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Social Anxiety and Rumination in the Context of the Revised Reinforcement Sensitivity Theory and the Mediation Model of Social Anxiety*

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The aim of this study was to examine the relationship between temperament, ruminative thought style and social anxiety using latent variable modeling. Before examining the integrated model that specifies the relations between the constructs, relevant measurement issues were examined. The study was conducted on a heterogeneous sample from the general population that included 1,029 participants (62.1% female) aged 19 to 79. The findings show that the Behavioural Inhibition System is the most important vulnerability factor for the development of social anxiety, and it has both a direct effect and an indirect one through the ruminative thought style. Also, Freeze has an additional contribution to the increased experience of social anxiety. The Behavioural Approach System has complex effects on social anxiety – with a direct protective effect, and indirectly – with a facilitation of the ruminative thought style. Thus, BAS can also act as a risk factor. The findings support the revised Reinforcement Sensitivity Theory and provide a basis for the extension of the Kimbrel's Mediation Model of Social Anxiety.

Keywords: social anxiety, ruminative thought style, the revised Reinforcement Sensitivity Theory, Mediation Model of Social Anxiety

Highlights:

- The Behavioural Inhibition System is a neurobiological/personality basis of social anxiety with an additional contribution of Freeze.
- The Behavioural Approach System is both a protective and a risk factor for social anxiety, depending on the mechanism that conveys its effect.

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- The Ruminative Thought Style can be regarded an aspect of the Behavioural Inhibition System but it is additionally facilitated by impulsivity from the Behavioural Activation System.
- The Behavioural Inhibition System increases social anxiety through repetitive cognition, and also directly.

The Revised Reinforcement Sensitivity Theory

The Revised Reinforcement Sensitivity Theory (rRST; Gray & McNaughton, 2000) postulates three major neuropsychological systems that underlie many of the individual differences seen in normal and pathological personality functioning. These systems are: 1) the Behavioral Inhibition System (BIS); 2) the Fight-Flight-Freeze System (FFFS), and 3) the Behavioral Approach System (BAS). BIS corresponds to anxiety and is responsible for detecting and resolving conflicts (Corr, 2009; McNaughton & Corr, 2004). BIS has a particularly prominent role because its activation depends on the subjective evaluation of stimuli (Corr & McNaughton, 2012), and it also controls behavior by activating or inhibiting reactions from other domains. The main role of FFFS is to activate behaviors that make it more likely for a person to defend him/herself from threatening stimuli. FFFS includes three defensive domains – Fight (anger), Flight (fear) and Freeze (panic). BAS represents the approach-related traits and reflects incentive motivation and pleasure experience components (see Corr et al., 2013). Due to its complex nature, the personality trait truly representative of the BAS as well as its operational definition is a controversial theme (Krupić, 2017). Some authors assume the BAS should be similar to extraversion or positive emotionality (Depue & Collins, 1999; Smillie et al., 2006), while others advocate it should be more aligned to impulsivity (Torrubia et al., 2001). Also, some authors view it as a unidimensional construct (Jackson, 2009; Reuter et al., 2015; Smederevac et al., 2014), while others support its multidimensionality (Corr & Cooper, 2016). In the contex of rRST there are four different operational definitions of the BAS (summarized by Krupić, 2017). In this study BAS is defined as a sensitivity to signals of reward (closely related to impulsivity) and to new and exciting situations (Smederevac et al., 2014).

Social Anxiety

Social anxiety can be considered and examined as a normal or a pathological feature, personality trait or a state. From the individual differences' perspective, social anxiety disorder is seen as the extremely high social anxiety disposition.

Social anxiety is the tendency to react to an actual or imagined evaluation by others with emotional distress (Leary, 1996; Schlenker & Leary, 1982). Hence, it is also called social-evaluative anxiety (Watson & Friend, 1969). This personality trait is characterized by low self-esteem, worrying about being perceived and evaluated negatively, hypersensitivity to rejection, and inhibition

in socially uncertain situations (Tovilović, 2004). Although a number of authors agree that the fear of negative evaluation is a core feature of social anxiety (e.g., Wilson & Rapee, 2005) others believe the fear of positive feedback plays a role as well (e.g., Weeks, Heimberg, & Rodebaugh, 2008). Thus, for example, the empirically validated bivalent fear of evaluation model (Weeks & Howell, 2012) suggests the general fear of evaluation (both negative and positive) as the basis of social anxiety.

The Mediation Model of Social Anxiety

There are numerous models that explain the social anxiety phenomenon, but mostly as a disorder (e.g., Cheek & Melchior, 1990; Clark & Wells, 1995; Kimbrel, 2008; Schlenker & Leary, 1982; Rapee & Spence, 2004). One of the most significant models of generalized social anxiety disorder is by Kimbrel (2008). Considering that the temperament and learning in social circumstances are important for shaping the tendency towards social anxiety, Kimbrel takes the rRST (Gray & McNaughton, 2000) as the framework for his model. The proximal part of the model refers to the current situational circumstances that favor the activation of certain personality systems. This segment of the model also refers to cognitive biases (biases in attention, memory, interpretation, etc.), which mediate the relationship between the personality systems and socially anxious behavior. Thus the proximal part of Kimbrel's model is called the *Mediation Model of Social Anxiety* (*MMSA*).

In the context of Kimbrel's model (Kimbrel, 2008), the joint hypersensitivity of BIS and FFFS represents the primary temperamental vulnerability of social anxiety. Kimbrel assumes that the link between BIS, FFFS, and social anxiety is moderated by BAS sensitivity. Precisely, a low level of BAS sensitivity is an additional risk factor in developing social anxiety. The research findings by Kimbrel et al. (Kimbrel et al., 2012) support the assumptions of the MMSA. In other words, the high reactivity of both BIS and FFFS and hyposensitivity of BAS have significant indirect effects on social anxiety through negative cognitive biases.

Previous studies have consistently documented the positive relationship between BIS and different measures of social anxiety while the role of FFFS in explaining social anxiety is less consistent and is primarily associated with social observation anxiety (Kimbrel et al., 2008; Ly, 2011). However, evidence regarding the relationship between BAS and social anxiety has been mixed. Some research shows a low to moderate negative link between BAS and social anxiety (Coplan et al., 2006; Kimbrel, 2009; Kimbrel et al., 2012), while other research reports the lack of a relationship between these constructs (Kashdan & Roberts, 2006; Kimbrel et al., 2008; Ranđelović & Želeskov Đorić, 2017). Finally, some studies suggest a negative significant relation between BAS and social interaction anxiety but a lack of relation between BAS and social observation anxiety (Kimbrel, 2012; Kimbrel et al., 2008; Kimbrel et al., 2010). Variations in the operationalization of BAS and the use of different samples

among studies can be the cause of different conclusions about the relationship between BAS and social anxiety.

It has to be taken into account that one part of these results is based on the original version of the Reinforcement Sensitivity Theory (oRST; Gray, 1987). Moreover, the roles of BIS and FFFS are not separately examined but rather as joint BIS–FFFS sensitivity. There is an additional value in examining a role of FFFS in social anxiety since rRST makes a distinction between anxiety-related reactions (BIS) and fear-related reactions (FFFS). Previous studies (e.g., Ranđelović, 2016; Ranđelović & Želeskov Đorić, 2017) show that BIS has a high positive correlation with the fear of negative evaluation and social anxiety, while Freeze has positive and moderate correlations with both constructs. Flight has positive moderate correlation only with the fear of negative evaluation (Ranđelović, 2016). On the other hand, Fight does not correlate with social anxiety and fear of negative evaluation, while BAS has an expected negative and low (and moderate) correlation with these constructs.

The hypersensitivity of BIS–FFFS is a primary biological/personal basis for both social anxiety and cognitive biases for threatening stimuli (Gray & McNaughton, 2000; Kimbrel, 2008; Kimbrel et al., 2012; Ranđelović, 2016; Ranđelović et al., 2018). Although the MMSA includes the cognitive bias domain, it would be important to expand the model to include other cognitive processes that increase discomfort in social situations, resulting in inhibition and avoidance. One such process is the ruminative thought style. The basis for including rumination in the MMSA-based social anxiety model is the empirical body of research that documents the relationship between rumination and social anxiety (for comprehensive review of these research see Valenas & Szentagotai, 2014). Most of these studies indicate that socially anxious and socially phobic individuals engage in more negative rumination.

The Ruminative Thought Style

Researchers propose that ruminative thinking can be viewed as a continually distributed cognitive style (Ehring & Watkins, 2008; Martin & Tesser, 1996; McEvoy et al., 2013). Drawing from this concept of the relative independence of rumination from the content (valence) domain of ruminative thought, Brinker and Dozois (2009) developed a measure for rumination (The Ruminative Thought Style Questionnaire – RTSQ) based on the definition of this construct as "a stable disposition towards repetitive, recurrent, intrusive, and uncontrollable thinking" (p. 4). Their aim was to disentangle rumination from its association with a depressed mood (as previously conceptualized by Nolen-Hoeksema et al., 2008). Also, compared to other measures of perseverative cognitions, the RTSQ measures more heterogeneous manifestations of repetitive thinking (Mihić et al., 2019), implying a greater transdiagnostic potential. It is this unconditional/general nature of ruminative thinking and its conceptualization as a dispositional rather than a transient and selective cognitive process that makes it a suitable mechanism to be studied in the context of temperamental personality

traits. The empirical data show that BIS stands out as a robust positive correlate of rumination, however, the remaining two personality systems – FFFS and BAS also have a positive correlation with rumination (Leen-Feldnera et al., 2004; Li et al., 2015; Randles et al., 2010). In the absence of more studies on the topic of rumination and rRST, the findings of this research should contribute to understanding the importance of the role of BIS, FFFS, and BAS in explaining rumination.

Rumination is associated with poor attentional control (Hsu et al., 2015), and experimental measures of interpretative bias (Mor et al., 2014) suggest that ruminative thinking can lead to the interpretation of ambiguous stimuli in a manner that is consistent with the ruminative content. In this respect, as a stable disposition that underlies a cognitive mechanism of interest, rumination is intimately intertwined with attentional bias relevant to the MMSA.

Goals of the Present Study

The goal of this study is to explore the role of rRST in explaining social anxiety and rumination. Namely, this study investigates relations between social anxiety and the ruminative thought style in the context of the rRST and MMSA. More precisely, the objective of the study was to test the hypothesis that rumination mediates the effects of personality systems on social anxiety. Structural Equation Modelling (SEM) was used to examine the relations between the proposed constructs (modelled as latent variables). As rRST and MMSA are both models based on the experimental paradigm, we consider SEM based on self-report measures in large samples as a step to further explore a proposed model (sets of relationships). Another reason for this approach is based on novel findings on the structure of RTSQ as a prominent transdiagnostic measure of repetitive cognitions, and on more recent findings on the common structure of social anxiety. SEM allows one to incorporate all of these measurement-related considerations (latent variable model) into an analytical strategy while retaining the ability to test the relations between the important elements in the theoretical model (the structural model; rRST, MMSA). Finally, this approach allows us to have a more comprehensive measurement of the constructs and to use large general population samples.

Method

Sample and Procedure

The sample consisted of 1,255 participants (63% were female) who were recruited by means of door-to-door direct invitations from trained interviewers from 37 urban and rural locations representative of the geographical distribution of residents in Serbia. This geographical-cluster sample was surveyed on a number of psychological measures in areas of work and family relations, personality, close interpersonal relations, and different forms of maladjusted behavior, along with the collection of a wide array of demographic data (joint together in what the research group named PORPOS–3 survey). The team of trained recruiters/

interviewers (who were psychology students that completed courses about psychological testing) were led by at least one researcher in the field-work data collection procedure. The procedure involved inviting participants to fill out the survey in door-to-door visits. The aim of this procedure was to have a sample of the population that was as heterogenous as possible. The age range was 18 to 79 with M = 38.41(SD = 13.05 years). The educational structure of the sample was as follows (valid responses): 47.6% had finished secondary education or less, 15 % had college degree, and 37.3% had a university degree. The ethical permission was obtained from the institutional review board.

Measures

The Reinforcement Sensitivity Questionnaire (RSQ; Smederevac et al., 2014) is an operationalization of the revised Reinforcement Sensitivity Theory, which was constructed to provide an optimal distinction between the systems of rRST in terms of scale content. The RSQ has 29 items for which we used a five-point Likert scale (although it was constructed with a 4-point Likert scale, the modification was done in order to incorporate the questionnaire in a large PORPOS–3 survey). Five scales of the RSQ are BAS, BIS, Fight, Flight, and Freeze. The scale reliabilities ranged from .76 to .80, apart from Flight, which had a reliability of .63 (which in part could be attributed to a smaller number of items).

The Ruminative Thought Style Questionnaire (RTSQ; Brinker & Dozois, 2009) is a 20-item measure of the general ruminative thinking style, developed to capture a general tendency to ruminate. It has four (lower-order) factors (Tanner et al., 2013) – repetitive thoughts (RT), counterfactual thinking (CFT), problem-focused thought (PFT), and anticipatory thought (AT). However, a unidimensional bifactor structure was suggested as more appropriate for scoring the scale when the RTSQ was adapted to Serbian (Mihić et al., 2019) with the method of forward-backward translation. The authors of the adapted RTSQ dropped one item (no. 16) from the scale for both psychometric and substantive reasons (Mihić et al., 2019). However, we conducted another forward-backward translation and had an expert in English and cognitive science review the two translations, which resulted in minor modifications. All 19 items used were rated on a five-point Likert scale. Cronbach's alpha estimate of the internal consistency of the full scale was .94. However, despite having converged, in our sample a measurement model of RTSQ produced a small negative variance estimate of an item loading on a specific factor of AT. This led us to model the AT group-factor variance with two correlated residuals between items that make up this factor.

The Social Anxiety Scale (SAS; Tovilović, 2004) started as a 32-item questionnaire but was later modified and refined by the first author of the scale and resulted in 25 items being used in this study. The scale was able to capture the effects of assertiveness training after controlling for anxiety, depression, and irrational beliefs (Tovilović, 2005), and it showed adequate external associations with neuroticism, extraversion (Alinčić, 2013; Vukić, 2018) and positive valence (Vukić, 2018), as well as convergent validity with Fear of Negative Evaluation Scale (Ranđelović & Želesko-Đorić, 2017). Cronbach's alpha estimate of the internal consistency of full scale was .96.

Data Analysis

SEM analyses were performed in R packages *lavaan* (Rossel, 2012) and *semTools* (Jorgensen et al., 2020). To account for non-normality, we applied weighted least squares means and variances adjusted (WLSMV) to estimate all models while treating data as ordered categorical. However, WLSMV estimation does not have the capability to take missing data into account while ML and MLR can be applied to this type of data although MLR/ML χ^2 shows more bias (Li, 2016a, 2016b; Rhemtulla et al., 2012). Before applying WLSMV,

missing data was imputed by using k-nearest-neighbour (kNN) imputation as this method is not based on strong distributional assumptions and it imputes only eligible and observed values (Andridge & Little, 2010) which allows us to treat data as ordinal. This was implemented in *bnstruct* package (Franzin et al., 2017). ML/R estimation was employed with standard full-information maximum likelihood procedure.

Moreover, model complexity can significantly reduce fit of SEM models (e.g., Kenny & McCoach, 2003). To this end, we also applied factor score regression approach to estimate the latent path coefficients (Devlieger et al., 2016; Devlieger & Rosseel, 2017). This approach can provide fairly unbiased structural estimates despite the misspecifications present in other parts of the model (e.g., measurement part of the model). At the time of writing this paper the following method can be applied with lavaan:::sam (Structural After Measurement; SAM) function (with sam.method = "local" argument which corresponds to factor score regression with Croon's correction). This led at first to computational difficulties and identification issues (smallest eigenvalue smaller than 0). Therefore, since group-factors are not included in structural relations we applied SAM as described in the text. The source code can be found at https://github.com/yrosseel/lavaan/blob/master/R/xxx_sam.R.

To investigate the underlying structure of SAS, we employed bifactor exploratory factor analysis (EFA) (Jennrich & Bentler, 2011). Bifactor EFA was applied with the WLS extraction method and bifactor rotation (see Beaujean, 2014) in the *psych* (Revelle, 2018) and *GPArotation* (Bernaards & Jennrich, 2005). To avoid overfitting, we used two samples derived from a random split of our total sample – one for EFA and the other for CFA. Following widely used recommendations, we evaluated model fit with a combination of fit indices ($\chi 2$, CFI, TLI, SRMR and RMSEA) with CFI and TLI > .95, RMSEA < .06, and SRMR < .08 indicating good fit while CFI and TLI > .90 and RMSEA < .08 indicating acceptable fit to the data (Brown, 2015; Browne & Cudeck, 1993; Hu & Bentler, 1999).

Results

Data Screening

Participants with more than 10% of their data missing were removed, leaving 1,242 participants. Also, multivariate outliers based on the Mahalanobis distance ($p < .01$) were removed. This resulted in 1,029 participants (62.1 % female) aged 19 to 79 ($M = 38.9$, $SD = 12.75$). Mardia's coefficient (Mardia, 1974) of multivariate kurtosis (67.49) suggested that data were nonnormally distributed.

The Structure of the Social Anxiety Scale

The shortened and modified item pool was obtained from the author of the SAS scale (no references were provided for that version of the questionnaire). This prompted us to explore the structure of the questionnaire based on the more recent findings on the common structure of widely used measures of constructs that are in the domain of social anxiety (Gomez, 2016). Recent research (Gomez & Watson, 2017) used the Social Interaction Anxiety Scale (SIAS) and the Social Phobia Scale (SPS; Mattick & Clarke, 1998) to model the general factor underlying all the items from the two scales, with two additional specific latent sources of variance over and above those that were accounted for by the general factor. This provided the rationale to explore whether the SAS scale could be deemed essentially unidimensional – i.e., to have one general factor with specific

factors to account for additional clustering based on content of the items (in order to resolve issues regarding the appropriate scoring of SAS; Reise et al., 2013).

To allow for cross-replication, the total sample was split in halves by a random assignment of participants. Parallel analysis performed on SAS data (Horn, 1967) suggested 4 factors, while BIC suggested 5. The first six eigenvalues are 12.83, 1.08, 0.72, 0.49, 0.33, 0.26; the first six eigenvalues extracted from random permutations (O'Connor, 2000) are 0.58, 0.49, 0.42, 0.37, 0.33, 0.29. However, the original structure of the first version of the instrument had four components (Tovilović, 2004) which suggests that the item content could cluster into four specific factors in addition to the one general factor. This led us to extract 5 factors with bifactor EFA. Finally, we used the bifactor confirmatory factor analysis (CFA) to test the EFA-derived model on a separate sample (see Appendix A) and found an acceptable fit to the data (WLSMV $\chi^2(258) = 916.431$, $p < .001$; RMSEA = .074, 90%CI [.069, .079], CFI = .966, TLI = .960). Bifactor statistical indices (Dueber, 2017; Rodriguez et al., 2016) provided support for the essential unidimensionality of the scale as the general factor had an omega hierarchical (Ω_H) of .95, ECV = .86, and construct replicability (H; Hancock & Muller, 2001) of .97. Omega hierarchical subscale (Ω_{HS}) coefficients for specific factors ranged from .16 to .19 which is comparable to that found for other widely used scales (Rodriguez et al., 2016). Given that a small amount of reliable variance was left once the general factor is accounted for, these findings provide support for essential unidimensionality (e.g., Slocum-Gori & Zumbo, 2011) of SAS. Hence, only general factor will be used in the latent mediation analysis.

Latent Mediation Model

Table 1 shows the means, standard deviations, and correlations between the variables.

Table 1
Means, standard deviations, and correlations

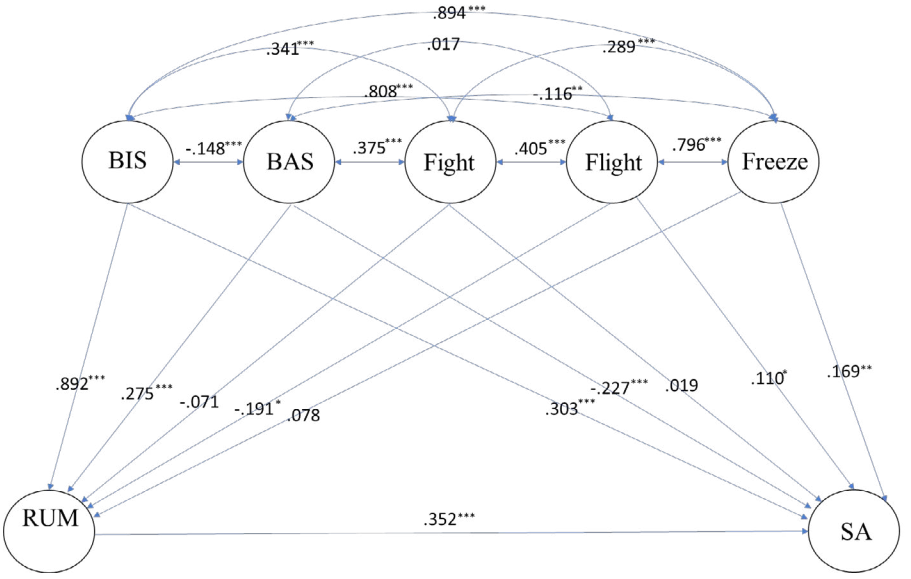
Variable	*M*	*SD*	1	2	3	4	5	6
1. RSQ_BIS	2.59	0.80						
2. RSQ_BAS	3.20	0.80	-.06*					
3. RSQ_Fight	2.58	0.82	.22**	.35**				
4. RSQ_Flight	2.82	0.79	.54**	.05	.22**			
5. RSQ_Freeze	2.27	0.89	.71**	-.05	.15**	.54**		
6. Rumination	2.79	0.85	.62**	.13**	.20**	.42**	.55**	
7. Social anxiety	2.17	0.84	.70**	-.16**	.13**	.50**	.68**	.65**

Note. * $p < .05$. ** $p < .01$.

Legend: RSQ = The Reinforcement Sensitivity Questionnaire (RSQ; Smederevac et al., 2014); BIS = Behavioral Inhibition System; BAS = Behavioral Approach System.

In this study, RTSQ was firstly modelled as a bifactor structure (Mihić et al., 2019) in which only the general factor was used as a mediator. SAS was modelled as described in the previous section.

Figure 1
Structural model (measurement part of the model was omitted)



Note. Standardized parameters are shown. Only general SAS and RTSQ factors are used (group-factors of these instruments were not of interest).

Legend: BIS = Behavioral Inhibition System; BAS = Behavioral Approach System; RUM = Ruminative thought style/Rumination; SA = Social anxiety as a trait; RTSQ = The Ruminative Thought Style Questionnaire (Brinker & Dozois, 2009); SAS = The Social Anxiety Scale (Tovilović, 2004). * $p < .05$.; ** $p < .01$; *** $p < .001$

Table 2 shows the calculated effects of the latent mediational analysis with a Monte Carlo CI.

Table 2
Indirect and total effects of BIS, BAS, and Flight on SAS mediated by rumination

	b	*SE*	*Std.est.*	*z*	*p*	LLCI	UPCI
Indirect effect of BAS	.209	.034	.097	6.078	.000	.145	.280
Indirect effect of BIS	.677	.113	.314	6.005	.000	.466	.906
Total effect of BAS	-.280	.058	-.130	-4.862	.000	-.396	-.169
Total effect of BIS	1.332	.174	.617	7.644	.000	.990	1.663

Note. Parameters were based on WLSMV estimation as shown in Figure 1. Confidence intervals for complex effects were derived from Monte Carlo method (based on default *semTools* options).

Legend: BIS = Behavioral Inhibition System; BAS = Behavioral Approach System.

In the first tested model all direct and indirect effects of personality traits were specified. The model had an acceptable fit (WLSMV $\chi^2(2504) = 10287.014$, $p < .001$; RMSEA = .055, 90%CI [.054, .056], SRMR = .063, CFI = .912, TLI

= .907). After removing the insignificant paths, the model retained the good fit (WLSMV $\chi^2(2628) = 90659.811$, $p < .001$; RMSEA = .055, 90% CI[.054, .056], SRMR = .063, CFI = .912, TLI = .908). However, two noteworthy parameter changes occur with this model modification – previously marginally significant path coefficient from Flight to Social anxiety ($p = .049$) is now statistically insignificant and a slight out-of-bound standardized path estimate between BIS and RTSQ of 1.041. This out-of-bound estimate probably stems from local empirical underidentification and hence we decided to report parameter estimates from the model in which all structural parameters are specified.

In light of concerns about multicollinearity as a cause of out-of-bound estimate, we used *matrixcalc* package (Novomestky, 2012) to test this particular part of the matrix of latent covariances (between latent dimensions of the rRST) for singularity. The results argue against the multicollinearity issue.

Applying MLR on the model with all latent paths specified had worsened the MLR fit $\chi^2(2504) = 7541.738$, $p < .001$; RMSEA = .044, 90%CI [.04, .045], SRMR = .059, CFI = .865, TLI = .859. However, fit indices are sensitive to the number of indicators per factor, size of factor loadings, and model complexity (Heene et al., 2011; Kenny & McCoach, 2003; for an overview, see Greiff & Heene, 2017). In this analysis, the effect of Flight on the RTSQ is also insignificant. This effect was not expected and also here shown to be unstable (likely artefactual) and this can be associated with the findings of somewhat lower reliability of Flight scale (Krupić et al., 2016; Ranđelović et al., 2018; Sadiković et al., 2020; Smederevac et al., 2014). Also, no out-of-bound standardized estimates occurred.

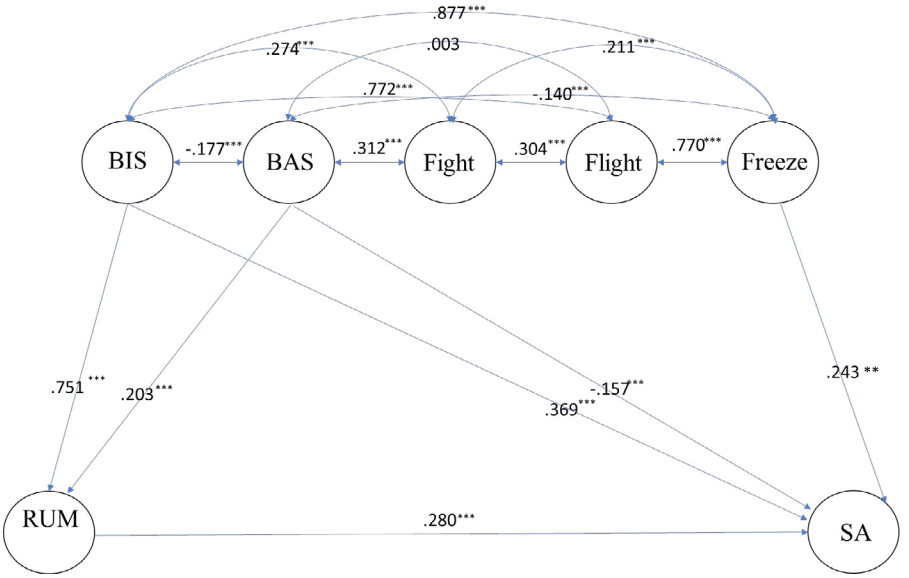
Although simulation studies have shown the DWLS/WLSMV estimation to be superior to ML/MLR for non-normally distributed ordinal data (Li, 2016b), it is also suggested that robust ML may be a viable alternative when the response scale has five or more categories (Rhemtulla et al., 2012), especially to estimate structural parameters of the model (although χ^2 statistic is likely unreliable, RMSEA could be used to evaluate model plausability; Li, 2016b).

To further validate findings of MLR-SEM and estimate only the structural part of the model, we repeated the analysis using the approach suggested by Devlieger & Rosseel (2017)[2] which has been shown to yield parameter estimates in the latent path analysis with as little bias as SEM (but is more robust to misspecifications). In this approach, the measurement part of the model is estimated first in order to estimate the structural part of the model using only the factor scores with Croon's (2002) bias-correcting method. However, to apply this method, the RTSQ and SAS were specified as unidimensional (not bifactor structures). In specifying a model to test with SAM method we only allowed latent paths we obtained in MLR-SEM (Figure 2). This approach did not produce Heywood cases, lending further support to the proposed model. The

2 We want to thank the anonymous reviewer who suggested this method as a way of testing the assumption that the model complexity (the measurement part of the model) did impact the fit downwards.

latent correlations although slightly reduced in magnitude are still very high but comparable to the ones obtained by the authors of the original test (Smederevac et al., 2014). This model had good fit to the data (ML $\chi^2(5) = 11.597$, $p = .041$; RMSEA = .036, 90%CI [.007, .063], SRMR = .008, CFI = .998, TLI = .993).

Figure 2
Structural parameters obtained by SAM (factor score regression) with ML estimation



Note. Standardized parameters are shown.

Legend: BIS = Behavioral Inhibition System; BAS = Behavioral Approach System; RUM = Ruminative thought style/Rumination; SA = Social anxiety as a trait; ML = Maximum likelihood.
* $p < .05$.; ** $p < .01$; *** $p < .001$.

The issue of high correlations between the dimensions of the rRST model although present in the studies on the latent structure of the different operationalizations of this model (e.g., Krupić et al., 2016; Smederevac et al., 2014) becomes particularly troublesome in using this model to predict different outcomes. Finally, zero-order correlations are comparable to those obtained by others (e.g., Sadiković et al., 2020).

The total and indirect effects are shown in Table 2. We used a Monte Carlo (MC) approach to construct confidence intervals (this method uses the sampling distribution of the compound statistic in order to calculate the CI) as these have been shown to perform as well as the bootstrapped CIs (MacKinnon et al., 2004). Noteworthy is that the indirect and total effect of BAS on the SA is rather small but significant, and with a CI interval that does not include a zero. Furthermore, regarding the role of BAS, its path coefficient on rumination (and its indirect effect on SA) is positive but its direct path coefficient on SA is negative.

Discussion

In order to examine the relations between the ruminative thought style and social anxiety in the context of rRST we aimed to specify the relations proposed by the theory using SEM. This offers a flexible framework to examine both the measurement and the latent relations of the constructs of interest. This approach also allowed us to gauge the relations among the constructs while simultaneously taking into account the complexities of measurement of these constructs in a large and heterogeneous sample from the general population.

Social Anxiety in the Context of rRST

The findings indicate that social anxiety can be explained based on three personality systems – BIS, Freeze, and BAS. BIS has the strongest and positive correlation with social anxiety. Freeze has also positive but lower correlation with social anxiety. The relationship between BAS and social anxiety is lower and negative. This essentially means that the BIS is primary neurobiological/ personality basis for an increased experience of social anxiety, with additional contribution of Freeze. On the other hand, BAS reduces the tendency to experience discomfort in socially evaluative situations.

According to rRST, tension, worry, and discomfort during the anticipation of threatening situations are attributed to BIS, and they are dominant components of social anxiety. Moreover, social anxiety takes the form of fear and even freezing in socially dangerous situations. Additional support to the explanation of the positive correlation between BIS and social anxiety is provided by The High Stakes Model of Social Anxiety (Buttermore, 2009). According to this model, the functions of social anxiety are related to danger detection and problem resolution, which at the same time represent the main functions of BIS. The results suggest that Fight and Flight do not have direct significant latent path coefficients with the social anxiety. This means that social anxiety, in the context of rRST, does not include explosive and disorganized aggressive reactions that represent a specific approach to threats in order to defend an individual (Fight). Also, it seems that socially anxious individuals perceive threats from the social environment as inevitable (Freeze) rather than as something that can be avoided (Flight).

Findings from some previous studies provide additional support for this pattern of results. For example, Ranđelović and Želeskov Đorić (2017) reported that BIS and Freeze are the only positive correlates of social anxiety among a sample of 237 psychology students. The study uses the same measures of social anxiety and personality systems as in the current study. Hence, in order to allow for the replication of findings from these studies it will be important to examine the relationships between different measures of social anxiety (e.g., Gee et al., 2012; Lee Nichols & Webster, 2015; Mattick & Clarke, 1998) as well as different measures of rRST personality systems (e.g., Corr & Cooper, 2016; Reuter et al., 2015). It would be expected that BIS is a robust positive correlate of different modalities of social anxiety, while differences in results would be

related to the significance of other personality systems in the prediction of the social anxiety phenomenon.

While the hypersensitivity of BIS is the primary facilitator of social anxiety, BAS is seen as a protective factor due to its direct effect on social anxiety. The protective role of BAS can be explained through its habituation effects on socially threatening situations. BAS activates approach behaviour, and this may mean that it predisposes a person to expose him/herself to situations that are perceived as socially threating but that lack actual social punishment (aversive outcome), which in turn may result in the reduction of negative affects related to social rejection. This finding is consistent with rRST (Gray & McNaughton, 2000), because the predictions of this theory suggest that the absence of punishment in certain social situations will act as a positive reinforcement, which further strengthens the activation of BAS in certain social situations. In that way, BAS protects a person from the development and maintenance of socially anxious experiences. This result is in line with Kimbrels' (2008) suggestion and some empirical findings (Coplan et al., 2006; Kimbrel, 2009; Kimbrel et al., 2012) that low BAS is an additional risk factor for social anxiety experiences. In contrast, Ranđelović and Želeskov Đorić (2017) failed to find a significant relationship between BAS sensitivity and social anxiety. A discrepancy in the results can be explained by differences in samples. Namely, in the study of Ranđelović and Želeskov Đorić (2017) the sample consisted of psychology students, mainly females. Hence, the variance of individual differences was reduced and this could be the reason for the absence of a significant link between BAS and social anxiety.

The Ruminative Thought Style in the Context of rRST

Different results were obtained with regards to the relationship between the personality systems and the ruminative thought style. Namely, BIS has a high positive correlation with rumination (a correlation of .87), while BAS, unlike its relationship with social anxiety, has a positive and low correlation with rumination. Given that BIS turned out to be the most strongly correlated with rumination (after controlling for the contribution of other domains of personality) this finding clearly shows the ruminative thought style is predominantly a cognitive manifestation of BIS. This is an important finding because it provides additional empirical support to the assumption made by Gray and McNaughton (2000) and Kimbrel (2008). According to these authors BIS is the main neurobiological/personality system underlying repetitive negative thinking. Moreover, this finding is consistent with previous empirical data (Leen-Feldnera et al., 2004; Li et al., 2015; Randles et al., 2010).

It was to be expected that the BIS would be highlighted as the core basis of the ruminative thought style considering that the activation of BIS is associated with increased arousal and with the attentional focus on threatening social information. This allows for the screening and monitoring of the internal and external environment, all in order to assess the threat, control the behaviour and resolve conflict in social contexts.

Even though RTSQ measures the general ruminative thought style, the content of items also includes problem-focused thoughts, counterfactual thinking, repetitive thoughts and anticipatory thoughts (Tanner et al., 2013). Hence, it can be said that increased BIS sensitivity is associated with ineffective conflict resolution. Finally, repetitive thoughts, which in part reflect automatic thoughts, also reflect the hyperactivity of BIS. Therefore, it can be concluded that at a cognitive level the heightened vulnerability in the BIS domain is manifested as a maladaptive ruminative thought style. Moreover, taking into account the high (latent) correlation between BIS and rumination (over .80), it can be concluded that rumination is an aspect of this personality system.

The Ruminative Thinking Style as a Mediator in the Relationship between Personality Systems and Social Anxiety

Results that refer to the mediating role of the ruminative thinking style suggest a complex relationship between personality systems and social anxiety. Namely, there is an indirect and total effect of BAS on social anxiety. More precisely, BAS has a positive correlation with rumination that in turn correlates positively with social anxiety. Furthermore, there is a negative direct effect of BAS on social anxiety. These findings suggest the complex effects of BAS on social anxiety. On one hand, this is reflected in the facilitatory effects of BAS on ruminative thought style, while, on the other, BAS has a direct protective effect on socially anxious experiences and behaviors. Moreover, the results have shown that there is a direct, an indirect and a total effect of BIS on social anxiety, with positive and direct association between rumination and social anxiety. Therefore, it can be noticed that BIS and BAS have a positive correlation with rumination, and their effects on social anxiety are positive and mediated by rumination. The previous studies suggest that BAS is a protective factor against cognitive biases (Kimbrel, 2009; Kimbrel et al., 2010; Kimbrel et al., 2012; Ranđelović, 2016; Ranđelović et al., 2018), and that rumination has a positive correlation with attentional and interpretative biases (Hsu et al., 2015; Mor et al., 2014). Moreover, previous studies point to a positive relationship between rumination and BAS (Li et al., 2015; Randles et al., 2010), and thus suggest a difference in rumination with respect to these cognitive biases. First of all, BAS and impulsivity (lack of constraint) are closely associated in terms of shared variance and conceptual overlap in the domain of the temperament. People with elevated BAS sensitivity exhibit weaker impulse control, which is reflected in reckless and risky behavior. The finding that BAS has a positive correlation with the ruminative thought style suggests that at the cognitive level BAS is manifested as the reduced ability to contain and control thought processes. In other words, the tendency towards uncontrolled (automatic) thoughts can be incited by BAS activity. This line of inquiry contributes to the heterogenous literature on complex relations between impulsivity and loose cognitive control over thought content (Valderrama et al., 2016; Lucas et al., 2010; Gay et al., 2010). Thus, through rumination, BAS increases the tendency towards socially anxious behavior, because it activates

a whole set of automatic thoughts that are related to the increased experience of social threat. This finding is very important because it helps to shed light on certain theoretical issues. Firstly, this finding, together with the finding that BIS is a positive correlate of rumination, indicates that the ruminative thought style has a maladaptive function. This is relevant for the ongoing research related to the functions of this cognitive tendency (Mihić et al., 2019; Tanner et al., 2013). Moreover, in the context of rRST, repetitive thinking can be explained as a component of BIS, while impulsivity from the BAS domain is a facilitating factor. Finally, the results point to the complex nature of BAS in terms of its predictive power for various forms of maladaptation, i.e., the various ways in which BAS affects social anxiety.

Limitations and Future Directions

The key limitation of present study is the usage of only one operationalization of social anxiety and rRST personality systems. Measurement of these constructs could be more comprehensive. Namely, social anxiety should not be operationalized only as a general tendency

towards specific psychophysiological responses in socially threatening situations, but also through different subtypes (e.g., social interaction anxiety and social observation anxiety). Further, it would be useful to operationalize the BAS in a multidimensional way (e.g., Corr & Cooper, 2016). Hence, future studies might consider the use of different and overall measures of these variables. This would be very important because that is a way to explore the generalizability of the findings of the current study. Although this research is correlational and it includes an extensive and heterogeneous sample from the general population, future studies should also include the experimental manipulation of social situations in which a certain way of thinking and socially anxious behavior are provoked. Given that one of the important variables in the MMSA is the current and potential socially threatening situation, it would be very useful to analyse the research problem under experimental conditions, and thus offer a more detailed empirical verification of the MMSA.

Conclusion

It can be concluded that different aspects of BAS have different mechanisms of exerting the opposite effects on social anxiety. One path is mediated by cognitive dysregulation and enhances the experience of social anxiety. The other mechanism bypasses cognition and uses the direct exposure to socially unpleasant situations ("without thinking"). BIS also has a twofold effect on social anxiety – through rumination and "bypassing" the cognition. Unlike BAS, BIS acts as a risk factor in both ways. The direct path from BIS to social anxiety can be explained by the fact that BIS facilitates associative learning of socially anxious reactions because a person is used to behaving in a certain way due to negative reinforcement in social situations.

The findings from this study are in line with previous studies on MMSA (Kimbrel, 2009; Kimbrel et al., 2012) as they show that some of the effects of BIS and BAS on social anxiety are mediated by the ruminative thought style. Thus, the results of this study provide a basis for the expansion of the MMSA by including rumination as a mediator variable. Moreover, Kimbrel (2008) postulates that the relationship between the personality system and socially anxious behavior is entirely mediated by negative cognitive biases. However, the findings of this research suggest that there is a partial mediation of ruminative cognition between personality traits and social anxiety. This provides a basis for extending the model.

Given that rumination is one of the possible mechanisms through which the temperament affects social anxiety, it seems reasonable to suggest the use of cognitive-behavioural therapy (CBT). CBT could be applied to learn how to control maladaptive thoughts, as well as to adopt the adaptive thinking patterns, and to learn more functional responses to social threats.

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Socijalna anksioznost i ruminacija u kontekstu revidirane teorije osetljivosti na potkrepljenje i medijacioni model socijalne anksioznosti

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Cilj ovog istraživanja bio je da se ispita odnos između temperamenta, ruminativnog stila razmišljanja i socijalne anksioznosti modelovanjem latentnih varijabli. Pre testiranja integrativnog modela koji specifikuje relacije između (ispitivanih, prim.prev.) konstrukata, proverena su relevantna svojstva mera. Istraživanje je sprovedeno na heterogenom uzorku iz opšte populacije koji je činilo 1,029 učesnika (62.1% žena) starosti od 19 do 79 godina. Nalazi pokazuju da je Sistem bihejvioralne inhibicije (eng. Behavioural Inhibition System, BIS) najvažniji faktor vulnerabilnosti za razvoj socijalne anksioznosti, kao i da na nju ostvaruje kako direktni, tako i indirektni efekat preko ruminativnog stila razmišljanja. Takođe, Blokiranje (eng. Freeze) dodatno doprinosi povećanju doživljaja socijalne anksioznosti. Sistem bihejvioralne aktivacije (eng. Behavioral Activation System, BAS) ima kompleksni efekat na socijalnu anksioznost – direktni efekat je protektivan, dok postoji i indirektni efekat koji se ostvaruje kroz facilitaciju ruminativnog stila razmišljanja. Dakle, BAS takođe može imati ulogu faktora rizika (za razvoj socijalne anksioznosti, prim. prev.). Nalazi podržavaju revidiranu Teoriju osetljivosti na potkrepljenje i daju osnovu za proširenje Kimberlovog Medijacionog modela socijalne anksioznosti.

Ključne reči: socijalna anksioznost, ruminativni stil razmišljanja, revidirana teorija osetljivosti na potkrepljenje, medijacioni model socijalne anksioznosti

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Appendix A

Table 1
The structure of the Social Anxiety Scale (SAS; Tovilović, 2004) – Bifactor exploratory and confirmatory factor analysis

		bifactor EFA (n = 513)						bifactor CFA (n = 516)					
		WLS1	WLS5	WLS2	WLS3	WLS4	h^2	G	F1	F2	F3	F4	h^2
1	It takes me some time to overcome my shyness when faced with new situations.	.64	-.11	.08	.16	-.08	.45	.71					.50
2	I become disturbed if I'm being watched while doing something.	.69	-.02	-.01	**.30**	.04	.56	.71			.19		.54
3	It's hard for me to establish contact with unfamiliar people.	.50	-.11	**.57**	.16	-.06	.61	.63		.46			.60
4	I become disturbed when speaking in front of other people.	.69	-.04	.09	**.43**	.00	.67	.74			.47		.77
5	I feel nervous when I am in a large group of people.	.72	-.05	**.21**	**.32**	.01	.66	.75		.24	.48		.85
6	I feel uncomfortable in the presence of unfamiliar people.	.73	-.08	.18	.12	-.06	.60	.80					.64
7	I become very disturbed when someone criticizes me.	.71	.09	-.14	**.21**	.08	.59	.72					.52
8	I feel uncomfortable when I am in the centre of attention.	.75	-.10	-.03	.16	-.11	.61	.78					.61
9	I become very disturbed when I have to talk to one of my authority figures	.80	-.02	-.18	.06	-.11	.69	.79					.62
10	I am afraid that people that I am talking to will notice that I am disturbed.	.84	.02	-.21	.02	-.13	.77	.85					.72
11	I find it hard to hide my nervousness when I am talking to people.	.80	-.01	-.17	-.07	-.13	.69	.83					.69
12	I would like to be more relaxed in the presence of others.	.81	-.01	-.03	-.03	-.15	.67	.82					.67
13	I don't know how to "small talk" with unfamiliar people.	.63	.00	**.47**	-.26	-.03	.69	.73		.48			.76
14	I usually behave overly shyly.	.75	.05	**.20**	-.22	-.14	.67	.82		.32			.78
15	The idea that I am being judged by the person I am talking to while I speak disturbs me.	.76	**.30**	-.01	-.08	-.02	.67	.79	.17				.65
16	I am very afraid of judgment or bad opinion others might have regarding me.	.68	**.55**	-.07	.01	.03	.77	.77	.46				.81
17	I fear that others will reject me.	.70	**.49**	-.03	-.05	.02	.73	.73	.58				.87

18	I avoid certain situations in order not to embarrass myself.	.72	**.33**	-.07	.04	.03	.63	.79	.30			.70
19	I am afraid that others will notice that my hands or body are shaking from nervousness while I am talking to them.	.76	**.25**	-.08	-.06	.04	.65	.82	.26			.74
20	I usually avoid eye contact with the person that I am talking to because it is uncomfortable for me to maintain direct eye contact.	.71	.07	.06	-.14	**.24**	.59	.74			.24	.60
21	Sometimes I cross to the other side of the street in order to avoid meeting certain individuals.	.53	.10	-.03	-.07	**.33**	.41	.55			.27	.37
22	I often lack self-confidence.	.74	.01	-.11	.09	**.31**	.66	.76			.40	.74
23	It is easy to overturn my opinion.	.61	.05	-.10	.09	**.35**	.52	.69			.36	.61
24	I am often dissatisfied with my appearance even when I am well-dressed.	.58	.04	-.13	.00	**.36**	.48	.61			.38	.51
25	Sometimes, when others are expecting of me to say something, I experience a complete “block”.	.75	.07	-.09	.01	.19	.62	.80				.63
						Ω_H/ $_{\Omega H}$S		.95	.95	.16	.19	.18	.17
						ECV		.86	.86	.19	.20	.23	.20

Note. The translation is based only by on one forward translation. The rights to the questionnaire belong to S. Tovilović (Tovilović, 2004). EFA group-factor loadings greater than .20 (bold) are kept in CFA structure if shown to be significant. Bifactor EFA used WLS extraction method. CFA used WLSMV estimation. $\Omega_{H\ -}$ omega hierarchical (for a general factor); Ω_{HS} = omega hierarchical subscale; ECV = Explained Common Variance.