



Effects of behavioral inhibition/activation systems on anger rumination and anger expression through Difficulty in Emotion Regulation

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ABSTRACT

Behavioral Inhibition and Activation Systems (BIS/BAS) are consistently associated with internalizing and externalizing disorders, respectively. Anger rumination is thought to be linked to internalizing disorders while anger expression demonstrates an association with externalizing disorders. Despite these theoretical associations, there is a dearth of studies examining the relationships between these constructs. The current cross-sectional study aimed to test indirect effects of BIS/BAS through a Difficulty in Emotion Regulation (DER) on anger in a group of college students ($n = 211$). Analysis showed a positive relationship between BIS and anger rumination and between BAS and anger expression. Further analysis showed an indirect effect of BIS on anger rumination through DER. Although BAS had direct effect on anger expression, our analysis found no indirect effect of BAS on anger expression. Potential limitations and directions for future research are discussed.

1. Introduction

Emerging adulthood is a developmental period, which represents a period of transition in life characterized by changes in young people's interpersonal relationships and professional lives (Arnett, Zukauskienė, & Sugimura, 2014). New challenging situations may predispose young adults to psychological disturbances. There is evidence suggesting that young adults are particularly prone to anger-related problems (Scanlan, Parker, & Montague, 2016) and anger is more prevalent among young people (Okuda et al., 2015). Anger, an emotional reaction to a perceived threat, may present itself in different forms namely anger rumination (excessively thinking about aggressive acts) or anger expression (acting out in an aggressive manner). It is suggested that anger rumination and anger expression are interrelated in that excessive anger rumination can impair capacity for self-control and executive functioning (Ding, Yang, Qian, & Gordon-Hollingsworth, 2015). Anger rumination may also increase physical arousal (Butler et al., 2003), which can energize aggressive behaviours (Anderson & Bushman, 2002). Nevertheless, anger rumination and anger expression are two different manifestations of anger emotion (Hay et al., 2014).

Research has examined personality factors to better understand psychological difficulties. Widiger (2011) suggests that personality

traits may explain why some people are more negatively affected by life stressors than others. Personality traits may influence responses via the individual's stable manner of thinking-feeling-behaving, that may give rise to psychological difficulties (Bijttebier, Beck, Claes, & Vandereycken, 2009). For example, Bettencourt, Talley, Benjamin, and Valentine (2006) reported that personality variables may predict people's aggressive reactions in unprovoking and experimentally designed provoking situations. It is therefore reasonable to study individuals' personalities to better understand their emotional experiences such as anger experience.

1.1. Reinforcement Sensitivity Theory

Two primary motivational systems are thought to underlie personality: the Behavioural Inhibition System (BIS) and the Behavioural Activation System (BAS) (Corr, 2009). According to the neurobiological-based Reinforcement Sensitivity Theory (RST) (Corr, 2009; Gray & McNaughton, 2000), behavior and learning are shaped by two major motivations; 1) the drive to receive reward and 2) the drive to avoid punishment. BIS/BAS are thought to underlie this process; BIS is related to aversive motivation and prevention of behaviours that results in punishment or the loss of reward. Conversely, BAS is thought to be

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involved in behaviours aimed at pursuit of reward (Björnebekk, 2007). BAS is thought to comprise of three subsystems of Reward Responses, Drive, and Fun-Seeking and is related to appetitive motivation and activated by reward-related stimuli (Carver & White, 1994). This link between BIS/BAS and motivational systems may explain their pattern of association with different presentations of psychological symptoms (Aldao & Nolen-Hoeksema, 2010). BIS is assumed to lead to anxiety and avoidance-related behaviours (Björnebekk, 2007) and accordingly is linked to internalizing problems (Muris, Meesters, de Kanter, & Timmerman, 2005) while BAS being sensitive to approach-related behaviours has been associated with externalizing problems (Taubitz, Pedersen, & Larson, 2015).

A similar pattern is observed between BIS/BAS and anger emotion, with inhibition of anger and anger rumination correlating with internalizing disorders (Zeman et al., 2002), whereas aggressive behaviours and anger expression are linked with externalizing symptoms (Smith & Day, 2018). We therefore suggest that anger rumination and anger expression may relate to BIS and BAS respectively.

1.2. Reinforcement Sensitivity Theory and difficulties in emotion regulation

Variations in the levels of BIS and BAS may contribute to different problems (Bijttebier et al., 2009). The notion that BIS/BAS may play as risk factors has also been supported by longitudinal studies (Kasch, Rottenberg, Arnou, & Gotlib, 2002). The specific mechanism underlying the BIS/BAS contribution to the emergence of psychological difficulties is, as yet, unclear (Bijttebier et al., 2009). A possible mediator of the relationship between BIS/BAS and psychological disturbances may be the ability to regulate one's emotion (Tull, Gratz, Litzman, Kimbrel, & Lejuez, 2010). Difficulty in Emotion Regulation (DER) indicates individuals' inability to effectively identify, understand and modulate emotional experiences in distressing situations (Gratz & Roemer, 2004). Given that individuals' difficulties in regulating their emotion affects the way in which they deal with emotions, DER has been suggested to be associated with various forms of psychopathology (Gratz & Tull, 2010) and to mediate the relationship between personality and psychopathology (Linehan, 1993). Accordingly, some researchers state that BIS and BAS have implications for the development of emotion dysregulation. Baglioni, Spiegelhalder, Lombardo, and Riemann (2010) suggested that BIS is positively related to DER. Studies investigating the BAS-DER link, however, have yielded inconsistent findings, with some (e.g., Markarian, Pickett, Deveson, & Kanona, 2013) reporting a negative association, and others (e.g., Serrano-Ibáñez et al., 2018) failing to detect any significant relationship. We are not aware of any study has been conducted examining the role that DER might play in the indirect effect of BIS/BAS on anger rumination and anger expression.

1.3. Present study

We examined the relationship between BIS/BAS and anger rumination and anger expression in a group of individuals who are arguably at elevated risk for the development of psychological problems, that is a group of young university students. We hypothesized that greater levels of BIS would be associated with greater levels of anger rumination. As both are associated with externalizing disorders, we hypothesized that high levels of BAS would be related to elevated anger expression. Given that evidence suggests that DER is associated with BIS/BAS and psychological difficulties such as anger-related problems (Garofalo & Velotti, 2017), we hypothesized that there would be significant indirect effects of BIS and BAS through DER on anger rumination and anger expression respectively.

2. Methods

2.1. Participants and procedure

Two hundred and eleven college students (156 female) aged between 18 and 25 years ($mean = 20.4$ years, $SD = 1.8$ year) voluntarily participated in this cross-sectional study. The study link was sent to the participants. It brought students to a site which provided them with information about the study. Participants completed the consent form before proceeding to the survey. The study was granted ethic approval by the Research Ethic's Committee in DCU (DCUREC/2020/280).

2.2. Measures

2.2.1. BIS/BAS Scale

The BIS and BAS were measured using the 20-item BIS/BAS Scale (Carver & White, 1994), a four-point questionnaire ranging from 1 (very true for me) to 4 (very false for me). The BIS scale, consisting of 7 items, measures individual differences with respect to their anticipation to punishment cues (e.g., I worry about making mistakes). The BAS scale, including 13 items, comprises three sub-scales: 1) the 5-item BAS-Reward concerned with anticipation to reward (e.g., It would excite me to win a contest), 2) the 4-item BAS-Drive focused on persistent seeking of desired goals (e.g., I go out of my way to get things I want), and 3) the 4-item BAS-fun seeking reflecting the tendency to impulsively pursuit of pleasure (e.g., crave excitement and new sensations). Higher scores indicate elevated levels of BIS and BAS. The Cronbach's alpha coefficient was 0.80 for BIS, 0.70 for BAS-Reward, 0.85 for BAS-Drive, and 0.77 for BAS-Fun Seeking.

2.2.2. Difficulty in Emotion Regulation (DER)-Short form

DER-S (Kaufman et al., 2016) is a self-report questionnaire consisting of 18 items and is a short version of the originally developed 36-item DER (Gratz & Roemer, 2004). It measures the participants' deficiency in effectively regulating emotions in difficult moments (e.g., When I'm upset, I have difficulty concentrating). Responses options range from 1 (almost never) to 5 (almost always). Higher score of DER indicates more difficulties in emotion regulation. The Cronbach's alpha for the current study was 0.88.

2.2.3. Anger rumination

We used two subscales of the Anger Rumination Scale (Sukhodolsky, Golub, & Cromwell, 2001) namely the 6-item "Angry Afterthoughts" (e.g., Memories of even minor annoyances bother me for a while) and the 4-item "Thoughts of Revenge" (e.g., I have daydreams and fantasies of violent nature) to measure the participants' tendencies for suppressing and internalizing anger. Unlike the other sub-scales, namely "Understanding Causes" and "Angry Memories", these two sub-scales measure thoughts about, particularly, recent or current anger episodes (Ibrahim et al., 2019) and correspond to the aim of the study investigating the effects of personality and DER on anger experiences in daily life. All items have four possible responses ranging from 1 (almost never) to 4 (almost always). A higher score on this scale indicates a greater degree of anger rumination. The Cronbach's alpha for the current sample was 0.82.

2.2.4. Anger expression

The Aggression Questionnaire (Buss & Perry, 1992) consists of 7 items (e.g., I have trouble controlling my temper) that measures an individual's tendency for expressing and externalizing anger. Responses options range from 1 (extremely uncharacteristic of me) to 5 (extremely characteristic of me). People with higher propensity to express their anger obtain higher score. The Cronbach's alpha was 0.83.

2.3. Statistical analysis

We used SPSS version 27 for data analysis. Descriptive analysis was calculated for all study variables and Pearson correlations were conducted to determine the extent to which variables were associated with each other (Table 1). We used model 4 from the SPSS PROCESS macro (Hayes, 2013) to conduct mediation analyses (Fig. 1). As Fig. 1 illustrates, Model A considered BIS as the predictor, DER as the mediator, and Anger Rumination as the outcome variable. Model B was tested through three separate mediation analyses to determine whether three BAS-subcales i.e., BAS-R, BAS-D, and BAS-F, related to Anger Expression through DER as the mediator. A bootstrapping procedure, which can estimate both direct and indirect effects, was employed for mediation analyses (Arbuckle, 2008). In this method, an effect is considered significant if the 95% Confidence Intervals (CI) does not contain zero (Preacher & Hayes, 2008). We also entered gender, using model 7 in the SPSS PROCESS macro, to determine whether the indirect effect (BIS → DER → Anger Rumination) was moderated by a third variable, namely gender. We did not enter age in the moderation analysis given the narrow age range among participants (18–25 years).

3. Results

3.1. Descriptive statistics

Table 1 presents means and standard deviations for the study variables. It also presents bivariate correlations between the variables.

BIS was significantly related to anger rumination. Three components of BAS were significantly associated with anger expression. A significant relationship was found between BIS, but not BAS subtypes, and DER. Both anger rumination and anger expression were significantly associated with DER.

3.2. Mediation analysis

For Model A, BIS was considered the predictor (X) and anger rumination as the outcome (Y). In Model B, BAS-Reward, BAS-Drive and BAS-Fun Seeking were considered the predictors (X) and anger expression as the outcome (Y). DER was considered as the mediator for both models. The models are presented in Fig. 1.

Model A: As illustrated in Table 2, there was a significant indirect effect of BIS on anger rumination through DER (estimate point = 0.214, SE = 0.061, 95% CIs {0.110 to 0.347}). The effect size (0.15) was small (Cheung, 2009). A moderation analysis demonstrated that gender did not moderate this indirect relationship. Hence Model A was supported.

Model B: DER failed to play a role in the association between BAS subtypes (BAS-Reward: estimate point = -0.058, SE = 0.057, 95% CI {-0.180; 0.049} BAS-Drive: estimate point = 0.007, SE = 0.042, 95% CI {-0.079 to 0.092} BAS-Fun Seeking: estimate point = 0.001, SE = 0.040, 95% CI, {-0.075 to 0.088}) and anger expression, even though the direct effects of BAS-R and BAS-F on anger expression were significant. Hence, our analysis failed to support Model B.

Table 1
Descriptive of and Correlations between the study variables.

	Mean	SD	1.	2.	3.	4.	5.	6.
1. BIS	22.43	3.83	–					
2. BAS-R	17.46	2.12	0.050	–				
3. BAS-D	10.96	2.64	-0.072	0.527**	–			
4. BAS-F	12.06	2.62	-0.144*	0.395**	0.316**	–		
5. DER	46.36	12.50	0.407**	-0.080	0.013	0.002	–	
6. Anger rumination	22.62	5.76	0.333**	0.125*	0.135*	0.000	0.428**	–
7. Anger expression	18.51	6.04	0.112	0.144*	0.131*	0.162**	0.244**	0.391**

* $P < 0.05$.

** $P < 0.01$.

4. Discussion

The association between BIS/BAS and psychological issues such as anger rumination and anger expression are not fully understood. A goal of this study was to determine whether BIS is associated with anger rumination and consistent with this the results indicated a positive relationship between BIS and anger rumination. We also found an association between BAS and anger expression. We also proposed that there would be significant indirect effects of BIS and BAS through DER on anger rumination and anger expression respectively. As expected, BIS had an indirect effect through DER on anger rumination but we did not find an indirect effect of BAS on anger expression, contrary to our hypothesis. More specifically, while both BAS subtypes and DER were associated with anger expression, we did not find indirect effects of BAS subtypes on anger expression through DER.

The link between BIS and anger rumination can perhaps be understood by the notion that anger is hierarchically structured (Teffelen, Lobbestael, Voncken, & Peeters, 2020; Watson, O’Hara, & Stuart, 2008). This structure of anger suggests that general aspects of anger like anger rumination, are shared with other negative affects such as fear and anxiety. Hence, although anger has been typically considered to be a BAS driven affect, it can be associated with BIS too, when considering aspects such as rumination (Watson, 2009). This is corroborated by evidence suggesting that repetitive thoughts, regardless of type, are related to negative affects that are strongly linked to BIS (Ruscio, Seitchik, Gentes, Jones, & Hallion, 2011).

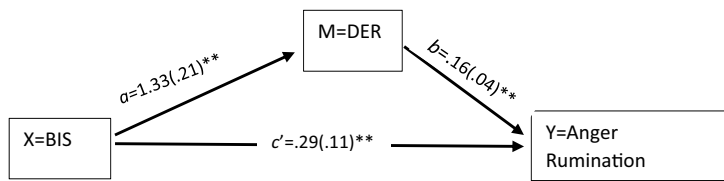
The association between BAS and anger expression can perhaps be explained by neurological findings that suggest anger expression is associated with elevations in left anterior cerebral activation (Carver & Harmon-Jones, 2009). This region is activated with both behavior tendencies such as anger expression and positive affects, unless anger is mixed with anxiety that leads to escape from the situation and avoid the risk of disapproval and punishment (Plant & Devine, 2003).

This may also explain our finding regarding the BIS-anger rumination link, and the reason why a certain type of anger experience namely anger rumination is associated with the inhibitory and avoidance rather than the activation and approach system.

The possible role of DER on the indirect effect of BIS on anger rumination is an important finding given that, as mentioned, problems with emotion regulation have been associated with several clinical disorders (Gratz & Tull, 2010) and that successful emotion regulation is essential for social adjustment and psychological well-being (Hu et al., 2014). Prior research suggests that elevated levels of BIS can disrupt people’s ability to regulate emotions (Markarian et al., 2013) and that emotion dysregulation predicts people’s vulnerability towards anger rumination (Martino et al., 2015). Emotion dysregulation may represent a possible pathway through which BIS may impact on psychological difficulties (Bijttebier et al., 2009). Our finding contributes to the literature by proposing possible mechanisms through which BIS may contribute to anger rumination.

Despite a role DER played in the indirect effect of BIS on anger rumination, the study failed to find similar role for DER on the relationship between the BAS subtypes and anger expression. Although we

Model A
Unstandardized direct effects of BIS on anger rumination and indirect paths through DER



Model B
Unstandardized direct effects of BAS on anger rumination and indirect paths through DER

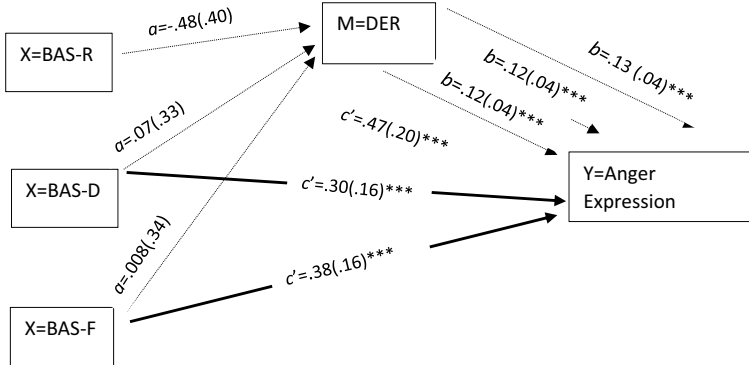


Fig. 1. Visual summary of mediation results. BIS = Behavioral Inhibition System; BAS-R = Behavioral Activation System-Reward; BAS-D = Behavioral Inhibition System-Drive; BAS-F = Behavioral Inhibition System-Fun Seeking; DER = Difficulty in Emotion Regulation; “a” represents direct effect of X on M; “b” represents direct effect of M on Y; “c’” represents direct effect of X on Y; solid lines represent supported direct- and indirect-effects, and dashed lines represented unsupported indirect-effects; $p^* < 0.05$, $p^{**} < 0.01$, $p^{***} < 0.001$. *Indicates confidence intervals not containing zero.

Table 2
The indirect effects and effect sizes of study variables on anger rumination and anger expression.

	Effects	SE	CI 95% bootstrapping		CSIE
			Lower	upper	
Indirect effects of BIS via DER	0.22*	0.07	0.11	0.35	0.15
Indirect effects of BAS-R via DER	-0.06	0.06	-0.18	0.50	-0.02
Indirect effects of BAS-D via DER	0.008	0.05	-0.08	0.10	0.003
Indirect effects of BAS-F via DER	0.001	0.04	-0.08	0.09	0.0004

CI confidence intervals, SE standard error, CSIE completely standardized indirect effects represents effect sizes, *Confidence intervals not including zero.

predicted an indirect effect of BAS components on anger expression through DER, we had expected to discover, at least, a weak relationship given that evidence in this field is controversial and the relationship between BAS subtypes and DER has not been consistently supported (Tull et al., 2010). Hence, our finding is inconsistent with those previous studies supporting the BAS components-DER relation (Azadi, Khosravi, King, Mohammadzadeh, & Baseri, 2020). Perhaps this can be explained by the generally weak relationship that exists between BAS and DER (Markarian et al., 2013). There is only 68% likelihood to replicate a medium-sized effect at the standard cut-off a probability of 5% with power of 80% (Cumming, 2014), rendering the finding not reliably replicable. Another possible explanation is the manner in which emotion dysregulation has been measured in previous studies that utilized scales eliciting specific types of DER, while the current study considered an overall deficit in emotion dysregulation. Further research is required to assess different types of emotion dysregulation when studying DER effects on a potential BAS-psychopathology relation. This finding is nonetheless in line with the literature suggesting a weaker relation between BAS, as opposed to BIS, and DER (Tull et al., 2010).

Although the study participants were a non-clinical group of people, considering the dimensional approach to psychopathology (Insel et al., 2010), the study findings may have some clinical implications. Considering the contributions of DER (Gratz & Tull, 2010) and anger rumination (Baer & Sauer, 2011) to the development of internalizing psychopathology, working on BIS can reduce difficulty in regulating emotions, which may in turn lead to a decrease in anger rumination and vulnerability to internalizing disorders. Since reduced DER may mitigate

the effects of BIS on anger rumination, this finding has particular implications for acceptance- and mindfulness-based treatments that enhance capacity for emotion regulation (Tang et al. 2015).

4.1. Limitations and directions for future research

A limitation of this study is its cross-sectional design in that we cannot infer causality. Cross-sectional studies undermine the principle of the temporal precedence of variables required for causal inferences. Longitudinal studies are required in order to establish a causal link between variables (Maxwell, Cole, & Mitchell, 2011). Our study was also limited to non-clinical participants. However, there has been a recent shift in paradigm from symptom-based systems such as the Diagnostic and Statistical Manual of Mental Disorders (DSM) towards understanding mental health as a spectrum of wellbeing. Mental health classifications rely on an often arbitrary cut-off for symptom counts to determine whether individuals meet a threshold for a certain disorder. One example of this movement is Research Domain Criteria (RDoC) (Insel et al., 2010). The RDoC favors a dimensional approach to mental disorders, as opposed to the DSM-categorical classification, and encourages researchers to study psychological constructs among people from the community as supplementary for research using clinical participants. We deemed it important to conduct this study among a non-clinical group of participants. Nevertheless, given that people with clinical disorders present elevated BIS/BAS (Taubitz et al., 2015) and DER (Houben, Van Den Noortgate, & Kuppens, 2015), there is a possibility that the mechanism through which BIS/BAS affect anger experiences may differ from that of non-clinical people. These findings can therefore be extended by further studies that examine our models among a clinical group of people. In addition, future studies are needed to test possible mediators that may link BIS/BAS to different manifestations of anger emotion. One possible variable is problem-focused coping strategies, which represent an individual's ability to take action in problematic situations. Evidence shows that people with mal-adaptive coping strategies are vulnerable to mental disorders (Compas et al., 2017). It is suggested that difficulties in problem-focused coping strategies are associated with both personality-related problems (Souza et al., 2014) and people's propensity for anger experiences (Coskun, 2010).

Another potential criticism of our study is the absence of Fight-Flight-Freeze System (FFFS), assumed to be a third element of RST. The revised RST (Gray & McNaughton, 2000) postulates that, similar to

BIS, FFFS is sensitive to aversive stimuli; however, while BIS is related to anxiety, FFFS is believed to be associated with fear. We did not include FFFS in our study because these two systems are believed to be very close (McNaughton & Corr, 2008) and FFFS is suggested to be mapping into BIS (Kimbrel, 2008). Corr (2009) argues that both BIS and FFFS can be combined into a single factor as punishment sensitivity. In addition, our study included non-clinical participants and aimed to examine their responses in day-to-day life, while FFFS is rarely activated in most circumstances. By excluding this system, the study remained focused on routine responses in daily basis. Moreover, unlike the commonly used tools to measure BIS/BAS, no scale has been developed that specifically measures FFFS. Future research is required to evaluate how FFFS may play out with regards to DER and anger rumination.

5. Conclusion

In this study we sought to examine whether BIS/BAS are associated with anger rumination and anger expression and if these relationships can occur via DER. While both BIS and BAS had direct effects on anger rumination and anger expression, DER was only involved in the relation between BIS and anger rumination. The study provides nuanced understanding about individual differences with respect to anger experiences. The study findings identify targets and generate hypothesis for future longitudinal studies.

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CRedit authorship contribution statement

Ali Khoshfetrat: Conceptualization, Investigation, Methodology, Formal analysis, Writing – review & editing. **Darina Scully:** Conceptualization, Investigation, Methodology, Writing – review & editing. **Catherine Fassbender:** Conceptualization, Investigation, Methodology, Writing – review & editing, Supervision.

Declaration of competing interest

None.

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