy and have a propensity to adopt a behaviour which would otherwise been considered immoral and selfish (LeBreton et al., 2018)[13]. 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 behaviour is always attuned to gaining additional esteem and status, even going to great length to take high stakes steps to boost their image (Vazire and Funder, 2006; Campbell et al., 2004; Chatterjee & Hambrick, 2007)[30,5]. Narcissist always believe that they possess higher intelligence than they actually do and always feel superior to their peers (Gabriel et al., 1994)[9]. 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 (Babriak & Hare, 2006; Hare, 1999, Patrick, 2007)[10,22] Psychopaths are ruthless, aggressive and selfish pursuing their own pleasures which might actually run counter to the socially accepted norms of behaviour. All dark triad personality traits are associated with risk taking behaviour. 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 (Babiak and Hare,2006; Stevens et al., 2012; Emmons, 1981; Rath et al., 2021; Rath & Kar, 2013)[1.29,8,25,26]

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 tested for normality using skewnessand kurtosis. Data was processed to fit a normal distribution and then converted into standard normal distribution (μ=0, ó=1) data by converting the data into z scores(Lee, 2018). 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 traits 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 coefficients 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.

Data Analysis

After the principal component analysis the scree plot was generated which showed a clear elbow at four factors. These factors represented 52% variability of the sample. We conducted K-Means clustering analysis with four cluster and the analysis terminated at 59 iterations. Table 1 shows a truncated iteration history. The final four cluster centers are shown in Figure 1.We further scaled the cluster centers by dividing each center distance by the largest value in the table. We next used JuPyter software to plot these four personality clusters in three dimensions (Figure 2). The four personality clusters are represented by coloured dots and showed scaled values of Machiavellianism, Narcisssm and Psychopathy from 0.5 to 1.0 as two extremes. The green dot represents a personality cluster low on Machiavellianism (0.5), Narcissism (0.61)and Psychopathy(0.5). This personality cluster would be the most reasonable or mild personality as far

as the dark traits are concerned. Next is the orange cluster characterized by low values on Machiavellianism (0.60) and Psychopathy (0.50) and high value on Narcissism (0.725). The blue cluster is characterized by high values on Machiavellianism (0.75) and Narcissism (0.80) and low value on Psychopathy (0.52). This cluster is more Narcissistic and slightly more psychopathic than the orange cluster. Finally, the red cluster represents a very dark personality cluster with extreme values of Machiavellianism (0.98), Narcissism (0.77) and Psychopathy (0.80).The sample thus showed four distinct clusters.

One-way random intraclass 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 3 and all three personality traits showed correlations significant at á=0.01 % levels. The highest correlation of 0.721 was found between Machiavellianism and Psychopathy and the correlations between Machiavellianism and Narcissism and Psychopathy and Narcissism had a correlation of 0.475 and 0.453 respectively.

Following the methodology adopted by Meuer (2021) we used regression to see whether any interdependence relationships existed between the dark triad 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. MACH = 0.186*NARS + 0.636*PSYC
2. NARS = 0.232*PSYC + 0.308*MACH
3. PSYC = 0.652*MACH = 0.144*NARS

Iteration History[a]

	Change in Cluster Centers			
Iteration	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

Source: Author

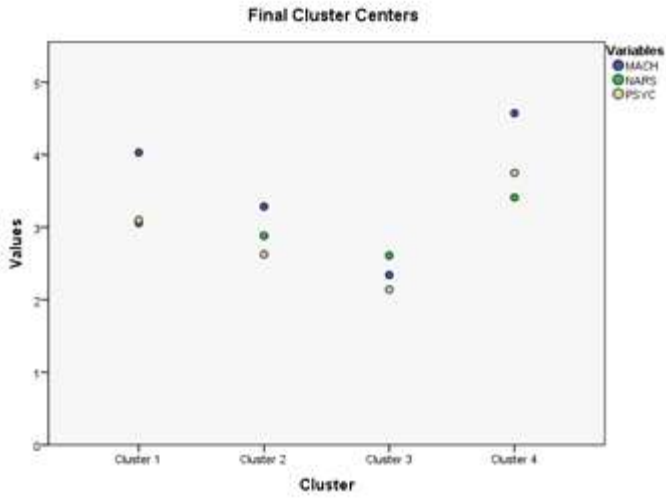

Figure 1: Final cluster centres

Source: Author

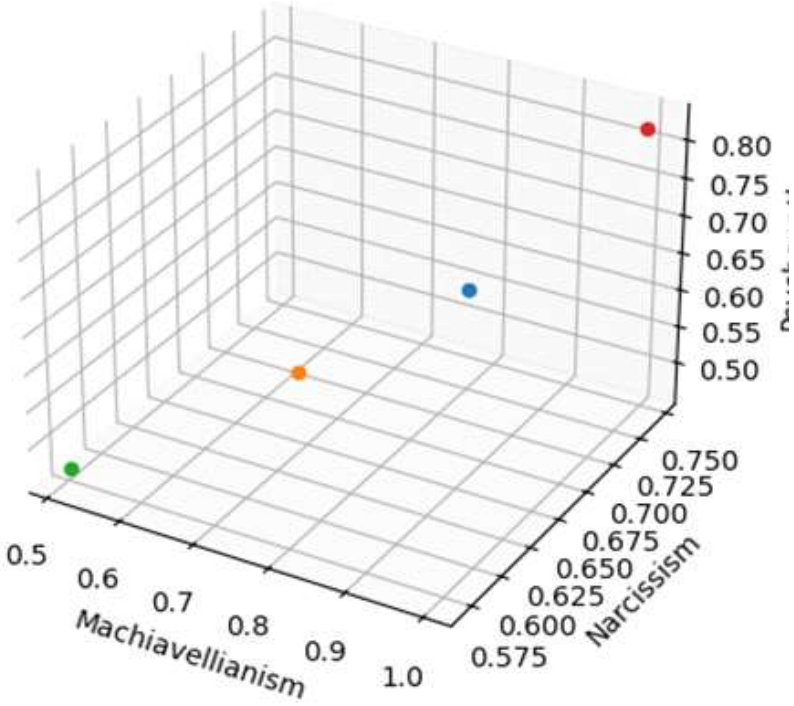

Figure 2: K-Means clustering of DT personality

Source: Author

Table 2: 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

Source: Author

Table 3: 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).

Source: Author

Table 4: 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

Source: Author

Table 5: 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

Source: Author

Table 6: 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

Source: Author

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 membership 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 á=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 coefficient. 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 (â = 0.636) and vice versa (â = 0.652). Narcissism was mildly explained by Machiavellianism (â = 0.308) and vice versa (â = 0.186). Psychopathy was affected largely by Machiavellianism (â = 0.652) and Narcissism (â = 0.144). the regression results for Machiavellianism (R^2=0.547) and Psychopathy (R^2=0.535) were indicative of fair predictions. Regression for Narcissism showed a poor result with R^2=0.251. Narcissism was not adequately predicted by the other two traits.

Limitations & Future Scope

The result used secondary data available from Kaggle database. The DT data comprised of 18192 responses but no demographic data was available. It would be of interest to see how the personality traits are affected by demographic details. Due to limitation of time secondary data was used. It would be interesting to see if similar results can be explored to a primary database. In future we plan to collect dark triad responses from corporate setting and investigate the supervisor attitudes and subordinates' intention.

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