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The relation between temperament and anger response among prisoners: comparison of Reinforcement Sensitivity Theory and the Psychobiological Model of temperament and character

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ABSTRACT

This study investigates the relation between temperament and anger response among prisoners, and compares temperament as proposed by Reinforcement Sensitivity Theory and the Psychobiological Model of Temperament and Character. We asked 210 prisoners to respond to Korean standardized questionnaires, with items of the Behavioral Inhibition System/Behavioral Approach System (BAS/BIS), and the items of Temperament and character inventory (TCI). Based on the Novaco Anger Scale, prisoners' anger responses were rated as those of direct, indirect, verbal, or impulsive. Three factors of the BAS and BIS all demonstrated significantly positive correlations, while reward dependence and novelty-seeking from the TCI showed a correlation nearing 0. Also, higher harm avoidance of TCI was associated with lower reward dependence, lower level of persistence, and higher level of novelty-seeking of TCI. Regression analyses showed that impulsive anger reaction was significantly explained by novelty-seeking of TCI and BIS; verbal aggression by fun-seeking of BAS and novelty-seeking of TCI; physical confrontation by novelty-seeking of TCI and fun-seeking of BAS; and indirect expression by novelty-seeking, harm avoidance, and persistence of TCI and fun-seeking of BAS.

1. Introduction

1.1. Anger response among prisoners

In Novaco (1994) model of anger, anger responses depend on how the individual interprets the circumstances, where anger is comprised of cognition, physiological arousal, and behavioral reactions. Cognition includes an individual's evaluation, expectations, attitudes, and beliefs; physiological arousal is a cognitive interpretation of the environment in which anger is triggered; and behavioral reactions triggered by anger include impulsive reactions, verbal aggression, physical confrontation, and indirect expression.

While anger is not a sufficient condition for violence or aggression, it is an important precursor (Howells, 1998). Empirical research has also suggested that anger affects prisoners by causing problems related to discipline, aggression, and violence (Howells et al., 2008). Ramirez, Jeglic, and Calkins (2015) argued that anger might cause interpersonal problems that can lead to violence through revenge and hostility.

Since it is likely that an individual's cognitive assessment applies to anger responses in prison life, this study investigated the characteristics of prisoners' anger responses as direct, indirect, verbal, or impulsive based on Novaco (1994) model of anger. Additionally, since anger responses originated to aid survival, we assumed that temperament might be associated with the formation and development of individual anger responses.

1.2. Reinforcement Sensitivity Theory and the Psychobiological Model of Temperament and Character

Today, researchers agree that personality is a result of the interaction between inherited traits, innate traits, and environmental effects. While temperament is an automatic emotional response to stimuli that is genetically predicated and considered a relatively stable property throughout life, personality is formed by interacting with the environment, and develops throughout life (Cloninger et al., 1993).

Principal models of temperament include Gray's Reinforcement Sensitivity Theory (RST) (1982, 2000) and Cloninger's Psychobiological Model of Temperament and Character (Cloninger et al., 1993). When first proposed, Gray's RST emphasized the Behavioral Approach System (BAS) and Behavioral Inhibition System (BIS); the revised model added the

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Fight-Flight-Freeze System (FFFS). The BAS is not simply a conditioned stimulus; it has three factors: "drive," "reward sensitivity," and "fun seeking." BIS is a comparator that assesses whether to approach or avoid a stimulus, and is activated when a threat is ambiguous and requires exploration, which results in arousal, over-sensitivity, or a cautious approach to the threat. The FFFS system mediates fear reactions to obvious stimuli. *Fight* is an active response to a threat and can be a defensive attack against inevitable pain; when evasion is possible, *flight* may be the active response to a threat; and *freeze* is associated with the physiological state of panic (Walker et al., 2017, p. 233).

Compared to conventional personality theories, Cloninger's Psychobiological Model of Temperament and Character (Cloninger et al., 1993), attempted to differentiate between temperament and personality. Cloninger suggested three dimensions corresponding to the neurobiological system that controls the three basic functions of behavior. Novelty seeking corresponds to the behavior activation system, comprises a response to novel stimuli or reward signals, and is activated to avoid punishment. Harm avoidance corresponds to BIS and is a response to a potential threat or lack of reward. Reward dependence corresponds to the behavior maintenance system, maintains rewarded behavior without continuous strengthening, and is further categorized into reward dependence and persistence. Thus, the current Psychobiological Model of Temperament and Character assumes that temperament consists of "novelty seeking," "harm avoidance," "reward dependence," and "persistence" and that personality consists of "autonomy," "solidarity," and "self-transcendence." This model, which attempts to combine the effects of genes and environment, is widely used in clinical research (Mardaga and Hansenne, 2007).

Conceptual similarities can be inferred between Gray's Reinforcement Sensitivity Theory and Cloninger's Psychobiological Model of Temperament and Character. For example, BIS and "fun seeking" in BAS from the RST are similar to "harm avoidance" and "novelty seeking" from the Psychobiological Model of Temperament and Character. Based on these inferences, Zelenski and Larsen (1999) conducted a factor analysis of the response values of two questionnaires, the Temperament and Character Inventory (1st version) and the BAS/BIS. As a result, novelty seeking and fun seeking combined into "impulsivity," harm avoidance and BIS into "punishment sensitivity," and persistence, reward sensitivity, and drive into "reward sensitivity."

However, Zelenski and Larsen (1999) study used a previous version of the questionnaire before the Psychobiological Model of Temperament and Character was revised. Thus, temperament was measured with three dimensions and the roles of reward dependence and persistence could not be examined separately. The current study measured the "novelty seeking," "harm avoidance," "reward dependence," and "persistence" of the revised Psychobiological Model of Temperament and Character, and the "drive," "reward sensitivity," and "fun seeking" in BAS and BIS from Reinforcement Sensitivity Theory using the Korean version of the standardized questionnaires, and examined how these factors related to prisoners' anger responses.

1.3. The relation between temperament and anger

The possibility of relating temperament and anger among prisoners convicted of a crime was supported by recent research (Kemp et al., 2018), which found that affective triggers can result in risky or impulsive behavior. They divided affect profiles into four types by avoidance and approach levels based on core temperament.

The relation temperament and anger was also supported by brain studies. Gray (1994) suggested that three central nervous system functions lead to synchronous behavior in RST, based on independent emotion systems, while previous empirical studies examined the relationship between BAS and BIS, brain activity levels, and specific emotional experiences. Sutton and Davidson (1997) found that higher activity in the left frontal cortex was associated with a higher level of positive emotional experiences. Harmon-Jones and Sigelman (2001) found that increased left frontal cortex activity and decreased right frontal cortex activity were correlated with trait and state anxiety. Furthermore, Gray and McNaughton (2000) and Corr (2002) suggested that BAS was associated with positive emotion, BIS with anxiety, and FFFS with fear. Moreover, higher cortical activity in the left prefrontal cortex after watching a happiness-inducing video was associated with positive emotions. These results demonstrated the interactive relationship between behavioral activation systems, positive emotional experiences, and left frontal cortex activity.

A number of empirical studies have argued that BAS is related to positive emotions, but could also be related to negative emotions (Harmon-Jones, 2003). Carver (2001) noted that failure to reach a desired goal can lead to depression, and inability to escape an outcome one was trying to avoid can lead to anxiety. In a study on brain activity in response to an anger-inducing situation, BAS correlated with anger. In other words, in anger-inducing situations, there is reduced activity in the right frontal cortex and increased activity in the left frontal cortex (Harmon-Jones et al., 2002). Studies have also demonstrated that chronic negative emotions and BAS significantly explain anger experiences, and that physical aggression positively correlates with BAS and negatively correlates with BIS (Harmon-Jones, 2003).

Several studies have focused on the relationship between anger and the four dimensions of temperament suggested by the Psychobiological Model of Temperament and Character. In a study on patients with eating disorders, a higher level of novelty seeking was associated with a greater tendency of anger-out and a higher level of trait anger (Fassino et al., 2001). A study of college students demonstrated that trait anger had a significant positive relationship with novelty seeking and harm avoidance and a significant negative relationship with reward dependence (Aslan and Arkar, 2016).

Based on these studies, it can be inferred that BIS is related to negative emotions and BAS to positive emotions. Similarly, the anger response in an anger-inducing situation might be positively related with BAS and novelty seeking, but negatively related with BIS and harm avoidance. However, there are few studies on the relationship between anger response, BAS factors, and the four dimensions of temperament in the Psychobiological Model of Temperament and Character. Furthermore, despite the high likelihood of a similarity between the temperaments suggested by the Reinforcement Sensitivity Theory and Psychobiological Model of Temperament and Character, there is little research comparing the associations between each dimension or system and the anger response.

Thus, this study aimed to 1) examine the strength of associations between temperament factors and anger response among prisoners, 2) investigate the similarities and differences of each temperament measure from Gray's Reinforcement Sensitivity Theory and Cloninger's Psychobiological Model of Temperament and Character, and 3) explore the relationship between the temperament factors in each model to understand the nature of temperaments.

2. Methods

2.1. Participants

Study participants included male prisoners in five different sites in South Korea. A prison officer explained the research purpose and instructions to the prisoners who were provided with the written informed consent. After they consented to participate, the questionnaire was administered in education centers, living rooms, investigation rooms, and workshops in the respective correctional facilities with a prison guard present. The questionnaires were completed alone or in groups. Where multiple participants worked in groups, the attending prison officer ensured that participants did not discuss their responses or look at others' responses. The questionnaire took approximately one hour to complete, and a total of 210 questionnaires were collected.

2.2. Ethical considerations

This study was approved by the Institutional Review Board (IRB) of Hanyang University Guri Hospital. To guarantee the security of personal data, names were deleted and access to all data was limited to the researcher.

2.3. Measurement and scales

2.3.1. Anger behavior

The anger behavior measurement index developed by Novaco (1994) and standardized by Kim (2009) was used to measure the response to an anger-inducing event. The survey comprises 48 items on a 3-point scale (from 1 = "never" to 3 = "sometimes") and is categorized into cognitive, arousal, and behavior sections. Our study used only items from the behavior section.

Anger behavior measures the response to anger-inducing stimuli, including impulsive reaction, verbal aggression, physical confrontation, and indirect expression. Impulsive reaction is an immediate unsuppressed response to an anger stimulus; verbal aggression involves aggressive language that targets others; physical confrontation involves physically harming others; and indirect expression refers to posing harm or threat to a weaker opponent. Each factor was measured with four items. The internal consistencies (Cronbach's α) in this study were: impulsive reaction $\alpha = .75$, verbal aggression $\alpha = .75$, physical confrontation $\alpha = .72$, and indirect expression $\alpha = .77$.

2.3.2. Behavior activation system and behavior inhibition system (BAS/BIS)

We used the BAS/BIS measures developed by Carver and White (1994) that were standardized by Kim and Kim (2001) into a Korean version of the BAS/BIS. The BIS is a single measure consisting of seven items, while the BAS comprises drive, reward sensitivity, and fun seeking, consisting of four, five, and four items, respectively, on a four-point scale.

In accordance with the research aim, drive, reward sensitivity, and fun seeking were selected from the BAS factors. Individual responses were calculated from the corresponding items total. The internal consistencies (Cronbach's α) of Kim and Kim (2001) measure were: behavior inhibition $\alpha = .86$, drive $\alpha = .87$, reward sensitivity $\alpha = .85$, and fun seeking $\alpha = .78$. The Cronbach's α of the measures in our study were: behavior inhibition $\alpha = .80$, drive $\alpha = .77$, reward sensitivity $\alpha = .76$, and fun seeking $\alpha = .70$.

2.3.3. Temperament and character inventory

We used the Korean TCI version with 140 items, developed by Cloninger et al. (1994) and standardized by Min et al. (2007). We obtained responses for 81 items that measure the four dimensions of temperament, with 20 items on novelty seeking, 21 on harm avoidance, 20 on reward dependence, and 20 on persistence measured. All items were on a 5-point scale and the total measure was the sum of the dimension scores.

The Cronbach's alphas reported from standardizing the inventory were: novelty seeking $\alpha = .84$, harm avoidance $\alpha = .84$, reward dependence $\alpha = .77$, and persistence $\alpha = .85$. The Cronbach's alphas in our study were: novelty seeking $\alpha = .80$, harm avoidance $\alpha = .81$, reward dependence $\alpha = .72$, and persistence $\alpha = .72$.

2.4. Data analysis

To examine whether the factors suggested by BAS/BIS (Gray, 1982) and the four TCI dimensions (Cloninger et al., 1993) affected responses to anger-inducing situations, we performed correlation and regression analyses. First, we calculated the Pearson correlational coefficients between the four types of anger response and temperament measures. Next, we performed a regression analysis using the enter method to examine the predictive effects of temperament measures for explaining each anger response. Finally, considering the significant correlations among temperament factors, we performed a stepwise regression analysis. IBM SPSS Statistics version 18.0 was used for all analyses.

3. Results

3.1. Relationship among temperaments

Table 1 lists the average values of the eight temperaments measured in our study as well as their descriptive statistical value and the correlations between temperaments.

The temperaments suggested in BAS/BIS all demonstrated significant positive correlations ($.29 < rs < .60$, $ps < .001$). The temperaments suggested in the TCI had larger value ranges and most demonstrated negative correlations. A higher level of harm avoidance was associated with a lower level of reward dependence ($r = -.24$, $p < .001$), lower level of persistence ($r = -.32$, $p < .001$), and higher level of novelty seeking ($r = .39$, $p < .001$). A higher level of reward dependence was associated with a higher level of persistence ($r = .25$, $p < .001$), and a higher level of persistence was associated with higher level of novelty seeking ($r = .27$, $p < .001$). In contrast, reward dependence and level of stimulus had a near zero correlation.

The correlations between factors which assumed to be similar were as follows. BIS and level of harm avoidance from the TCI showed a positive relationship ($r = .46$, $p < .001$) and reward sensitivity from BAS and reward dependence from the TCI showed a correlation that nears 0 ($r = -.03$). Drive from BAS and persistence from the TCI showed a moderately positive correlation ($r = .50$, $p < .001$). Level of fun-seeking from BAS and novelty-seeking from the TCI showed a moderately positive correlation ($r = .56$, $p < .001$).

3.2. Relationship between temperament and anger response

Table 2 shows the relationship between anger response and each temperament factors. Impulsive reaction, a tendency to fail to inhibit response to anger stimuli and to respond immediately, was higher when BIS was higher ($r = .31$, $p < .001$), reward sensitivity from BAS was higher ($r = .29$, $p < .001$), drive from BAS was higher ($r = .30$, $p < .001$), and fun-seeking from BAS was higher ($r = .36$, $p < .001$). It was also higher when reward dependence from the TCI was lower ($r = -.46$, $p < .001$), harm avoidance from the TCI was higher ($r = .24$, $p < .001$) and novelty seeking from the TCI was higher ($r = .52$, $p < .001$).

Verbal aggression was higher when BIS was higher ($r = .22$, $p < .01$), reward sensitivity from BAS was higher ($r = .23$, $p < .01$), drive from BAS was higher ($r = .29$, $p < .001$), and fun-seeking from BAS was higher ($r = .33$, $p < .001$). It was also higher when persistence from the TCI was higher ($r = .15$, $p < .05$) and novelty-seeking from the TCI was higher ($r = .32$, $p < .001$).

Physical confrontation was higher when BIS was higher ($r = .21$, $p < .01$), reward sensitivity from BAS was higher ($r = .28$, $p < .001$), drive from BAS was higher ($r = .26$, $p < .001$), and fun-seeking from BAS was higher ($r = .42$, $p < .05$). It was also higher when level of harm avoidance from the TCI was higher ($r = .14$, $p < .05$) and novelty-seeking from the TCI was higher ($r = .42$, $p < .001$).

Furthermore, indirect expression was higher when BIS was higher ($r = .34$, $p < .001$), reward sensitivity from BAS was higher ($r = .30$, $p < .001$), drive from BAS was higher ($r = .22$, $p < .01$), and fun-seeking from BAS was higher ($r = .37$, $p < .001$). It was also higher when harm avoidance from the TCI ($r = .39$, $p < .001$) and novelty-seeking from the TCI were higher ($r = .48$, $p < .001$).

3.3. Results of simultaneous regression analysis of temperament on anger response

Table 3 shows the results of simultaneous regression analysis performed to examine the relative explanatory power that each temperament has on anger response. The models predicting anger response from

Table 1
Mean (standard deviation) by temperament and correlation coefficients between temperaments.

	M(SD)	Theoretical range	1	2	3	4	5	6	7	8
1 Behavior inhibition system	16.81 (3.36)	7–28	1.00							
2 Reward sensitivity from behavior activation system	11.60 (2.76)	4–16	.48***	1.00						
3 Drive from behavior activation system	9.04 (2.58)	5–20	.29***	.58***	1.00					
4 Fun seeking from behavior activation system	8.42 (2.40)	4–16	.34***	.53***	.60***	1.00				
5 Harm avoidance from TCI	36.68 (10.11)	0–84	.46***	.25***	-.04	.08	1.00			
6 Reward dependence from TCI	41.34 (6.77)	0–80	-.10	-.03	.10	.07	-.24***	1.00		
7 Persistence from TCI	44.28 (10.02)	0–80	.03	.20**	.50***	.36***	-.32***	.25***	1.00	
8 Novelty seeking from TCI	32.68 (11.05)	0–80	.30***	.39***	.39***	.56***	.39***	.00	.27***	1.00

*$p < .05$, **$p < .01$, ***$p < .001$.

Table 2
Correlation coefficients of temperament and each anger response.

	Impulsive response M(SD)	Verbal aggression M(SD)	Physical confrontation M(SD)	Indirect expression M(SD)
	1.57 (.50)	1.75 (.48)	1.61 (.50)	1.46 (.48)
Behavior inhibition system	.31***	.22**	.21**	.34***
Reward sensitivity from behavior activation system	.29***	.23**	.28***	.30***
Drive from behavior activation system	.30***	.29***	.26***	.22**
Fun seeking from behavior activation system	.36***	.33***	.42***	.37***
Harm avoidance from TCI	.24**	.07	.14*	.39***
Reward dependence from TCI	-.46***	.05	-.05	-.12
Persistence from TCI	-.05	.15*	.11	-.05
Novelty seeking from TCI	.52***	.32***	.42***	.48***

*$p < .05$, **$p < .01$, ***$p < .001$.

only the eight temperaments were all significant (impulsive reaction, $R^2 = .28$, F = 9.76, p < .001; verbal aggression, $R^2 = .16$, F = 4.74, p < .001; physical confrontation, $R^2 = .24$, F = 7.85, p < .001; indirect expression, $R^2 = .33$, F = 12.29, p < .001).

For each type of anger response, we found the following. First, temperaments that significantly explain impulsive reaction are BIS ($\beta = .16$, $t = 1.98$, $p < .05$), drive from BAS ($\beta = .18$, $t = 2.06$, $p < .05$), persistence from the TCI ($\beta = -.21$, $t = -2.70$, $p < .01$), and novelty-seeking from the TCI ($\beta = .37$, $t = 4.49$, $p < .001$). Novelty-seeking from the TCI significantly explains verbal aggression ($\beta = .21$, $t = 2.38$, $p < .05$). Fun-seeking from BAS ($\beta = .26$, $t = 2.91$, $p < .01$) and novelty-seeking from the TCI ($\beta = .30$, $t = 3.56$, $p < .001$) significantly explain physical confrontation. Fun-seeking from BAS ($\beta = .16$, $t = 1.97$, $p < .05$), novelty-seeking from the TCI ($\beta = .32$, $t = 4.08$, $p < .001$) and persistence from the TCI ($\beta = -.18$, $t = -2.31$, $p < .05$) significantly explain indirect expression.

3.4. Results of stepwise regression analysis of temperament on anger response

We performed a stepwise regression analysis to calculate the predictive value of each temperament on anger response by including the covariations between temperaments (see Table 4). Each model was significant (impulsive reaction, $R^2 = .23$, F = 32.33, p < .001; verbal aggression, $R^2 = .14$, F = 16.26, p < .001; physical confrontation, $R^2 = .23$, F = 29.93, p < .001; indirect expression, $R^2 = .32$, F = 23.48, p < .001).

For impulsive reaction, novelty-seeking from the TCI in step 1 ($\beta = .46$, $t = 7.31$, $p < .001$) and BIS in step 2 ($\beta = .19$, $t = 3.03$, $p < .05$) showed significant explanatory power. For verbal aggression, fun-seeking from BAS in step 1 ($\beta = .33$, $t = 5.08$, $p < .001$) and novelty-seeking from the TCI in step 2 ($\beta = .19$, $t = 2.46$, $p < .05$) showed significant explanatory power. For physical confrontation, novelty-seeking from the TCI in step 1 ($\beta = .42$, $t = 6.67$, $p < .001$) and fun-seeking from BAS in step 2 ($\beta = .27$, $t = 3.58$, $p < .001$) showed significant explanatory power. For indirect expression, novelty-seeking from the TCI ($\beta = .48$, $t = 7.78$, $p < .001$), harm avoidance from the TCI ($\beta = .25$, $t = 3.82$, $p < .001$), fun-seeking from BAS ($\beta = .18$, $t = 2.53$, $p < .05$), and persistence from the TCI ($\beta = -.15$, $t = 2.18$, $p < .05$) showed significant explanatory power.

Table 3
Results of simultaneous regression analysis of temperament predicting anger response.

	Impulsive response				Verbal aggression				Physical confrontation				Indirect expression			
	B	*SE*	*β*	|*t*|	*B*	*SE*	*β*	|*t*|	*B*	*SE*	*β*	|*t*|	*B*	*SE*	*β*	|*t*|
BIS	.02	.01	.16*	1.98	.02	.01	.12	1.52	.01	.01	.05	.68	.01	.01	.10	1.37
BAS_RS	-.01	.02	-.03	.35	.00	.02	-.02	.18	.01	.02	.04	.50	.00	.01	.00	.01
BAS_D	.04	.02	.18*	2.06	.02	.02	.12	1.27	.00	.02	.00	.01	.01	.02	.07	.77
BAS_FS	.02	.02	.10	1.13	.03	.02	.14	1.51	.05	.02	.26**	2.91	.03	.02	.16*	1.97
TCI_HA	-.01	.01	-.04	.50	-.01	.01	-.09	.95	-.01	.01	-.09	.99	.01	.01	.14	1.70
TCI_RD	-.01	.01	-.02	.26	.01	.01	.04	.55	-.01	.01	-.07	1.01	-.01	.01	-.05	.89
TCI_P	-.02	.01	-.21**	2.70	-.01	.01	-.06	.74	-.01	.01	-.09	1.06	-.02	.01	-.18*	2.31
TCI_NS	.03	.01	.37***	4.49	.01	.01	.21*	2.38	-.02	.01	.30***	3.56	-.02	.01	.32***	4.08
R^2	.28				.16				.24				.33			
F (8,198)	9.76***				4.74***				7.85***				12.29***			

*$p < .05$, **$p < .01$, ***$p < .001$.
'BIS' = Behavior inhibition system; 'BAS_RS' = Reward sensitivity from behavior activation system; 'BAS_D' = Drive from behavior activation system; 'BAS_FS' = Fun seeking from behavior activation system; 'TCI_HA' = Harm avoidance from Temperament and Character Inventory; 'TCI_RD' = Reward dependence from Temperament and Character Inventory; 'TCI_P' = Persistence from Temperament and Character Inventory; 'TCI_NS' = Novelty seeking from Temperament and Character Inventory.

Table 4
Results of stepwise regression analysis of temperament predicting anger response.

	Impulsive response				Verbal aggression				Physical confrontation				Indirect expression			
	Predictor	β	$\|t\|$	ΔR^2	Predictor	β	$\|t\|$	ΔR^2	Predictor	β	$\|t\|$	ΔR^2	Predictor	β	$\|t\|$	ΔR^2
Step 1	TCI_NS	.46	7.31***	.21	BAS_FS	.33	5.08***	.11	TCI_NS	.42	6.67***	.18	TCI_NS	.48	7.78***	.22
Step 2	BIS	.19	3.03**	.02	TCI_NS	.19	2.46*	.03	BAS_FS	.27	3.58***	.05	TCI_HA	.25	3.82***	.05
Step 3	-				-				-				BAS_FS	.18	2.53*	.02
Step 4	-				-				-				TCI_P	-.15	2.18*	.03
R^2	.23				.14				.23				.32			
Fchange	9.15**				6.06*				12.80***				14.57***, 6.41*, 4.75*			
F	32.33***				16.26***				29.93***				23.48***			

*$p < .05$, **$p < .01$, ***$p < .001$.
'BIS' = Behavior inhibition system; 'BAS_FS' = Fun seeking from behavior activation system; 'TCI_HA' = Harm avoidance from Temperament and Character Inventory; 'TCI_P' = Persistence from Temperament and Character Inventory; 'TCI_NS' = Novelty seeking from Temperament and Character Inventory.

4. Discussion and conclusion

The first purpose of this study was to examine the effect of temperament on anger response in prisoners who revealed anger-induced aggressive behavior that exceeded the level permitted by law. We found that three BAS and BIS factors had significant positive correlations with impulsive reaction, verbal aggression, physical confrontation, and indirect expression. Previous studies have suggested that BAS is related to positive emotion and BIS to negative emotion (Corr, 2002; Gray and McNaughton, 2000; Sutton and Davidson, 1997). In contrast, Harmon--Jones (2003) tested whether BAS was associated with anger experience, a representative negative emotion, and found a significant relationship between anger and all of BAS. Physical aggression also demonstrated a positive relationship with BAS and a negative relationship with BIS (Harmon-Jones, 2003). When developing the Korean version of the BAS/BIS questionnaire, Kim and Kim (2001) tested the correlation with Sielberger's anger factor to test validity and showed significant positive correlations (.15 - .36) between BIS, three BAS factors, and trait anger. Also they found significant positive correlations (.15 - .28) of three BAS factors with a tendency to express anger (Kim and Kim, 2001, p. 29). This finding is consistent with our results showing significant positive correlations between the three BAS factors and four types of anger response.

The relationship between BIS and anger experience or response is unclear. According to previous studies, the level of behavior inhibition was not related to anger response and showed an inconsistent relationship with the level of anger experienced in daily life; however, our study demonstrated a significant positive relationship between BIS and anger response. Such results are likely attributable to participant characteristics—although their behavior is inhibited by situational demands, prisoners also risk demonstrating impulsive anger.

Examining the relationship between anger response and harm avoidance, reward dependence, persistence, and novelty seeking (based on the Psychobiological Model of Temperament and Character), novelty seeking had a significant positive correlation with anger responses, while harm avoidance demonstrated a positive relationship with impulsive reaction and indirect expression. Moreover, reward dependence was negatively correlated with impulsive reaction. The fact that novelty-seeking showed a positively significant correlation with anger is consistent with Fassino et al. (2001) study. The current result of reward dependence and harm avoidance is also consistent with Aslan and Arkar (2016).

The second purpose of this study was to investigate the similarities and differences of each temperament measure from two representative theories. We compared the effects of BAS and BIS from the Reinforcement Sensitivity Theory, and reward dependence, persistence, novelty seeking, and harm avoidance from the Psychobiological Model of Temperament and Character. Higher levels of the three BAS factors were associated with higher anger experience or response. This is not surprising because they are often measured together, tend to covary, and comprise one factor. In contrast, the correlations among reward dependence, persistence, and novelty seeking from the Psychobiological Model of Temperament and Character, which correspond to the three BAS factors were ranged from negative to positive.

Although a higher level of BIS was associated with a higher level of other anger responses, including impulsive reaction, the level of harm avoidance demonstrated a significant relationship with impulsive reaction and indirect expression. Therefore, prisoners who try to operate a high level of BIS and avoid risk appear to be lowering their chances of harm to themselves by expressing anger toward subjects who are weaker, rather than expressing anger directly toward the anger-inducing target. However, when this mechanism fails, impulsive reaction occurs intermittently.

The third purpose of this study was to explore the relationship between the temperament factors in each model; BIS and harm avoidance of the TCI showed a correlation of .46; drive of BAS and persistence of TCI, .50; and fun-seeking of BAS and novelty-seeking of TCI, a high correlation of .56. In contrast, reward sensitivity of BAS and reward dependence of TCI did not show a correlation, at -.03. Reward sensitivity and reward dependence were also shown to perform different roles in anger response. In other words, higher reward sensitivity was associated with higher levels of four types of anger response, but higher level of reward dependence was associated with lower level of impulsive reaction. Thus, reward sensitivity and reward dependence may measure fundamentally different entities: Reward sensitivity of BAS indicates how sensitively one perceives the rewards that will be obtained when one does or does not perform an action and how sensitively one responds to this. In contrast, reward dependence of TCI seems to have a strong relationship with the rewards one can obtain in a social setting and the tendency to respond to many factors that apply in the process of achieving this.

4.1. Implication

This study found that temperament is related to prisoners' anger response overall. Novelty seeking had the strongest and most consistent effect. Additionally, BIS showed a significant effect on impulsive reaction, and fun-seeking of BAS on verbal aggression and physical confrontation. The strong effect of novelty-seeking of TCI on anger response is consistent with results from Stuettgen et al. (2005), which showed that novelty-seeking temperament was more related to the dopaminergic neurotransmitter system than BAS.

Indirect expression was higher when novelty-seeking of TCI was high, harm avoidance of TCI was high, and persistence of TCI was low. This helps understand the role of temperaments in the process of revealing anger to one subject while experiencing anger in relation to a different target. Novelty-seeking influences all stages of experiencing and revealing anger, while harm avoidance level affects not showing anger to the anger-inducing person, and that failure of persistence can cause anger to be shown instead to a different person.

Our study findings present implications for corrective interventions administered in prison. Various anger-management training programs have been implemented in different prisons, and this study found that novelty seeking increases the anger response while persistence lowers

anger. Thus, implementing a module in the anger-management training program that increases self-control over immediate novelty seeking or that helps the individual pay continued attention to the desired task to increase persistence, may be useful.

4.2. Limitation and future direction

Because our study participants' responses may differ from the responses of adults who have not been incarcerated, in Table 5 we compare the average values obtained in our study with the average values reported in the Korean version of standardized research. Overall, there are no noteworthy differences in the average values, and the alpha levels relating to measurement error are relatively low. However, the generalizability of the relationship between temperament and anger response and level of temperament is still low. For example, it is difficult to ignore the possibility that certain findings may be attributable to participant characteristics. Therefore, it is necessary to compare the results to results from the general adult population.

Second, our study sample consisted solely of male prisoners, and data on the age of arrest, number of arrests, number of prison sentences, and type of crime were not collected out of the need to protect personal information. These variables may have moderating or mediating effects in the relationship between temperament and criminal behavior. Therefore, the current study findings have limited generalizability and require subsequent studies to substantiate the results.

Third, FFFS measures were not included in our study because the most recent version of the scale has not been standardized in Korean. If this third system were to be added, the predictive values of temperament on anger response obtained from the stepwise regression analysis may differ. Specifically, the strong and consistent effect of novelty seeking might be reduced. Therefore, future studies need to incorporate a reliable and valid tool that measures the third system of revised Reinforcement Sensitivity Theory.

Fourth, this study aimed to investigate the effects of temperament on anger response in prisoners who committed crimes. However, anger or maladaptive responses may be affected by character variables related to self-control, chronic emotionality and personality. A recent study that investigated the association between temperament, antisocial behavior, and criminality by reviewing 300 studies (DeLisi and Vaughn, 2014) proposed effortful control and negative emotionality as the most potent variables. This finding has been strengthened by subsequent studies that applied their findings to independent samples (Baglivio et al., 2016; Wolff et al., 2016). Moreover, in a meta-analysis on subfactor effects of the Five Factor Model on antisocial behavior and aggressive behavior (Vize et al., 2018), the agreeableness and conscientiousness effect sizes were meaningful. Because we did not examine the impact of these variables, it is difficult to conclude whether we have identified the pure effects of temperament. Subsequent studies should investigate the independent or interactive effects of temperament and character variables.

4.3. Conclusion

1 Temperament affects prisoners' anger responses. In particular, novelty seeking affected all four types of anger response and the second strongest temperament was fun-seeking of BAS.
2 Harm avoidance of TCI and BIS of RST, and novelty seeking of TCI and fun-seeking of RST tended to covary and had similar effects on anger response.
3 Reward sensitivity of BAS, reward dependence OF TCI, drive of BAS, and persistence of TCI had differential effects; reward sensitivity and reward dependence were found to be highly disparate concepts.

Table 5
Comparisons of statistical values of eight temperament factors between our study and previous studies.

	Statistical values of this study		Statistical values of Korean version standardization studies	
	Mean value	Alpha value	Mean value	Alpha value
BIS*	16.81	.80	18.3	.86
Reward sensitivity*	11.60	.76	15.6	.85
Drive*	9.04	.77	9.6	.87
Fun seeking*	8.42	.70	9.5	.78
Harm avoidance**	36.68	.81	35.18	.84
Reward dependence**	41.34	.72	42.51	.77
Persistence**	44.28	.72	43.55	.85
Novelty seeking**	32.68	.80	27.66	.84

* Adapted from Kim and Kim's standardization study (2001).
** Adapted from Min, Oh, and Lee's standardization study (2007).

Declarations

Author contribution statement

E. Jang: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Additional information

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