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Relations between self-regulation, divergent thinking, and perceived stress in emerging adults

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This study investigated the relationships between self-regulation and stress, self-regulation and creativity, and perceived stress as a mediator for the relationship between self-regulation and creativity. Questionnaires were administered to undergraduate students to individually access each construct. Creativity was measured through divergent thinking and self-regulation was measured through the SRS and effortful control. Regression analyses were run to determine the relationships between the constructs. A negative association was found between effortful control and stress. Individual positive relationships were found between effortful control and all of the creative thinking styles except convergent-unpleasant. Lastly, the indirect effect of effortful control on the convergent-unpleasant thinking style as mediated by stress was significant. This is a notable finding when considering previous research on the topic is contradictory.

Relations between self-regulation, divergent thinking, and perceived stress in emerging adults

Accompanying the influx of newfound responsibilities that come with enrolling in college (Arnett, 1999), many undergraduate students experience an increasing level of stress in response to heightened academic and social expectations (Olpin, 1996). In light of these increasing demands, many students thrive within secondary education, finding innumerable opportunities to hone skills and refine their interests. There are, however, an important set of abilities that can either facilitate or impede knowledge and skill attainment and encompass a myriad of capacities that can aid an individual in focusing on the task at hand, resisting distractions, and not overreacting with violence or aggression when presented with undesirable stimuli. Such abilities constitute our capacity to engage in self-regulation, an umbrella term capturing a range of skills reflecting the volitional control of thoughts, feelings, and behaviors in the pursuit of a goal (e.g., Bridgett, Oddi, Laake, Murdock, & Bachmann, 2013; Friedman et al., 2015; Nigg, 2017; Poon, 2018).

Research on Self-Regulation

A review of the literature on these important cognitive abilities highlights that such capacities have been studied from multiple disciplines, most notably work investigating aspects known as executive functions, effortful control, and executive control (e.g., Bridgett et al., 2013; Liew, 2012; Nigg, 2017; Zhou, Chen, & Main, 2012). Although these different perspectives contribute to both a rich, yet nebulous framework for the organization of self-regulatory abilities, there remains an important theoretical overlap warranting a greater appreciation for the differing (i.e., multifaceted) aspects of self-regulation (e.g., Liew, 2012; Nigg, 2017). From within the clinical and neuroscience literatures, the executive functioning perspective of cognitive self-regulation has largely been typified by three component abilities: inhibitory control, working

memory, and cognitive flexibility (e.g., Best & Miller, 2010). Inhibitory control allows for focusing in on the target stimuli by blocking out irrelevant stimuli and prevents one from depending solely on impulsive responses (Roos et al., 2017). Working memory is responsible for updating information and suppressing content that is not relevant to the task at hand (Carriedo et al., 2016). Finally, cognitive flexibility is the extent to which behavioral adaptation is possible in the face of a changing environment, for instance, changing how a task is carried out in light of new rules or demands (Marko & Riečanský, 2018) while effortful control deals with the focusing of attention or inhibition of behavior (Bridgett et al., 2013). Together, these capacities more often reflect a more clinical orientation and are collectively grouped as executive functions, however, there is merit in viewing the different perspectives of self-regulation within a complementary, rather than competitive framework (e.g., Nigg, 2017).

Although effortful control has been predominantly researched within the field of temperament, it is an important aspect of self-regulation, as it reflects processes related to the control of a variety of systems that are useful in understanding the inhibition of one dominant response for another (e.g., Evans & Rothbart, 2006; Rothbart, Ellis, Rueda, & Posner, 2003). Furthermore, these self-regulatory abilities, regardless of originating discipline, support both concurrent and enduring success across the lifespan (e.g., McClelland, Acock, Piccinin, Rhea, & Stallings, 2013) and given the conceptual overlap between these similar skills, the current study investigates self-regulation using indices that embody both temperamental and clinical (i.e., executive functioning) perspectives, as there is value in taking a multidisciplinary approach to the cognitive abilities and processes behind adapting one's mindset and meeting increasingly complicated demands, a reflection of the increased novel experiences in college.

Additionally, recent research on the association between divergent thinking—a thinking style typified by solving problems with new frameworks (Soroa, Balluerka, Hommel, & Aritzeta, 2015)—and effortful control has been conflicting. For instance, individuals who engage in greater divergent thinking might experience lower effortful control due to previous research that suggested negative correlations between cognitive inhibition and creativity were often measured through divergent thinking instruments (Lin, Hsu, Chen, & Chang, 2013). However, Zabelina & Ganis (2018) found that those who engaged in greater divergent thinking exhibited greater cognitive control, not less. Moreover, cognitive self-regulation, inclusive of the EF and EC literatures, has been increasingly investigated due to its ties to various aspects of social and academic success across the lifespan (e.g., Best & Miller, 2010; Best, Miller, & Jones, 2009).

Furthermore, prior research has found relations between aspects of creativity and the role it can have on cognitive flexibility, another self-regulatory ability (Best & Miller, 2010; Zabelina & Ganis, 2018). It could be that creativity makes use of divergent thinking through the process of generating several ideas that could then be used to solve a problem in an innovative or unique way. However, this generation of ideas can be hindered by high levels of perceived stress (Seehagen, Schneider, Rudolph, Ernst, & Zmyj, 2015). Stress is an inevitable experience and while it does have evolutionary benefits such as providing and boosting energy, too much stress can have detrimental effects on health (Ganster & Rosen, 2013). Perceived stress, like objective stress, can vary from person to person depending on how they process environmental stressors (Burger & Samuel, 2017).

Research on Creativity

Creativity is an important part of intelligence, but the scientific community has struggled to clearly define it. Creativity is often associated with divergent thinking because it utilizes the

idea generating process to create novel ideas. A positive correlation was found to exist between divergent thinking and creativity (Batey, Furnham, & Safiullina, 2010). Divergent thinkers prefer to work with new frameworks through creativity to solve problems (Soroa, Balluerka, Hommel, & Aritzeta, 2015). Since students who align themselves with the fine arts are thought to be more creative, important research was done on whether or not creativity was more prevalent in students based on their area of study. In what follows, an overview of studies investigating the association between area of study and facets of creativity is provided.

Art students are not inherently more creative; art education is designed to foster creative thinking skills through the use of a sensory anchor, being engaging, and encouraging rich connections (Moga, Burger, Hetland, & Winner, 2000). Experimental studies found that a modest relationship existed between creativity and art education if the type of creativity was figural—in relation to hypothetical situations and stimuli (Dău-Gaşpar, 2013). However, no relationship existed if the type of creativity was verbal or conceptual. It could be that creative students are naturally drawn to more creative areas of study (Eisenman, 1969). Creativity was tested in English versus Business majors and found that the participants who studied English were far superior. These studies demonstrate a correlation between higher creativity levels in english and art majors.

Individuals engage in a variety of artistic areas of study. Contrary to Moga and his colleagues (2000) and Eisenman (1969), Woodward and Sikes (2015) did not find higher creativity in an area of study deemed creative. When individuals trained in music were tested to see if they could respond more divergently (i.e., creatively) than nonmusicians by creating original meanings for the abstract sounds, no significant difference was found between the groups' visual and written creativity. In addition, students' high school major did not make a

significant difference on their level of creativity (Dău-Gaşpar, 2013). Thus providing further evidence for an area of study's lack of impact on level of creativity.

Study Aims

The goal of the present study is to investigate whether there is a connection between an individual's self-regulatory ability and perceived stress and how this relates to their ability to engage in more original problem-solving (i.e., divergent thinking). In turn, being able to shift one's perspective to allow for one to reach a solution any number of ways is theorized to be an important predictor of less perceived stress (Seehagen, Schneider, Rudolph, Ernst, & Zmyj, 2015). In light of this, the aims of the current study are to elucidate these connections. The conceptual mediation diagram can be found in Figure 1.

Specifically, the following research questions guided the present study. First, I sought to investigate the association between an individual's self-regulation abilities and their perceived level of stress. As an individual progresses through adolescence and emerging adulthood, the expectation to make autonomous decisions increases commensurate with age (Arnett, 2007). In the context of college, as one progresses through their program of study, the requirements become increasingly complex, requiring solutions to novel problems. As such, the greater an individual's ability to have effortful control, the less perceived stress they should experience.

I also wanted to evaluate the association between an individual's self-regulatory abilities and their ability to engage in divergent thinking. It was hypothesized that a positive relationship would be found between effortful control and divergent thinking, aligning with previous research supporting that divergent thinking relies on executive control (Zabelina & Ganis, 2018).

For the third research question, I sought to examine the relation between an individual's self-regulatory abilities and their ability to engage in divergent thinking to see if they are partially explained through levels of perceived stress. As divergent thinking reflects novel approaches to problem solving, it was hypothesized that the relationship between effortful control and perceived stress would be partially mediated by divergent thinking due to the diversion from a more rigid thought process.

The last research question guiding the present study was more exploratory in nature and sought to examine whether any indirect effects of cognitive self-regulation on divergent thinking through perceived stress was moderated by academic major (i.e., moderated mediation). Despite some students demonstrating greater creative abilities than their peers, it was hypothesized that any indirect effects of self-regulation on divergent thinking through perceived stress will not be dependent on academic major (Dău-Gaşpar, 2013).

Method

To answer these research questions, this study utilized questionnaires to individually assess the constructs of creativity (through divergent thinking), perceived stress, and self-regulation. Self-regulation was measured with both the Self-Regulation Scale and effortful control due to the theoretical overlap across disciplines. Students were recruited through the Psychology Department's subject pool coordination system and Qualtrics was utilized in order to deliver the questionnaires.

Participants

The study was composed of approximately 327 undergraduate students between the ages of 18 and 51 (*M=20.09, SD=3.781)* who identified as either female (74%), male (13.1%),

transgender (less than 1%). My sample was predominantly White (69.7%); followed by Black (9.8%), Two or more races which do not include Hispanic or Latino (4.6%), Asian (2.4%), American Indian or Alaska Native (<1%), and less than 1% decided not to answer.

Procedures

All measures were administered through the SONA subject pool coordination system, where all study materials, including informed consent were contained. Participants were offered SONA credit for their involvement in the project, which some professors in the psychology department accept as extra credit in their courses as a way to encourage students to participate in research throughout the semester.

Measures

Self-Regulation

The Self-Regulation Scale (SRS; Diehl, Semegon, & Schwarzer, 2006) is a 10-item questionnaire rated on a 4-point Likert scale (1: *not at all true* and 4: *completely true*). The SRS assesses one's abilities to accomplish their goals over time while circumstances change and asks questions such as "When I worry about something, I cannot concentrate on an activity" and "If an activity arouses my feelings too much, I can calm myself down so that I can continue with the activity soon." The reliability for the SRS in the current study was good with internal consistency of $\alpha = .802$. Diehl, Semegon, and Schwarzer (2006) demonstrated validity with the SRS when positive correlations were found with positive affect and negative correlations with depressive symptoms.

The Adult Temperament Questionnaire-Short Form (ATQ-SF; Evans & Rothbart, 2007) is a shortened version of the original ATQ (Evans & Rothbart, 2007) which is a self-report temperament questionnaire that has four constructs: effortful control, negative affect,

extraversion/surgency, and orienting sensitivity. In the present study, effortful control items were administered to assess cognitive self-regulation and yielded values for three indices: attentional control, activation control, and inhibitory control. Attentional control refers to one's ability to choose what they want to concentrate on. For example, a questionnaire item for attentional control reads "When I am trying to focus my attention, I am easily distracted." Activation Control refers to one's ability to perform a task despite a strong desire to avoid it. A questionnaire item for this construct is "I can make myself work on a difficult task even when I don't feel like trying." Finally, inhibitory control refers to one's ability to withhold inappropriate behavior. One of the items reads "I can easily resist talking out of turn, even when I'm excited and want to express an idea." In the current sample, internal consistency estimates for the three effortful control variables ranged from .504 to .705 [INH: .504; ATT: .705; ACQ: .679]. The ATQ-SF has been found to show convergence with the Big Five.

Creativity

The Emotion/Motivation Related Divergent and Convergent Thinking Styles Scale (EDICOS; Soroa, Balluerka, Hommel, & Aritzeta, 2015) is a 30-item questionnaire rated on a 6-point Likert scale (1: *strongly disagree* and 6: *strongly agree*). The EDICOS assesses 4 distinct thinking styles of creativity: convergent-unpleasant, convergent-preventative, divergent-proactive, and divergent-pleasant. The scales are distinguished by divergent vs. convergent (thinking styles), pleasant vs. unpleasant (affective styles), and proactive vs. preventative (motivational systems) to account for dynamic individual differences. An example item for convergent-unpleasant reads "While working on a complex problem I feel a certain level of anxiety" while a convergent-preventative item example would read "I like to anticipate the consequences that my decisions will have." Additionally, an example item for divergent-

proactive was “I am motivated to change ideas until finding the most innovative one” in comparison to a divergent-pleasant example item which stated “When I get involved in projects that require creativity I feel joy” (Soroa, Balluerka, Hommel, & Aritzeta, 2015). The reliability for the EDICOS in the current study was acceptable with internal consistency values ranging from .703 to .844. Construct validity with the EDICOS has been demonstrated with the creative thinking styles relating positively to measures of motivational and emotional creativity (Soroa, Balluerka, Hommel, & Aritzeta, 2015).

Perceived Stress

The Perceived Stress Scale (PSS; Cohen, Kamarck & Mermelstein, 1983) is a 14-item questionnaire that is rated on a 5-point Likert scale (0: *never* and 4: *very often*). The PSS assesses one’s level of self-reported stress and asks questions such as “In the last month, how often have you felt confident about your ability to handle your personal problems?” and “In the last month, how often have you found that you could not cope with all the things you had to do?” Cohen, Kamarck, and Mermelstein (1983) found that the PSS was both reliable and correlated with physical symptomatology. The reliability for the PSS in the current study was good with an internal consistency estimate of □ = .861.

Data Analytic Plan

Multiple regression analyses were used within a path analytic framework to answer my first three research questions: R1 investigating the association between an individual’s self-regulation abilities and the amount of stress perceived in college, R2 evaluating the association between an individual’s self-regulation abilities and their ability to engage in divergent thinking and R3, examining the relation between an individual's self-regulatory abilities and their ability to engage in divergent thinking to see if they can be partially explained through levels of

perceived stress. In the case of missing values on the ATQ, any missing data was replaced with the item mean from the sample as recommended by the ATQ test authors (Evans & Rothbart, 2007).

Results

Initial means and correlations can be found in Table 1. In the present study, my first research question investigated the relation between an individual's cognitive self-regulatory abilities and the amount of perceived stress experienced in a sample of college students. To assess this, multiple regression analyses were performed utilizing the PROCESS macro for SPSS (Hayes, 2012). Results of the regression analyses revealed that there were significant direct effects between each facet of self-regulation and perceived stress. Specifically, INH (ß= -.17), ACV (ß= -.19), ATT (ß= -.19), and SRS (ß= -.76) each significantly predicted perceived stress.

The second research question sought to find the association between an individual's self-regulatory abilities and their ability to engage in divergent thinking. When predicting convergent-preventative thinking styles, each of the self-regulation scales were each significant predictors (ATT (β = .11), ACV (β = .11), INH (β = .18), and SRS (β = .44). For both divergent-proactive and divergent-unpleasant thinking styles, both ACV (β = 0.12 & 0.15, respectively) and SRS (β = 0.36 & 0.42, respectively) were significant predictors. Convergent-unpleasant thinking styles were not significantly predicted by any of the measured self-regulatory abilities. Results of parameter estimates can be found in Table 2.

For my third research question, I wanted to see if the relationship between an individual's self-regulatory abilities and their ability to engage in divergent thinking could be partially explained through levels of perceived stress. There was a significant indirect effect of the convergent-unpleasant thinking style on the ATT through stress: ATT (95%CI: -.09, -.03), ACV

(95%CI: -.11, -.04), INH (95%CI: -.10, -.03), and SRS (95%CI: -.40, -.18). There was no significant indirect effect of stress on the association between the convergent-preventative thinking style and the ATT (ACV, INH, SRS), divergent-proactive and the ATT (ACV, INH, SRS), nor divergent-pleasant and the ATT (ACV, INH, SRS).

Finally, my last research question, assessing whether any indirect effects between self-regulatory abilities and the ability to engage in divergent thinking through levels of perceived stress were dependent upon major (i.e., moderation mediation) was not able to be determined due to an insufficient number of non-psychology majors. More specifically, less than 2% of participants self-identified as working towards one of UTC's creative majors, including Art Education, Painting and Drawing, Creative Writing, Music, Photography and Media, and Theatre.

Discussion

In regard to research question 1, I hypothesized that there would be a negative association between self-regulation and stress. That turned out to be correct on all four measures as a negative association was found between the two constructs. For research question 2, I predicted that a positive relationship would be found between self-regulation and the ability to engage in divergent thinking. This turned out to be correct for some factors of the creative thinking styles, but not all. This could be in part because, conceptually, as one's ability to understand a situation and determine the appropriate response increases so does their control of the situation; therefore, lessening one's stress response. When predicting convergent-preventative thinking styles, ATT, ACV, INH, and SRS were each significant predictors of self-regulation. ACV and SRS each significantly predicted both divergent thinking styles. Convergent-unpleasant thinking styles were not a significant across any factor. These findings were in line with previous research

suggesting that higher divergent thinking requires greater levels of cognitive control (Zabelina & Ganis, 2018).

Research question 3 was hypothesized that there would be a partial mediation between the self-regulatory abilities and the creative thinking styles through perceived stress. The results indicated that there were significant indirect effects of stress between a few of the thinking styles and the ATT. There was a significant indirect effect of stress on the association between the convergent-unpleasant thinking style and the ATT, specifically: ACV, INH, and SRS. However, there was no significant indirect effect of stress on the association between convergent-preventative and the ATT, divergent-proactive and the ATT, nor the divergent-pleasant and the ATT. While stress has a higher influence on certain mental abilities more than others, previous research has shown stress to affect divergent thinking as opposed to convergent (Krop, Alegre, & Williams, 1969). The difference in findings are important to note because it could be that stress and the convergent-unpleasant thinking style are more closely linked than previously thought.

One of the limitations of this study was that the internal consistency for inhibitory control was very low. Additionally, there were not enough participants to properly address the fourth research question regarding the moderation of the indirect effect (i.e., moderated mediation) by academic major. Future studies should make an effort to ensure more creative majors are recruited as UTC's subject pool coordination system (SONA) primarily serves psychology majors. Perhaps the deficiency of creative majors was brought on by a lack of familiarity with SONA when presented with the survey and the additional privation of potential incentive for extra credit for a class outside of the psychology department led to a deterrence in participation.

In conclusion, I set out to find the relationship between self-regulation and stress. The regression analysis revealed a negative association between the two which was in line with some

of the previous literature and adds further validity to the negative association between the two constructs. In regards to the relationship between self-regulation and divergent thinking, a positive relationship was found for both divergent thinking styles which goes along with previous research demonstrating a positive relationship between the two, but does not explain the positive correlation between effortful control and the convergent-preventative thinking style. More research should be done to further investigate the relationship between the two. Lastly, stress was shown to have significant indirect effects as a mediator between effortful control and the convergent-unpleasant thinking style. This indirect effect is notable considering these findings contradict previous research stating that stress affects divergent thinking.

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Figure 1: *Conceptual Mediation Diagram*

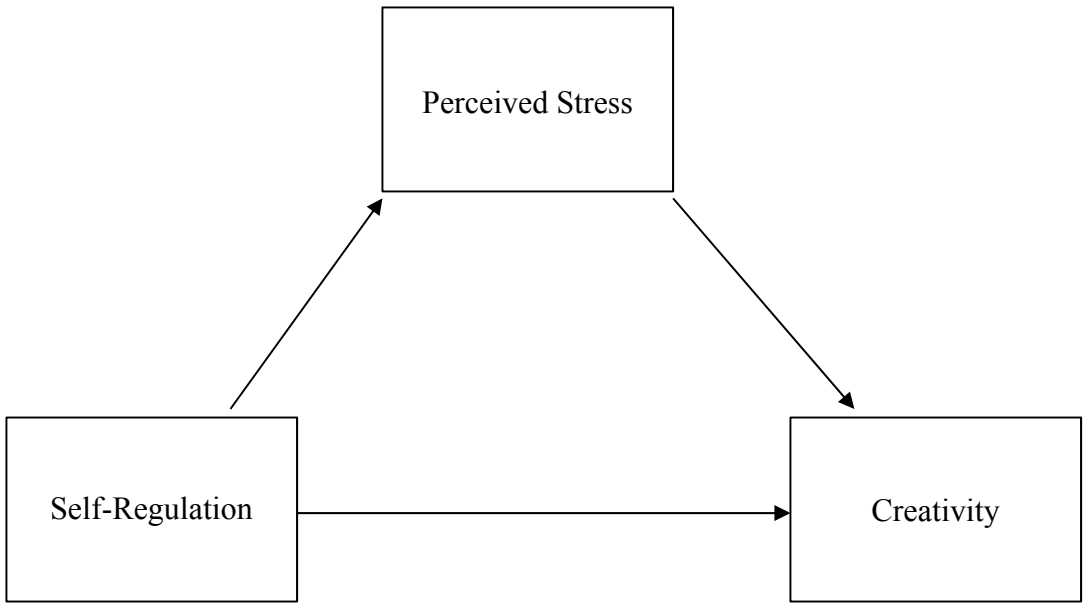

Table 1. Descriptive Statistics and Correlations

Variable	Mean	*SD*	1	2	3	4	5	6	7	8	9
1. Convergent-Unpleasant	35.63	5.47									
2. Convergent-Preventative	35.64	5.74	0.14								
3. Divergent-Proactive	37.65	6.27	0.04	0.47							
4. Divergent-Pleasant	21.74	3.97	0.43	0.41	0.61						
5. Attentional Control (ATT)	19.16	4.9	-0.17	0.19	0.53	0.08					
6. Activation Control (ACV)	33.81	5.76	-0.05	0.15	0.14	0.17	0.37				
7. Inhibitory Control (INH)	30.15	5.39	-0.05	0.2	0.09	0.05	0.37	0.23			
8. Self-Regulation Scale (SRS)	27.26	4.26	-0.16	0.24	0.16	0.19	0.63	0.41	0.36		
9. Perceived Stress	19.7	6.1	0.32	-0.11	-0.01	-0.05	-0.35	-0.28	-0.24	-0.53	
10. Age	20.09	3.78	0.04	0.22	0.07	0.09	0.19	0.02	0.15	0.19	-0.17

Table 2: *Parameter Estimates of Direct and Indirect Effects*

Parameter Estimates

	Convergent-Unpleasant		Convergent-Preventative		Divergent-Proactive		Divergent-Pleasant	
	Est.	*SE*	*Est.*	*SE*	*Est.*	*SE*	*Est.*	*SE*
INH➔ Thinking Style (X➔Y)	0.01	0.04	0.18***	0.05	0.08†	0.05	0.04	0.06
INH➔ Stress (X➔M)	-0.17***	0.04	-0.17***	0.04	-0.17***	0.04	-0.17***	0.04
Stress➔ Thinking Style (M➔Y)	0.36***	0.06	-0.08	0.07	0.01	0.06	-0.05†	0.08
Indirect effect	*ab = -0.06 [CI= -0.10, -0.03]*		*ab = 0.01 [CI = -0.00, 0.04]*		*ab = -0.00 [CI = -0.02, 0.02]*		*ab = 0.00 [CI = -.017, 0.04]*	
ACV➔ Thinking Style (X➔Y)	0.02	0.04	0.11*	0.05	0.12**	0.04	0.15**	0.05
ACV➔ Stress (X➔M)	-0.19***	0.04	-0.19***	0.04	-0.19***	0.04	-0.19***	0.04
Stress➔ Thinking Style (M➔Y)	0.37***	0.06	-0.09	0.07	0.04†	0.06	-0.00	0.08
Indirect effect	*ab* = -0.07 [*CI* = *-0.12, -0.04*]		*ab = 0.01 [CI = -0.00, .05]*		*ab = -0.00 [CI = -.03, 0.01]*		*ab = 0.00 [CI = -.03, 0.03]*	
ATT➔ Thinking Style (X➔Y)	-0.04	0.03	0.11**	0.04	0.03*	0.03	0.05*	0.04
ATT➔ Stress (X➔M)	-0.19***	0.03	-0.19***	0.03	-0.19***	0.03	-0.19***	0.03
Stress➔ Thinking Style (M➔Y)	0.32***	0.06	-0.06	0.07	0.01	0.07	-0.02	0.08
Indirect effect	*ab= -0.06 [CI= -0.09, -0.03]*		*ab = 0.01 [CI= -0.01, 0.47]*		*ab = -0.00 [CI= -0.03, 0.02]*		*ab =0.00 [CI= -0.02, 0.04]*	
SRS➔ Thinking Style (X➔Y)	0.03	0.10	0.44***	0.11	0.36***	0.11	0.42***	0.12
SRS➔ Stress (X➔M)	-0.76***	0.07	-0.76***	0.07	-0.76***	0.07	-0.76***	0.07
Stress➔ Thinking Style (M➔Y)	0.37***	0.07	0.02	0.08	0.12	0.07	0.09*	0.09
Indirect effect	*ab = -0.28 [CI= -0.41, -0.18]*		*ab =-0.02 [CI= -0.14, 0.09]*		*ab = -0.09 [CI= -0.22, 0.02]*		*ab= -0.07 [CI= -0.20, 0.06]*	

Note: (*†= p < .1, *= p < .05, **= p < .01, ***= p < .001*)