© Journal of the Indian Academy of Applied Psychology
Jan 2024, Vol. 50, No. 1, 136-143

Variation In Executive Functions among Accused of Different Types of Crime

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This research paper aims to examine variations in cognitive executive functions among individuals accused of different types of crimes, including recidivism, property crime, crime against the human body, and offenses related to the Narcotic Drugs and Psychotropic Substances Act (NDPS). A total of 125 participants, housed in the Central Prison, were selected for the study. The participants' executive functions were assessed using the Wisconsin Card Sorting Test for mental shift, the Digit Backward test for working memory, and the Go/No-Go test for impulse inhibition. The collected data were analysed using MANOVA. The results of the tests showed statistical significance. Individuals accused of crimes related to the NDPS act demonstrated superior performance in the WCST and working memory tasks.

Keywords: Impulsiveness, Executive functions, mental shift, working memory, prisoners, imprisonment.

According to Goldstein & Naglieri (2014), Executive functions (EF) are the cognitive functions that allow the individual to set and reach a goal by controlling, altering, and changing one's behavior either to adapt or to meet the demands of the environment. It is an umbrella term used for several cognitive processes such as working memory, attention, inhibition, self-monitoring, self-regulation, and initiation carried out by prefrontal areas of the frontal lobes (Goldstein & Naglieri, 2014). Often, people with impaired executive functions show impulsivity, lack of self-regulation, irritability, rigidity, neglectfulness, and carelessness (Seruca& Silva, 2016). EF is one of the several other factors that influence and drive the behaviour of an individual. According to Miyake et al., (2000) the three distinguishable executive functions are impulse control, mental shift, and working memory. The functions of each of these EFs are to deliberately inhibit pre-potent or automatic response, being flexible to change one's mental constructs in accordance with the changing environment, and able to hold information while performing other cognitive tasks (Friedman & Miyake, 2017). The findings of several studies provide consistent evidence regarding the impaired performance of individuals involved in antisocial behavior in tasks related to executive functions. Ogilvie et al. (2011) and Morgan & Lilienfeld (2000) conducted comprehensive analyses of 39 and 126 studies, respectively, and both found that antisocial groups exhibited significantly poorer performance in EF tasks compared to control groups. Kuin et al. (2019) focused specifically on hot executive functions and found that offender groups performed poorly in these tasks. Lantrip et al., (2016) found that the individuals diagnosed with antisocial personality disorder and high psychopathy scores did not differ from control in perseverative scores on the Wisconsin Card Sorting Test, while those with low psychopathy scores showed higher perseverative error scores. Hanlon et al. (2016) conducted a study that revealed lower overall IQ scores and poor performance on attention, executive function, and memory measures among individuals in the study's spontaneous domestic homicide group. They also demonstrated reduced cognitive flexibility and inductive perceptual reasoning. Seruca & Silva (2016) found that the general group of offenders performed worse than non-offenders in measures of mental flexibility and planning. Meijers et al. (2015) suggested that individuals with high psychopathic traits may have dysfunction in the orbitofrontal cortex,

impacting their ability to plan and follow rules. Bagshaw et al. (2014) observed a higher prevalence of previous trauma, depression, anxiety, and stress among inmates compared to the control group, along with neurocognitive deficits such as sustained attention, impulsivity, and executive dysfunction. Kavanagh et al. (2010) discovered that inmates with a history of recidivism exhibited significantly higher Verbal Interference error scores. Collectively, these findings indicate a consistent pattern of cognitive impairments in antisocial individuals, particularly in domains related to executive functions. The presence of psychopathy, childhood trauma, substance dependence, previous trauma, and a history of recidivism further exacerbates these impairments. Understanding these cognitive deficits is crucial for forensic psychologists and the development of effective interventions and rehabilitation programs for individuals involved in criminal behavior. However, no study could be found in google scholar, American Psychological Association search engines on the executive function tasks exclusively among the accused of crime commission.

According to 2021 Prison Statistics India, the occupancy rate of the Indian prisons is found to be 120.1% with 1,22,852 convicted prisoners and 4,27,165 under-trial prisoners facing their court trials for the verdict. The under-trials are arrested and kept in the judicial custody when there is circumstantial evidence accusing the person to have committed crime. According to the diathesis model, the biologically determined anti-social traits may get exhibited by adverse life experiences or stress which would disrupt the chemical balance in the central nervous system (Busari, 2015) thus changing the personality/cognitive functioning and making their reintegration back to the society difficult (Jarrett, n.d.). Thus the accused are an extremely vulnerable population and understanding their EFs would help in better managing the crowd in the prison also, it facilitates in choosing appropriate interrogation techniques. The objective of the study is to investigate whether there are any differences in the performance of executive function tasks among the accused of different types of crime.

Method

Problem:

Is there significant difference in the performance of executive function tasks by the accused of different types of crimes?

Hypothesis:

H0: There is no significant difference in executive functions of mental shift, working memory and impulse inhibition among the accused of different types of crimes

Tools-

A comprehensive assessment of an individual's cognitive abilities was conducted using a battery of tests including the Digit Backward Test, the Wisconsin Card Sorting Test (WCST), the Go/No-Go Test, and the Mini-Mental Status Examination (MMSE). The Digit Backward Test, an integral part of the Wechsler Adult Intelligence Scale (WAIS-III), was developed by Wechsler in 1997 with the purpose of assessing working memory capacity. It involves the recall and manipulation of a sequence of numbers in reverse order, thus providing insight into an individual's working memory capabilities. The test-retest reliability scores for digit backward test on the WAIS ranges from moderate to high i.e. from 0.69 to 0.89. Internal consistency scores are ranges from 0.73 to 0.86. Similarly, the WCST is utilized as an assessment tool to evaluate cognitive mental shift abilities. During this test, individuals are required to sort a set of cards based on different attributes, such as color, shape, or number. However, the sorting rules change throughout the test, necessitating cognitive adaptation and strategy shifting. In this study, the researchers employed the PsyToolkit experiment library, a web-based service, to administer the test. However, the test used was not an exact replica of the copyrighted WCST. Instead, it was a computer-based task that drew inspiration from the original work by Berg (1948). There were notable differences between the test used in this study and the original WCST, such as its computer-based nature and the focus on total errors, perseverative errors, and non-perseverative errors only. The intra-class correlation coefficient for perseverative errors

and non-perseverative errors are 0.92 and 0.88 suggesting being excellent inter-scorer reliability. The test-retest reliability scores for all the scoring dimensions to range between 0.50 to 0.90 indicating a moderate to high reliability scores. Similarly, PsyToolkit, was utilized to conduct the assessment of go/no-go. The participant are instructed to press the space bar when they see 'Green Go signal' and withhold their response when they see 'Red No Go signal' to the Robert's target stimulus 'X' and 'Y'. There are 25 trials in the test and out of which 5 are of no-go signal and 15 are of go signal. The test-retest reliability ranges between 0.55 to 0.87 and internal consistency ranges from 0.65 to 0.90 for the go/no-go test. The test is scored based on the number of correct responses and errors committed to assess the impulse inhibition. Furthermore, the Mini-Mental Status Examination (MMSE), developed by Folstein in 1975, is employed as a screening tool to detect cognitive impairments in individuals. It encompasses various cognitive domains, including orientation, memory, attention, language, and visuospatial skills. Based on the MMSE results, further assessments of cognitive executive functions can be determined.

Sample:

125 under-trial prison participants were selected using a purposive sampling method.

Design-

Comparison group design

Inclusion criteria:

The target population for this study comprises under-trial prisoners who are incarcerated in Central Jail and accused of committing property crimes, crimes against the human body, crimes related to the Narcotic Drugs and Psychotropic Substance Act and those suspected for recidivism. In addition, the participants must have scored above 24 in the mini-mental status examination, indicating a minimum level of cognitive functioning. It is also necessary for the participants to possess the ability to read, write, and comprehend English and/or Kannada languages.

Exclusion criteria:

Under-trials who are currently on bail

Procedure:

Approval from the Doctoral committee of the Department, Karnatak University has been obtained along with it written permission from the Additional Director General of Police, Department of prisons and correctional services, State of Karnataka was obtained, to conduct the study and collect the data from under-trial prisoners of Central Prison. After obtaining consent from the participants, a rapport was established, and data pertaining to the specific type of crime for which they are suspected of perpetrating was gathered. All participants underwent the Go/No-Go test, digit backward test, and WCST as part of the assessment process.

Data analysis:

MANOVA is utilised to test the hypothesis using SPSS

Results and Discussion

This study involved a total of 125 participants, comprising 116 males and 9 females, who were under-trial prisoners. All the participants have successfully completed the data collection process. Due to security concerns, a purposive sampling technique was employed to select the participants, as the researcher did not have the discretion to choose them independently. Mini mental status examination was used to screen the participants with cognitive impairments. The three executive functions namely working memory, impulse inhibition and mental shift were measured through the digit backward test, the Go/No-go test, and the Wisconsin card sorting test. Further categorization was made based on the type of crime they are suspected to have committed. They are crime against human body (which included murder and rape), crime against property (which included theft, robbery, dacoity) and crimes of Narcotic-Drugs-and-Psychotropic-Substances act. In addition, the sample consisted of prisoners who had previously committed a crime and were currently under trial for another alleged offense.

The scores are converted to Z scores and Mahalanobis distance is calculated to identify the multivariate outliers. The maximum and minimum scores for mahalanobis distance were

48.226 and .374, based on these values two outliers were identified and eliminated from the data set using Chi-square table. Test of normality is conducted through Shapiro-Wilk test (Refer to Table 1).

Table 1: Tests of Normality

	Shapiro-Wilk		
	Statistic	df	Sig.
Zscore(DigitBackward)	.896	123	.000
Zscore(ImpulseInhibitionR)	.686	123	.000
Zscore(TotalErrors)	.982	123	.099
Zscore(PE)	.979	123	.050
Zscore(nPE)	.885	123	.000

Table 2: Multivariate Test for significance

Wilks' Lambda	F	Hdf	Edf	P
.824	1.949	12.000	307.199	.029

All the assumptions of MANOVA, including sample size, outlier testing, distribution of normality, multicollinearity, and equal variance, have been met. MANOVA was employed to examine potential variations in the performance of executive function tasks among individuals accused of different types of crimes. The results of the MANOVA test indicate a statistically significant difference in the performance of executive function tasks among suspects associated with various crime types, as the p-value is less than 0.05 (Refer to table 2). Consequently, we reject the null hypothesis, which states that there is no significant difference in mental shift, working memory, and impulse inhibition executive functions among accused individuals involved in different types of crimes. In summary, the findings of this study indicate a noticeable discrepancy in executive functions among suspects involved in various types of crimes.

The present study utilized Sheffe's post-hoc analysis to examine the group means and determine significant differences among various categories of crime offenders. The findings revealed statistically significant differences in performance on two cognitive tests, namely the digit backward test and the Wisconsin Card Sorting Test (WCST), for different groups of offenders. These results have important implications for our understanding of the cognitive abilities and potential differences among individuals involved in different types of crimes.

Firstly, regarding the digit backward test, the analysis demonstrated a significant difference in performance between individuals accused of crimes related to the Narcotic Drugs and Psychotropic Substances (NDPS) Act and those accused of property crimes. The obtained p-value of 0.039 indicates that the likelihood of obtaining such a difference due to chance is relatively low. The respective Z-scores of 0.586 and -0.256 further support this finding. These results suggest that individuals accused of NDPS crimes exhibit superior working memory abilities compared to those accused of property crimes.

Working memory plays a crucial role in various cognitive processes, such as information retention, manipulation, and mental multitasking. The superior performance of NDPS crime offenders on the digit backward test may suggest a heightened capacity for holding and manipulating information in their working memory. It is important to note that this finding does not imply a causal relationship between cognitive abilities and criminal behavior. However, it does provide evidence for a potential cognitive distinction between these two groups.

Secondly, the WCST was used to assess cognitive abilities related to mental shifting. The analysis revealed a significant difference in the non-perseverative errors of the WCST between individuals accused of NDPS crimes and those suspected to be recidivists. The obtained p-value of 0.049 and the corresponding Z-scores of -0.519 and 0.269 indicate that accused NDPS crime offenders outperformed re-offenders in terms of mental shifting abilities. A lower Z-score indicates better performance, as it reflects fewer errors in mental shifting.

Cognitive flexibility is a crucial aspect of executive functioning, allowing individuals to adjust their mental constructs and adapt to changing environmental demands. The superior performance of NDPS crime offenders on the WCST suggests that they possess better

cognitive abilities to shift their mental strategies and adjust their behavior in response to environmental cues, compared to re-offenders. The lower number of non-perseverative errors in the WCST reflects their enhanced capacity to maintain focus and resist distractions. These findings highlight potential differences in the cognitive processes involved in the commission of different types of crimes.

On the other hand, no significant differences were found in impulse inhibition and perseverative errors of the WCST among the accused re-offenders, NDPS crimes, property crimes, and crimes against the human body. These results would imply that individuals suspected to be involved in these different categories of crimes exhibit similar cognitive profiles in terms of impulse control and perseverance errors during the WCST.

Overall, the findings of this study provide valuable insights into the potential cognitive distinctions among individuals involved in different types of crimes. The superior performance of accused NDPS crime offenders in working memory and cognitive flexibility tasks suggests that cognitive abilities may vary across offender groups. However, it is important to note that these findings do not imply causation, and other factors beyond cognitive abilities likely contribute to criminal behavior.

Table 3: Scheffe's post hock analysis

	Multiple Comparison Scheffe			
Dependent Variable	Categorical Division	CategoricalDivision	Mean difference	Sig.
Z score (Digit Backward)	Reoffenders	NDPS	-.7440333	.073
		Property offences	.0984136	.982
		Offenses against Human body	-.1646321	.898
	NDPS	Reoffenders	.7440333	.073
		Property offences	.8424469*	.039
		Offenses against Human body	.5794012	.195
	Property offences	Reoffenders	-.0984136	.982
		NDPS	-.8424469*	.039
		Offenses against Human body	-.2630457	.712
	Offenses against Human body	Reoffenders	.1646321	.898
		NDPS	-.5794012	.195
		Property offences	.2630457	.712
Z score (Impulse Inhibition R)	Reoffenders	NDPS	-.0378393	.999
		Property offences	.3286259	.458
		Offenses against Human body	.2312035	.654
	NDPS	Reoffenders	.0378393	.999
		Property offences	.3664652	.520
		Offenses against Human body	.2690428	.699
	Property offences	Reoffenders	-.3286259	.458
		NDPS	-.3664652	.520
		Offenses against Human body	-.0974224	.967

Z score (Impulse Inhibition R)	Offenses against Human body	Reoffenders	-.2312035	.654
		NDPS	-.2690428	.699
		Property offences	.0974224	.967
Z score (Total Errors)	Reoffenders	NDPS	.0706613	.212
		Property offences	-.3545021	.987
		Offenses against Human body	-.3123700	.996
	NDPS	Reoffenders	-.0706613	.212
		Property offences	-.4251635	.378
		Offenses against Human body	-.3830313	.249
	Property offences	Reoffenders	.3545021	.987
		NDPS	.4251635	.378
		Offenses against Human body	.0421321	.999
	Offenses against Human body	Reoffenders	.3123700	.996
		NDPS	.3830313	.249
		Property offences	-.0421321	.999
Z score (PE)	Reoffenders	NDPS	.7897852*	.997
		Property offences	.3922253	.596
		Offenses against Human body	.3096489	.606
	NDPS	Reoffenders	-.7897852*	.997
		Property offences	-.3975599	.595
		Offenses against Human body	-.4801363	.616
	Property offences	Reoffenders	-.3922253	.596
		NDPS	.3975599	.595
		Offenses against Human body	-.0825764	.999
	Offenses against Human body	Reoffenders	-.3096489	.606
		NDPS	.4801363	.616
		Property offences	.0825764	.999
Z score (nPE)	Reoffenders	NDPS	.6210571	.049
		Property offences	.0922841	.446
		Offenses against Human body	.0548230	.553
	NDPS	Reoffenders	-.6210571	.049
		Property offences	-.5287730	.589
		Offenses against Human body	-.5662341	.355
	Property offences	Reoffenders	-.0922841	.446
		NDPS	.5287730	.589
		Offenses against Human body	-.0374611	.987
	Offenses against Human body	Reoffenders	-.0548230	.553
		NDPS	.5662341	.355
		Property offences	.0374611	.987

*. The mean difference is significant at the .05 level.

Implications

This research study has significant implications for our understanding of cognitive differences among individuals involved in different types of crimes. The findings suggest that individuals accused of crimes related to the Narcotic Drugs and Psychotropic Substances Act demonstrate superior working memory and cognitive flexibility compared to those accused of property crimes and re-offenses. The results emphasize the potential influence of cognitive factors on criminal behavior, highlighting the need for further investigation into the underlying mechanisms. Replicating the findings with larger and more diverse samples would enhance the generalizability of the results. Additionally, exploring factors such as socio-economic conditions, education levels, and substance abuse patterns could provide a more comprehensive understanding of the complex relationship between cognition and criminal behavior. Understanding these cognitive distinctions among offender groups could assist in the development of targeted interventions and rehabilitation programs tailored to address the specific needs of individuals involved in different types of crimes.

Limitations of the study

The present study has a few limitations that should be acknowledged. Firstly, the Go/No-Go test used to assess impulse inhibition did not reveal any significant differences between the groups. It is possible that using a test with better discriminating power could have provided more accurate measurements of impulse inhibition abilities. Additionally, important factors known to influence executive function performance, such as intelligence, attention deficit disorder, major depression, substance use, and traumatic brain injury, were not taken into account in this study. Considering these factors in future research could provide a more comprehensive understanding of the relationship between psychopathy traits and executive functions.

Conclusion:

The findings of this study provide compelling evidence for the presence of significant variations in executive function performance among individuals accused of different types of crimes. By satisfying the necessary assumptions, the MANOVA analysis demonstrated a statistically significant difference in executive functions across crime types. Consequently, the null hypothesis, suggesting no significant differences in executive functions among accused individuals involved in various crimes, was convincingly rejected. Further post-hoc analysis using Sheffe's test revealed specific group differences. Specifically, accused individuals of NDPS act crimes exhibited superior working memory compared to those accused of property crimes, as evidenced by the significant difference in the digit backward test. Similarly, accused individuals of NDPS crimes displayed greater cognitive abilities in mental shifting, adjusting their mental constructs based on environmental cues, in comparison to re-offenders, as indicated by the significant difference in the non-perseverative errors of the WCST. However, no significant differences were found in impulse inhibition and perseverative errors of the WCST among individuals accused of re-offending, NDPS crimes, property crimes, and crimes against the human body. These findings contribute to our understanding of the relationship between executive function and crime types, highlighting the importance of considering cognitive factors when assessing individuals involved in criminal behavior.

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