



Structural Relationships between brain- behavior systems and Cloninger Temperament and Character model with Tetrad dark sides of personality

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ABSTRACT

Background and Aim: It seems that one of the important factors affecting the dark dimensions of personality is brain-behavioral systems and dimensions of temperament and character, so the purpose of the present study is the relationship between brain-behavioral systems and temperament and character with dark dimensions of personality in students. **Methods:** The design of this research was a correlation method in terms of applied purpose and in terms of controlling variables. The statistical population of the study was all male and female students of national, free and non-profit universities of Tabriz in the academic year 2021. From this population, 450 people were selected by cluster random sampling and studied. The questionnaire of dark personality traits, brain-behavioral systems and temperament was used to collect data. Data has been analyzed using Pearson correlation coefficient and structural equation methods. **Results:** The results showed that there is a positive and significant relationship between behavioral activation system and dark dimensions of personality. There is also a significant negative relationship between behavioral deterrence system and war and escape with the dark dimensions of personality. On the other hand, innovation, self-avoidance, reward of dependence and self-escape with the dark dimensions of personality have a positive relationship and there is a negative and significant relationship between perseverance, self-direction and cooperation with the dark dimensions of personality. On the other hand, the results of path analysis showed that the variables of behavioral activation system and behavioral inhibition play a mediating role between temperament and character with dark personality traits. **Conclusion:** The results of this research show that paying attention to the variables of behavioral brain systems and temperament and character play an important role in the dark dimensions of personality.



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Introduction

Personality refers to a set of stable and variable, internal (hidden) and external (observable), unique and common characteristics of individuals that cause reaction and individual differences among humans. Behavioral differences in individuals may be the result of personality traits, which significantly influence thoughts and emotions, thus affecting an individual's behavioral responses (Forouzesh et al., 2018). One of the relatively new concepts in the field of personality is the dark triad of personality, or the dark triangle, first introduced in 2002 by Paulhus and Williams. They stated that in a normal statistical society and under conditions where unconventional behavioral signs have not appeared, the three traits of narcissism, antisocial behavior, and Machiavellianism can be considered as a single trait. These traits have a high internal correlation with each other, but are not equivalent. In other words, they have a lot of overlap with each other, but are separate constructs. They believe that these three characteristics all focus on malice, emotional coldness, deceit, and aggression, and focus on the dark and dirty aspects of personality (Paulhus & Williams, 2002).

In recent decades, this trait set has been considered as the core of emotional coldness, exhibitionism, and social deviation. The research of Meere and Egan (2017) showed that among the dimensions of dark personality traits, psychopathy is a strong predictor of psychological and physical/sexual abuse. The research of Flexson, Meldrum, Young, and Lehman (Franken, Morris, and Georgieva, 2006) showed that low self-control and dark personality traits independently predict crime commission. Knight's (2016) research showed that all three dark personality traits (narcissism, psychopathy, and Machiavellianism) are related to aggression; therefore, it is not surprising that these three traits are frequently considered as part of the dark nature of humans (Twenge & Campbell, 2009). The three dark personality traits are related to some negative traits such as dishonesty (Ashton & Lee, 2009), aggression (Jonason & Webster, 2010), and marital life problems (Jonason et al., 2009; Jonason et al., 2011).

There is extensive evidence supporting the inclusion of sadism or the infliction of pain on others in the dark triad traits (Chebrol et al., 2009; Buckels, Jones, and Paulhus, 2013;

Mededovic & Petrovic, 2015). Non-clinical sadism refers to a tendency towards hostility, lowly behavior, and aggressive behavior for pleasure or dominance. According to another definition, sadism is derived from the pleasure of confusing and harming others (Baumeister and Campbell, 1999). Sadism or the infliction of pain has a positive relationship with dark personality traits, with a correlation between 0.27 and 0.37 (Buckels, Jones, and Paulhus, 2013). Although sadism shows a common state of psychopathy, narcissism, and Machiavellianism, such as low empathy and emotional coldness (Mededovic & Petrovic, 2015), it is in fact a unique construct that is related to psychopathy, narcissism, and Machiavellianism (Buckels, Jones, and Paulhus, 2013; Mededovic & Petrovic, 2015). The research of Jones and Paulhus showed that individuals with high levels of Machiavellianism, psychopathy, and sadism score lower on empathy sub-scales, and those with higher levels of narcissism score higher on impulsivity sub-scales. Also, their research showed that psychopathy and sadism predict the lack of empathy, while only sadism predicts poor impulse control (Jones & Paulhus, 2014; 2010). Research findings have also reported the relationship of dark personality triads with impulsivity, behavioral risk-taking, and lack of self-control. Risk-taking refers to behaviors that increase the likelihood of negative, unpleasant, and physically, psychologically, and socially destructive outcomes. There are various reasons why people engage in risk-taking behavior. One possibility is that individuals, due to traits related to the dark personality triads, have an innate tendency to engage in risk-taking behaviors (Rassaei Keshkouk & Mansouri, 2020).

Gray's personality theory emphasizes the separate evolution of reward and punishment mechanisms in the brain of vertebrates. Gray, by revising the literature of animal research in Reinforcement Sensitivity Theory (RST), presented a biological model of personality, which includes three brain-behavior systems: (1) the Behavioral Activation System (BAS), (2) the Behavioral Inhibition System (BIS), (3) the Fight-Flight System (FFS) (Matthews and Gilliland, 1999; Core, 2004; Garcia, 2012; Malik, Sharp, and Alfano, 2014). According to Gray (1975), excessive inhibition is the central core of anxiety disorders and high impulsivity along with low anxiety is the basis of antisocial

personality disorders. Furthermore, from this perspective, emotional stability originates from low anxiety along with low impulsivity. In Gray's view, an individual whose behavioral inhibition system is stronger than his behavioral activation system is introverted. While a person with a relatively stronger behavioral activation system compared to the behavioral inhibition system is more extraverted. Therefore, according to Gray, the factor of extraversion indicates the level of desire and also anxiety, while neuroticism indicates the combined strength of both, where an increase in the sensitivity of each system increases the level of neuroticism. Gray's theory also argues that extraverts are conditioned quickly by unconditional reward stimuli, but Eysenck's prediction is that introverts are more conditioned (Gray & McNaughton, 2000).

Many studies have examined Gray's model based on Eysenck's model, showing the points of overlap and differences between the two theories. The results of these studies are sometimes contradictory. In this regard, Pickering and Diaz, by examining the relationship between the major dimensions of Eysenck's and Gray's personality theories, showed that the behavioral inhibition dimension has a non-negligible correlation with neuroticism. Studies have also shown that the behavioral inhibition dimension correlates with psychotism, indicating the importance of high sensitivity and activity of the behavioral inhibition system with antisocial behavior. Also, these two researchers claimed that the dimensions of Gray's behavioral inhibition-activation system theory, like Eysenck's dimensions, are not opposed to each other as the behavioral inhibition system correlates with various dimensions including psychotism, neuroticism, and extraversion of Eysenck's personality questionnaire (Pickering & Diaz, 2003).

Cloninger is one of the theorists of biological personality who has tried to create a solid theoretical framework for personality with a focus on biological parameters, covering both normal and abnormal personality. Cloninger, with a focus on biological parameters, has created a solid theoretical framework in two areas of temperament and character and has designed a questionnaire for temperament and character. Cloninger in the neurobiological model has proposed that temperamental systems in the brain have functional organization

consisting of different and independent systems for activation, continuation, and inhibition of behavior in response to specific groups of stimuli. Behavioral activation in response to new stimuli and signs of reward and relief from punishment is such a capability and is called "novelty seeking" (Cloninger, 1987; 1991; Garcia, Nima, and Archer, 2013).

Cloninger, Svrakic et al., and Cloninger and Svrakic in their research have shown that dimensions of temperament and especially character constructs have a strong correlation with personality disorders, such as antisocial personality (Cloninger, 1991; Svrakic et al., 2002; Cloninger and Svrakic, 2008). Kowalski et al. (2016) also showed in a study that the dark triad of personality correlates positively with undesirable personality dimensions that have negative temperamental or character traits such as mental disorders, and negatively with social desirability (Kowalski et al., 2016). Kaufman et al. (2019) also showed in their research that some temperamental and character traits such as sociability, selfishness (as opposed to cooperation), life satisfaction (similar to self-direction), exploitation of others, and aggressiveness are related (Kaufman et al., 2019). Additionally, Hudson et al. also confirmed the relationship between the dark triad of personality with some of the character dimension constructs (Hudson et al., 2018). Daynes and Vertig also confirmed this relationship in a similar study (Daynes and Vertag, 2018).

Overall, Gray's brain-behavior system and Cloninger's temperament and character model provide a framework for understanding differences and various personality traits. What is open for discussion and study is how these variables are placed in an organized model framework that can well explain the relationships between these variables and also due to the research gap in the field of explaining and forming the quadruple dark personality traits from the perspective of these two theorists, the present research investigates the structural relationships between Gray's brain-behavior systems and Cloninger's temperament/character model with the quadruple dark personality dimensions.

Method

The statistical population of this research includes all male and female students of public,

private, and non-profit universities in Tabriz who were studying in the academic year 2020-2021. The sample included 450 students selected through cluster random sampling from the universities of Tabriz. Ethical considerations included informed consent for participation in the research, emphasis on confidentiality of information, and avoidance of any harm to them.

Materials

1. Temperament and Character Questionnaire:

This questionnaire was developed by Cloninger (1994) to measure temperament and acquired character. It contains 125 questions answered as true or false by the subjects. It measures temperament (novelty seeking, harm avoidance, reward dependence, and persistence) and character (self-directedness, cooperativeness, and self-transcendence). The Cronbach's alpha coefficient of this questionnaire is reported as 0.68. In a study in Tehran, the Cronbach's alpha ranged from 0.55 to 0.84. Weak to moderate correlations (less than 0.40) were found between temperament and character dimensions. However, the correlation between self-directedness and harm avoidance was higher than 0.40 (Bahari and Narimani, 2008). The reliability of this questionnaire using Cronbach's alpha method was 0.89.

2. Revised Jackson's Reinforcement Sensitivity Scale (r-RST):

The revised Jackson's Reinforcement Sensitivity Scale (r-RST) developed in 2009 by Jackson, consists of 30 items. It includes three brain-behavior systems: the Behavioral Activation System (BAS) subscale, the Behavioral Inhibition System (BIS), and the Fight-Flight-Freeze System (r-FFF). The third system itself consists of three components: fight, flight, and freeze, which along with the activation and inhibition systems form Jackson's five factors. In this questionnaire, questions for the five subscales are: Behavioral Activation System (questions 1-6), Behavioral Inhibition System (questions 7-12), and three components of the Fight, Flight, Freeze System: fight component (questions 13-18), flight component (questions 19-24), and freeze component (questions 25-30). Jackson (2009) examined the psychometric properties of the revised r-RST scale. Construct validity for the five factors of the Behavioral Activation System (BAS), Behavioral Inhibition System

(BIS), and Fight, Flight, and Freeze was confirmed. He used Cronbach's alpha method for reliability assessment and reported the overall Cronbach's alpha coefficient as 0.70. The reliability of its subscales was reported as 0.83 for the Behavioral Activation System, 0.76 for the Behavioral Inhibition System, and 0.74 for the Fight, Flight, and Freeze System. In Iran, Hasani and colleagues (2010) standardized this questionnaire. Cronbach's alpha range (0.72 to 0.88), retest coefficients (0.64 to 0.78), and item-total correlations (0.28 to 0.68) indicated the validity of the Persian version of Jackson's five-factor questionnaire. Exploratory and confirmatory analyses supported the original five-factor model.

3. Dark Personality Traits Quadruple Questionnaire:

This questionnaire, combining the "Short Sadistic Impulse Scale" by O'Meara, Davies, and Hammond (2011) and the "Dirty Dozen" by Jonason and Webster (2010), was developed and standardized in Iran by Yousefi and Imanzad (2018). It consists of four subscales: narcissism (questions 9, 10, 11, 12), Machiavellianism (questions 1, 2, 3, 4), antisocial behavior (questions 5, 6, 7, 8), and sadism (questions 13-21). The questionnaire has 21 items, and subjects rate the relevance of each item to their condition on a 7-point Likert scale (strongly disagree = 1, to strongly agree = 7). Construct validity of the four-factor structure was shown through confirmatory factor analysis. Reliability coefficients ranged from 0.76 to 0.84 through retesting and from 0.68 to 0.88 through internal consistency (Cronbach's alpha).

Implementation

Initially, several faculties were randomly selected from public, private, and non-profit universities, then several classes from each faculty, and finally 450 students from these classes were selected as the sample. After coordinating, explaining the research objectives, obtaining their consent, and ensuring the confidentiality of information, questionnaires were simultaneously distributed to them. Structural equations using Lisrel software version 8.8 and SPSS version 20 were used for data analysis.

Results

Table (1) presents descriptive findings related to the mean and standard deviation of each of the research variables.

Table 1. The results of descriptive statistics

Variable		Mean	SD	Standard mean error
Dark triad	BAS	11.64	6.47	0.30
	BIS	12.68	6.77	0.31
	F&F	10.97	5.85	0.27
	Novelty seeking	11.79	6.58	0.31
Brain-behavioral system	Harm avoidance	28.88	13.71	0.64
	Reward dependence	34.18	11.60	0.54
	Persistence	36.35	12.88	0.60
Tamperament	Self-directedness	13.94	3.90	0.18
	Self-transcendence	13.19	3.88	0.18
	Cooperativeness	13.01	2.81	0.13
	BAS	13.69	3.10	0.14
Character	BIS	12.57	4.96	0.23
	F&F	11.75	2.85	0.13
	Novelty seeking	13.38	4.73	0.22

According to the contents of the above table, the means of dark personality traits, namely Machiavellianism, narcissism, antisocial behavior, and sadism, are respectively 11.64, 12.68, 10.97, 11.79; the means of brain-behavior system dimensions, namely the behavioral activation system, behavioral inhibition system, and fight or flight, are respectively 28.88, 34.18,

and 36.35; the means of temperament dimensions, namely novelty seeking, harm avoidance, reward dependence, and persistence, are respectively 13.94, 13.19, 13.01, and 13.69; finally, the means of character dimensions, namely self-directedness, self-transcendence, and cooperativeness, are respectively 12.57, 11.75, and 13.38.

Table 2. Correlation matrix

Variable		Machiavellianism	Antisocial	Narcissism	Sadism
Brain-behavioral system	BAS	0.13**	0.06	0.07	0.12**
	BIS	-0.34**	0.01	-0.19**	-0.02
	F&F	-0.10*	0.03	-0.11*	-0.05
Tamperament	Novelty seeking	0.14**	0.11*	0.07	0.06
	Harm avoidance	0.16**	0.12**	0.12**	0.01
	Reward dependence	0.10*	0.07	0.06	0.03
	Persistence	-0.15**	-0.05	-0.05	-0.009
Character	Self-directedness	-0.04	-0.13**	-0.03	-0.12**
	Self-transcendence	-0.09*	-0.07	-0.02	-0.02
	Cooperativeness	0.05	-0.11*	-0.02	-0.06

* $p < 0.05$; ** $p < 0.01$

Contents of Table (2) show that there is a positive and significant relationship between the behavioral activation system with dark personality traits, and the components of Machiavellianism and sadism ($p < 0.05$; $p < 0.01$). There is a negative and significant relationship between the behavioral inhibition system with dark personality traits, and the components of Machiavellianism and narcissism. There is a negative and significant relationship between the fight or flight system with dark personality traits, and the components of Machiavellianism and

narcissism ($p < 0.05$; $p < 0.01$). There is a positive and significant relationship between novelty seeking, harm avoidance, reward dependence with dark personality traits, and the components of Machiavellianism, narcissism, antisocial behavior, and sadism. There is a negative and significant relationship between self-directedness and cooperativeness with dark personality traits, and the components of antisocial behavior and sadism ($p < 0.05$; $p < 0.01$). The causal relationship model of the variables under study is presented next (Figure 1).

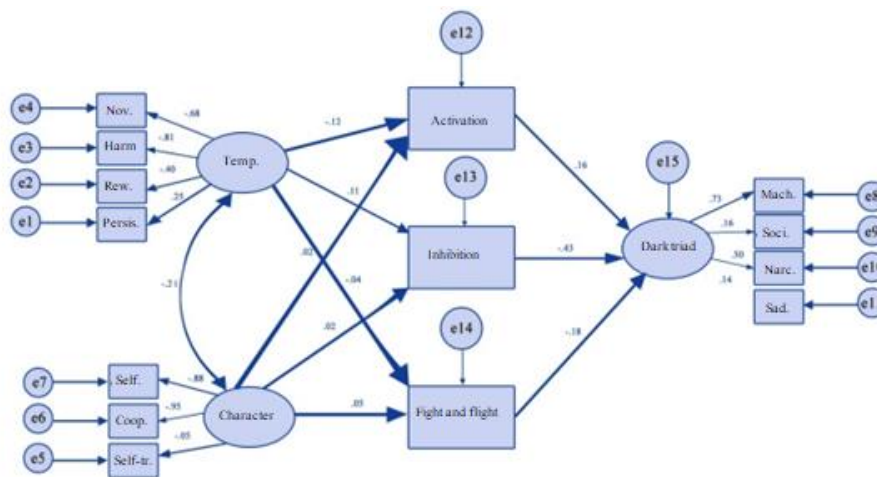


Figure 1. Causal model with beta values

Index	X ²	DF	X ² /df	GFI	AGFI	IFI	CFI	RMSEA
Model	140.56	70	2.008	0.92	0.90	0.93	0.93	0.04

Values obtained in Table (3) indicate that the variables in the proposed model can explain the variance of dark personality traits; because the values of the Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Incremental Fit Index (IFI), and Comparative Fit Index (CFI) in the model are more than 0.9. Also, in suitable models, the ratio of chi-square to degrees of freedom (X²/df) should be in the

range of 1 to 3, which in this model is within the range of 1 to 3. Additionally, the Root Mean Square Error of Approximation (RMSEA) should be less than 0.09, which in this model is 0.04, indicating the model's credibility. Therefore, the presented model is fully saturated.

Subsequently, the direct and indirect effects of the variables are presented:

Independent variable	Dependent variable	Effect	t	Sig.	Result
Temperament	BAS	-0.12	1.94	0.04*	Approved
	BIS	0.11	1.77	0.07	Rejected
	F&F	-0.04	0.69	0.48	Rejected
Character	Novelty seeking	0.02	0.38	0.70	Rejected
	Harm avoidance	0.01	0.31	0.75	Rejected
	Reward dependence	0.05	0.76	0.44	Rejected
BAS	Persistence	0.15	2.74	0.006**	Approved
BIS	Self-directedness	-0.43	-7.26	0.001**	Approved
F&F	Self-transcendence	-0.17	-3.15	0.002**	Approved

According to Table (4), the effect of temperament on behavioral activation with an effect size of -0.12 is statistically negative and significant. The effect of temperament on behavioral inhibition and fight or flight with effect sizes of 0.11 and 0.04 is statistically insignificant. The effect of character on behavioral activation, behavioral inhibition,

and fight or flight is not statistically significant. The effect of behavioral activation on dark personality traits with an effect size of 0.15 is statistically significant. The effect of behavioral inhibition on dark personality traits with an effect size of -0.43 is statistically significant. The effect of fight or flight on dark personality traits with an effect size of -0.17 is significant.

Table 5. Indirect effect and t-values

Independent variable	Mediator	Dependent variable	Effect size	t	Sig.
Temperament	BAS	Dark triad	0.06	2.45	0.02
	BIS	Dark triad	0.001	0.56	0.07
	F&F	Dark triad	0.002	0.32	0.10
Character	BAS	Dark triad	-0.01	3.45	0.001
	BIS	Dark triad	0.09	2.87	0.001
	F&F	Dark triad	0.01	0.45	0.06

The effect of temperament and character on dark personality traits through the behavioral activation system and behavioral inhibition system is statistically significant and plays a mediating role.

Conclusion

This research aimed to investigate the relationship between brain-behavior systems, temperament and character dimensions, and dark personality traits among students. The findings revealed that there is a significant positive relationship between the behavioral activation system and dark personality traits, specifically Machiavellianism and sadism. This aligns with the studies of Azami and Kakabaraei (2016) and Carr (2016), where Carr demonstrated that individuals with a more sensitive behavioral activation system experience positive emotions like hope and happiness, and also report higher emotional arousal such as aggressive tendencies. Azami and Kakabaraei found that dark personality dimensions can be predicted by the variables of the behavioral activation system, behavioral inhibition system, and emotional dysregulation. These variables are crucial in predicting student turmoil and dark personality. It has been established that the behavioral activation system is negatively and significantly associated with emotional problems. One of the symptoms of heart disease includes emotional problems and the experience of negative emotions such as fear, depression, and anger, leading to emotional dysregulation. These results suggest that individuals with more problems are less reward-seeking and inclined towards pleasurable behaviors, thus experiencing fewer pleasant emotions than average individuals. Students with more dark personality components likely have limited ability to choose an adaptive emotional regulation strategy. They might misinterpret physiological feelings associated with emotional arousal and perceive these sensations as behavioral inhibition. Essentially,

the behavioral activation system increases dark personality traits in students (Carr, 2016).

Another finding showed a significant negative relationship between the behavioral inhibition system and dark personality traits, including Machiavellianism and narcissism. Abnormal sensitivity in brain-behavior systems indicates a predisposition and readiness for various mental disorders. Thus, it is hypothesized that the behavioral activation and inhibition systems can explain a wide range of disorders. Individuals with a weak inhibition system exhibit poor control over attention, planning, action organization, behavior control, and emotional regulation, increasing their vulnerability to emotional dysregulation. A person capable of regulating their emotions can experience or prevent emotions without any internal or external compulsion. In contrast, someone unable to manage or regulate emotions cannot experience them properly or prevent their occurrence, leading to an increase in dark personality dimensions (Miller et al., 2013).

The study also found that there is a significant positive relationship between novelty seeking, harm avoidance, reward dependence, and dark personality traits, including Machiavellianism, narcissism, antisocial behavior, and sadism. Conversely, persistence shows a significant negative relationship with dark personality traits. These findings are consistent with the research of Ahmadi Azar and Jahan (2017) and Widiger (2011), where Ahmadi Azar and Jahan found that negative affect had a positive and significant direct effect on the dark triad of personality, while temperament, character, and wisdom had a positive and significant structural effect on affect. The indirect effects of temperament and character on the dark triad were negative and significant. Widiger's study showed that individuals with high levels of Machiavellianism and narcissism could not understand others' intentions and might display violent behavior,

leading to interpersonal problems and emotional turmoil.

High harm avoidance, characterized by avoidance of risky situations, cautiousness, and introversion, acts as a barrier against obsessive-compulsive symptoms. Low harm avoidance traits, such as confidence in the face of uncertainty, lead to excessive efforts with minimal personal distress, with the drawback of not responding to danger and unrealistic optimism, potentially leading to risky situations and an increase in dark personality dimensions (Ahmadi Azar & Jahan, 2017).

The results suggest that higher levels of self-transcendence increase dark personality traits. This aligns with the studies of Ahmadi Azar and Jahan (2017) and Dossey (2018), where Dossey showed that positive affect is positively related to self-transcendence (a character component) and life satisfaction and well-being (representations of self-directedness in the temperament variable).

In conclusion, the study indicates that identifying biological systems in students can assist professionals in identifying risk and maintenance factors and planning interventions based on the biological characteristics of their clients. Limitations of the study include self-reported data collection and the restriction of the sample to students of specific university types, cautioning against generalizing the findings to other universities. Other limitations include the inability to control other influencing variables during the research. Therefore, it is suggested to use other research methods such as interviews and observations for data collection and to conduct further studies with the same variables in a broader target population.

Conflict of Interest

According to the authors, this article has no financial sponsor or conflict of interest.

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