The effects of stress, threat/challenge appraisal, and coping flexibility on emotion

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UNIVERSITY**

**THE EFFECTS OF STRESS, THREAT/CHALLENGE
APPRAISAL, AND COPING FLEXIBILITY ON
EMOTION**

CHEN LUXI

SCHOOL OF HUMANITIES AND SOCIAL SCIENCES

2017

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School of Humanities and Social Sciences

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Abstract

Stress occurs when environmental demands exceed individual competence. Threat/challenge appraisal reflects individuals' negative or positive interpretation of stress. Coping flexibility equips individuals with the ability to employ effective strategies to deal with environmental changes. Plenty of research has explored the influence of appraisals and coping on psychological well-being, however, the working mechanism regarding how stress determines psychological outcomes through threat/challenge appraisal and coping flexibility, has not been fully understood. Hence, it is essential to investigate how threat and challenge appraisals, as well as coping flexibility, influence each other and determine individuals' psychological outcomes under stress.

The main objective of the current thesis was to examine the mediating role of threat/challenge appraisal in the stress-emotion link, and that of coping flexibility in the appraisals-emotion link. The project began with Study 1, a correlational study, to examine the general conceptual model linking self-reported experienced stress, threat and challenge appraisals, coping flexibility, and emotional outcomes. Two paths (a negative path and a positive path) and two mediators (threat appraisal and coping flexibility) were discovered. In particular, threat appraisal mediates the association between experienced stress and negative emotional outcomes, in the negative path; coping flexibility mediates the relation between challenge appraisal and negative emotional outcomes, in the positive path. Study 2 experimentally manipulated the type of stress so as to verify the negative path in an actual stressful situation. Different types of stress were respectively

evoked by providing negative, positive, and neutral instructions for an upcoming task. All participants were randomly assigned to one of the three stress conditions (negative, positive, and neutral stress). The results showed that, compared to baseline, participants who experienced negative stress reported more threat appraisal and less positive emotion, whereas those who experienced positive stress engaged in less threat appraisal and more positive emotion. The negative path was verified in both negative and positive stress conditions, suggesting that threat appraisal mediated the influence of both negative and positive stress on positive emotion. Study 3 aimed to verify the positive path by experimentally manipulating appraisals. A single-session Cognitive Bias Modification for Interpretation (CBM-I) program was adopted to alter appraisals. All participants were randomly assigned to one of the three training conditions (positive, negative, and mixed training). Our results illustrated that, compared to baseline, participants who received positive training engaged in more challenge appraisal and maintained their coping flexibility levels and positive emotion; in contrast, those who received negative training engaged in less challenge appraisal, displayed lower coping flexibility, and experienced less positive emotion. The positive path was verified in the positive training condition by showing that enhanced challenge appraisal could promote coping flexibility and increase positive emotion.

Taken together, the present research revealed a two-mediator conceptual model with two paths to explain the process how emotional outcomes are determined by appraisals and coping flexibility. Besides the risky factors, namely experienced stress and threat appraisal, the protective roles of challenge appraisal

and coping flexibility have also been highlighted in facilitating adaptive emotional outcomes under stress. Moreover, positive instruction for a particular stressor and the CBM-I program are effective methods for altering appraisals, promoting coping flexibility, and enhancing positive emotion. This thesis theoretically expands our understanding of the mechanism concerning how stress influences emotional outcomes through threat and challenge appraisals as well as coping flexibility. It also provides practical implications for ways to promote adaptive coping behaviors to achieve adaptive outcomes.

CHAPTER 1

INTRODUCTION

Stress conceptualizes an interaction between a person and the environment, and it occurs when external or internal demands exceed individual competences or resources (Folkman & Lazarus, 1980; Lazarus, 1966; Lazarus & Folkman, 1984). A large body of research has demonstrated the impacts of stress on people's well-being and mental health. Observations show that some individuals can achieve adaptive adjustment outcomes under stress, whereas others may experience maladaptive adjustments. Early in 1902, Baldwin and Poulton's (1902) Vital Plasticity Theory (cited in Change, Lau, and Chan's (2014) research) views an individual as a self-initiating and self-organizing system, and implied that individuals' responses to changing situations are not primarily determined by environment, but by themselves. In addition, more and more researchers (e.g., Bandura, 1982; Lazarus, 1966) have highlighted that psychological and physical adaptations under stress do not merely depend on the objective stressful event, but rely more on the subjective interpretation of the events and the coping behaviors pertaining to the perceived stressful events. Lazarus (1999) specifically suggested that in response to the same stressful situation, some people employ adaptive coping strategies while others display maladaptive coping behaviors, and the different coping behaviors may lead individuals to different adjustment outcomes. Thus, it is necessary to investigate how individuals cope with stress and what factors determine their adjustment outcomes.

During the initial stage of response to stress, *appraisal*, a process in which an individual evaluates a particular encounter in terms of the relationship between self and stressful situations, occurs (Folkman, 1982; Lazarus, 1991; Lazarus, 1991a; Lazarus & Folkman, 1984). Individuals may adopt a positive attitude towards overcoming obstacles, which is termed as *challenge appraisal*, while some others may engage in *threat appraisal*, negatively perceiving the obstacles as involving threat or harm. Once individuals make a judgment about the situation and their own capability, they will decide how to respond to the situation. *Coping* refers to individuals' cognitive and behavioral efforts that aim at managing the interface of changing personal and external environmental demands (Folkman, Lazarus, Gruen, & DeLongis, 1986; Holroyd & Lazarus, 1982). Although there are various types of coping strategies, it is significant for individuals to deploy different coping strategies in different situations, so as to accomplish different coping goals. This ability is conceptualized as *coping flexibility*, the deployment of diverse coping strategies that meet the specific demands of stressful situations (Lazarus & Folkman, 1984). Both appraisal and coping flexibility play important roles in the response to stress. The literature has indeed shown that psychological well-being is associated with appraisal (Lazarus, 1991a; Lazarus & Folkman, 1984; Rapee & Heimberg, 1997; Sarason, 1990; Smith, 1991) and coping flexibility (Compas, Malcarne, & Fondacaro, 1988; Fresco, Williams, & Nugent, 2006; Mischel & Shoda, 1995).

Nevertheless, the process of how appraisal and coping flexibility influence one another to determine adjustment outcomes in response to stress, has yet to be fully understood, and empirical studies are still lacking. Therefore,

the present research seeks to investigate the roles that appraisals and coping flexibility play in individuals' psychological adjustment under stress.

From an integrative perspective, I propose a process in which stress influences psychological adjustment via appraisals and coping flexibility. Based on the posit of the transactional model of stress process (Lazarus, 1991a; Lazarus & Folkman, 1984) that appraisal mediates the relation between stress and stress responses, it is hypothesized that appraisal may mediate the relation between stress and coping flexibility. Given previous empirical findings that coping flexibility is associated with adaptive adjustment (Compas et al., 1988; Fresco et al., 2006), it is further expected that coping flexibility may serve as the mediator in the association between appraisal and emotional outcomes. The important mechanism may be that: people may interpret stress in different manners, and the different types of appraisals may influence their levels of coping flexibility while confronting stressful situations, and eventually lead them to different outcomes. Specifically, people who interpret stressful situations negatively may show lower levels of coping flexibility by using ineffective coping behaviors to deal with changing situations, thus falling into maladaptive adjustment outcomes such as depression and anxiety. In contrast, people who interpret stressful situations positively may show greater levels of coping flexibility by using effective coping strategies to deal with various situations, and eventually achieve adaptive adjustment outcomes such as excitement and improvement.

To examine the proposed working mechanism, three studies were conducted in the current thesis to examine the hypothesized mediating roles of appraisals and coping flexibility in the stress-emotion link. The first study

(presented in Chapter 3) used a correlational study design to examine the general conceptual model with threat and challenge appraisals as the mediators in the relation between stress and emotional outcomes, and with coping flexibility as the secondary mediator in the relation between appraisals and emotional outcomes. On the basis of the first study, Study 2 (presented in Chapter 4) and Study 3 (presented in Chapter 5) respectively examined the mediating effects of appraisals and coping flexibility using an experimental approach. Study 2 experimentally evoked stress and manipulated the types of stress by providing instruction for an upcoming stressful task, to evaluate the effects of stress on appraisal, coping flexibility and emotion, as well as the mediating roles of appraisals and coping flexibility in the association between stress and emotion. Study 3 experimentally induced appraisals and manipulated the types of appraisals by a single-session training program on appraisal, to evaluate the effects of appraisals on coping flexibility and emotions, as well as the mediating role of coping flexibility in the association between appraisals and emotions.

With concerns to the structure of the thesis, Chapter 2 reviews the literature on the existing theories of stress, appraisal, and coping flexibility, as well as the empirical findings of the roles that appraisal and coping flexibility play in the influence of stress on psychological adjustment outcomes. Chapters 3 to 5 report three studies on the mediating roles of appraisal and coping flexibility in the relation between stress and emotions. Lastly, Chapter 6 summarizes the findings, discusses the limitations and implications of the present research, and provides future research directions.

CHAPTER 2

LITERATURE REVIEW

In this chapter, I reviewed the existing theories of stress, appraisals and coping flexibility, the empirical findings on the relationships among the above attributes, as well as their effects on adjustment outcomes.

Theoretical Framework

In the area of stress, numerous theories describe the interaction between a person and the environment, and reflect the process how the person reacts to stress. In the current thesis, the primary-secondary control model, the cognitive transactional model of stress, and the cognitive interactional model of appraisal and coping are adopted as the main theoretical framework.

The Primary-Secondary Control Model

The primary-secondary control model is a two-process model of perceived control developed by Rothbaum and co-workers (Rothbaum, Weisz, & Snyder, 1982; Weisz, Rothbaum, & Blackburn, 1984) to explain the interaction between a person and the environment by introducing two paths to gain control. When facing difficulties, people can either change the environment, or accommodate themselves to the environment. The attempt to gain control by changing the environment to fit their wishes and needs is termed as *primary control*, whereas the attempt to gain control by changing themselves to fit more effectively with environmental is defined as *secondary control*. Moreover, Rothbaum et al. highlighted that stress occurs when one's perception of the need for changing environment (i.e., primary control)

increases; also, perceived ineffective methods of control may induce stress.

Facing stress, the behaviors reflecting secondary control, such as the tendency to adjust the self's behaviors, interpretations and goals to make oneself compatible with a difficult situation, can be viewed as efforts to react to stress.

Interpretative control, is one type of control referring to a belief that a person can derive meaning from a problem then solve it (Rothbaum et al., 1982), and it has provided interesting insights into understanding how the person interacts with environment. From the two-process perspective, interpretative control comprises (a) primary control process that involves the attempt to understand the difficulties so as to solve them, and (b) secondary process that involves the attempt to understand the difficulties in order to make meaning of them and thus accept them. The two-process model suggests that the meaning sought from the difficulties contributes to one's ability to accept the potential stressful events, and thus diminishes stress. Hence, changing oneself, especially the views of stress, helps people better accept the world. In fact, some experimental studies (e.g., Lazarus & Alfert, 1964) also showed the significance of giving a new meaning for an event, for example, interpreting a painful event as something desired.

This theory introduces two paths for individuals to gain control: changing the environment and changing the self. The two types of control explain when stress would occur and how individuals could react to stress. More important, besides coping behaviors, it highlighted the essential roles of the meaning attached to a stressful event in dealing with stress. Cognitive processes such as interpretation in response to stress, however, was not deeply discussed in this theory. It motivated later researchers to further explore the

important role that interpretation plays in the process where stress determines adjustment outcomes.

The Cognitive Transactional Theory of Stress

Lazarus (1966) proposed appraisal, one's interpretation of the environment, as a crucial factor in the research of stress, coping and emotion. He and co-workers claimed that cognitive appraisal processes transcend the personal and the environmental variables, and mediate the various relationships between the person and the environment (Lazarus & Launier, 1978). In the cognitive-transactional theory of stress process (Lazarus, 1966; Lazarus, 1991a; Lazarus & Folkman, 1991), stress is characterized as individuals' interactions with the environment, and it occurs when environmental demands exceed personal resources. Stress is an active process with three components: (a) *antecedents*, including personal variables (e.g., personal resources) and environmental variables (e.g., situational demands); (b) *mediating processes*, which constitutes coping process and appraisal process (of situational demands and personal coping); and (c) *effects*, including both immediate effects (e.g., on affectivity) and long-term effects (e.g., on well-being) that stress exerts through mediating processes. Schwarzer and Schulz (2003) summarized three meta-theoretical assumptions of the transactional theory: relationship between person and environment, continuously changing context, and the meaning of a particular transaction. The stress process is presented in Figure 1.

Figure 1. Stress process, based on the transactional theory of stress process (Lazarus, 1991)

The transactional model of stress plays a critical role in the stress coping research, by introducing the two concepts of appraisal and coping as two mediating processes in the determination of stress on emotion. The transactional perspective of stress has inspired plenty of researchers to study not only the dispositional but also the situational variables associated with coping in response to stressful situations (e.g., Parkes, 1986; Watson & Hubbard, 1996), and sheds light on the later exploration on stress coping. Moreover, this theory highlighted that the effectiveness of coping depends on situational characteristics, and inspired the later researchers to investigate the essential role of flexibility in the deployment of coping strategies across various stressful situations. Nonetheless, this theory did not include coping flexibility in the process of stress; and it did not discuss how the two mediating processes, namely appraisal and coping, interact with each other in the influential stress-emotion link. This silence motivated us to explore the patterns of appraisal and coping flexibility, as well as their influence on one another.

The Information Processing Model of Anxiety

The information processing model of anxiety developed by Beck and Clark (1997) is a three-stage schema-based information processing model. The first stage, initial registration of stimuli, involves an orienting mode which assigns a processing to the incoming information. The stimuli are recognized in this stage in terms of the valence (positive, negative, and neutral). The second stage, immediate preparation, activates a primal threat mode which consists of negative automatic thoughts and images involving possible threat and danger of the stimuli. In the final stage, secondary elaboration, a more constructive reconsideration of the stimuli occurs, in terms of situational characteristics and personal coping resources. This information process model argues that the excessive threat meaning generated from stimuli may lead to emotional disorders like anxiety.

The crucial influence of cognitive appraisal on emotional outcomes was deeply discussed in this theory. Moreover, by distinguishing two distinct information processes in response to ‘threat stimuli’, including one automatic process and one strategic process, this theory expands our understanding of the information processing underlying appraisals. However, coping process was not included in this theory; and how the two information processes influence coping behaviors was not discussed. Thus, it is necessary to further explore the relationships between different information processes and coping behaviors.

The Cognitive Interactional Model of Appraisal and Coping

As a conceptual extension of past stress coping research and theories, the cognitive interactional model of appraisal and coping (CIMAC) was proposed by Williams (2002) to explain the interaction between appraisals and

coping patterns to determine emotional outcomes. He posited that consistent patterns of cognitive appraisal are associated with consistent patterns of coping across various situations. More importantly, coping flexibility has been taken into account in this model. To be specific, biased cognitive styles may lead to rigid and maladaptive coping styles, which can be conceptualized as lower level of coping flexibility. Emotional disorders including anxiety and depression can be seen as a product of the interaction between cognitive styles and coping styles.

This theory advanced our understanding of the interaction between appraisals and coping behaviors, especially coping flexibility, in the determination of emotional outcomes. The influence of different types of appraisal (e.g., threat and challenge appraisal) on coping flexibility, however, still needs further investigation. Therefore, it is essential to continue to explore the working mechanism by which different types of appraisals interact with coping flexibility to determine emotional outcomes under stress.

Summary

Together, these four theories have recognized cognitive styles as important psychological antecedents of emotional outcomes. We can conclude that stressors exert effects on emotion via mediating processes: appraisal and coping. The interaction between cognitive appraisals and coping behaviors (and even coping flexibility) has obtained more and more attention and in-depth discussion. The summary of the three theories in terms of their content, focus, contributions and limitations is presented in Table 1.

Table 1
Summary of Theoretical Models

Theory	Content	Focus	Contribution	Limitations
Primary-Secondary Control Model (Rothbaum, Weisz, & Snyder, 1982; Weisz, Rothbaum, & Blackburn, 1984)	Two processes of perceived control: When facing difficulties, individuals use <u>primary control</u> (change the environment), or <u>secondary control</u> (change the self).	Stress occurs when: the need for primary control increases; The tendency of secondary control can be viewed as the efforts to deal with stress.	(1) It introduced two paths to gain control. (2) Two types of control explain the stress process. (3) “Interpretative control” highlighted the significance of meaning attached to an event.	It did not examine the role of cognitive processes in the process where stress determines adjustment outcomes.
Cognitive Transactional Theory of Stress (Lazarus, 1966; 1991; Lazarus & Folkman, 1984; 1991; Lazarus & Launier, 1978.)	Stress is an active and dynamic process with three components: <u>Antecedents</u> (stressors) → <u>Mediating Processes</u> (appraisal and coping) → <u>Effects</u> (emotion)	Two mediating processes, Appraisal and Coping, transact the interaction between the person and the environment, and mediate the influence of stress on emotion.	(1) It introduced appraisal and coping as two mediating processes between stress and emotion. (2) It highlighted the significance of flexibility in coping according to situational demands.	(1) It did not explain how appraisals and coping influence one another. (2) It did not include coping flexibility in this model.
Information Processing Model of Anxiety (Beck & Clark, 1996)	Three stages of information processing: <u>initial registration</u> of stimuli → <u>immediate preparation</u> (primal threat mode) → <u>secondary elaboration</u>	Two information processes: (a) one automatic process (threat mode) (b) one strategic process (elaborative and reflective mode of thinking)	(1) It distinguished two distinct information processes. (2) It expands the understanding of the information processing underlying appraisals. (3) It discussed the influence of cognitive processes on emotions.	(1) Coping was not included in this model. (2) How the two information processes influence coping patterns was not explained.
Cognitive Interactional Model of Appraisal and Coping (CIMAC; Williams 2002)	(1) Consistent patterns of cognitive appraisal lead to consistent patterns of coping, which manifest across situations. (2) Biased cognitive styles lead to rigid and maladaptive coping styles.	(1) The link between cognitive appraisal and coping styles/coping flexibility (2) The interaction of cognitive styles and coping styles determines anxious and depressive symptoms.	(1) It advanced the understanding of the interaction between cognitive styles and coping styles to predict emotional outcomes. (2) It took coping flexibility into account.	How different types of appraisal (e.g., threat or challenge) influence coping flexibility needs further investigation.

Stressors

Experienced Stress

Individuals might encounter frequent but minor stressful situations in their daily life, and they might also be confronted with rare but major stressful events on certain occasions. Lazarus and Delongis (1983) posited that daily stressors have stronger effects than major life events on individuals' psychological adjustment outcomes. In 1989, Lazarus and Folkman documented that cumulative daily stressful events were found to be more closely related to mental illness compared to major stressful life events. Compared to acute stress, chronic stress is more strongly related to negative emotion such as depressive symptoms (McGonagle & Kessler, 1990). For example, college is a particularly stressful period as college students face changes in their environment like increased personal responsibility and enlarged social networks (Vaez & Laflamme, 2008). College students are routinely confronted with an array of daily stressors such as academic difficulties, time pressure, financial constraints, as well as relationships with friends, professors, family, and romantic partners (Kohn, Lafreniere, & Gurevich, 1990). Previous studies demonstrated that college students reported higher negative emotional outcomes such as psychological distress than their working peers (Vaez, Kristenson, & Laflamme, 2004) and the general population (Adlaf, Gliksman, Demers, & Newton-Taylor, 2001). Hence, in the present thesis, the population of college students can serve as a suitable sample for investigating the influence of daily stressors on psychological outcomes.

Measurements of Experienced Stress

Kanner, Coyne, Schaefer, and Lazarus' (1981) Hassles Scale has been the most commonly used hassles measure to assess adults' experienced daily hassles in the areas of work, family, friends, environment, and health. Participants respond to the scale with ratings of the severity of each hassle they experienced in the past month. The Inventory of College Students' Recent Life Experiences (ICSRLE; Kohn, Lafreniere, & Gurevich, 1990) is well-established in the context of college, to measure college students' experienced daily uplifts, including developmental challenges, time pressure, academic alienation, romantic problems, assorted annoyances, general social mistreatment, and friendship problems.

Operational Definition of Experienced Stress and the Choice of Measurement

In the present thesis, experienced stress is defined as the frequency of experiencing daily hassle in the past month. In the sample of college students, the ICSRLE is a desired measure to assess college students' cumulatively experienced stress in several domains (e.g., academic, self development, and social relationships). A particular stressful event is characterized as a situation where the demands exceed an individual's perceived competence.

Experimental Manipulation of Experienced Stress

To explore the impact of a particular kind of stressful events, previous research has adopted various methods to evoke stress and experimentally manipulate the types of stress. Motivated performance situations (Blascovich & Tomaka, 1996), in which individuals are required to exert effort to achieve certain goals, have been often used to evoke stress. Motivated performance

situations such as a mental arithmetic task (Tomaka, Blascovich, Kelsey, & Leitten, 1993) and a competitive task (Williams et al., 2012) are characterized by pressurized situations, as they are important or self-relevant (Seery, 2011). These motivated performance situations may be negatively appraised as a threat by some people, and it may also be appraised positively as a challenge by others (Meijen, Jones, Sheffield, & McCarthy, 2014). Athletes' appraisal evoked in competitive tasks may explain why some athletes perform better while others underperform under stress (Cerin, Szabo, Hunt, & Williams, 2000). Additionally, an ambiguous situation in which consequences and goals could be interpreted in either a positive or negative manner, could also evoke stress. For example, in Qu & Lim's (2016) study, a stressful situation was evoked by an ambiguous situation, with positive and negative appraisals were respectively emanated by guiding preschoolers to focus on positive and negative consequences in the ambiguous situation.

Dynamic Mediating Processes

Mediating processes are comprised of appraisal process and coping process. According to the dynamic transactional model of stress process (Lazarus & Folkman, 1984), appraisal and coping act as two important determinants of responses to stress, and serve as the mediators in the influence of stress on outcomes. Appraisal and coping can change over time in accordance with situational demands. In other words, people do not react passively to the environment, but instead respond dynamically to changes. Appraisal is a critical process in which individuals input relational meaning to the ongoing and changing relationship with the environment (Lazarus, 2006b).

Coping is also a crucial process underlying the ways in which individuals interact with the environment (Lazarus & Folkman, 1987).

Appraisals

When an individual initially encounters a stressful situation, cognitive appraisal serves as a function to evaluate situational demands and personal coping resources (Lazarus & Folkman, 1984). The appraisals of situational and personal characteristics in a particular encounter occur at the initial stage of the coping process, and it evokes action tendencies and emotions (Arnold, 1960).

Types of appraisal. Lazarus and Folkman (Lazarus & Folkman, 1984) introduced three pairs of stress appraisals: primary and secondary appraisals, threat and challenge appraisals, and harm/loss appraisal. Primary appraisal and secondary appraisal are two sub-processes of appraisal. *Primary appraisal* defines the appraisal of situational characteristics, such as the possibility of a positive or negative consequence; and *secondary appraisal* defines the appraisal of personal coping potentials to deal with the situation, like the available coping options to deal with the stressful situation. Threat and challenge appraisals constitute the two processes of primary appraisal and secondary appraisal, occurring before and in anticipation of a stressful situation. In particular, *threat appraisal* occurs when an individual's coping resources (indicated by secondary appraisal) are inadequate to meet the demands of the situation (suggested by primary appraisal), whereas *challenge appraisal* occurs when an individual's coping resources (indicated by secondary appraisal) are adequate to meet the demands of a particular stressful situation (suggested by primary appraisal). The third type of appraisal is *harm/loss appraisal*, which occurs after a stressful experience, and refers to the evaluation of the harm or

loss that had already occurred. To summarize, appraisal is comprised of two processes of primary appraisal and secondary appraisal, where an individual evaluates situational demands or personal resources. Appraisal can be categorized into threat appraisal and challenge appraisal based on how negatively or positively an individual interprets a potential stressful situation, or be categorized into harm/loss appraisal in terms of one's evaluation after a stressful event.

Threat appraisal and challenge appraisal. When facing stressful situations, some people feel threatened, whereas others feel challenged. Threat appraisal and challenge appraisal can be understood as two distinct responses to stress (Blascovich, Vanman, Mendes, & Dickerson, 2011; Seery, 2011). In recent decades, some models have explained what threat appraisal and challenge appraisal are, from diverse perspectives. Lazarus and Folkman (1984) argued that, people with threat appraisal are concerned about the potential harms or losses in a stressful situation, whereas people with challenge appraisal focus on the anticipated gain or growth. Blascovich and co-workers' Biopsychosocial (BPS) Model (Blascovich, Mendes, Hunter, & Lickel, 2000; Blascovich & Tomaka, 1996) described threat and challenge as two motivational states, engaging individuals in meaning making process that involves cognitive, emotional and physical components. Specifically, an individual engages in threat appraisal when he or she perceives inadequate personal resources to meet the situational demands; in contrast, an individual engages in challenge appraisal when he or she perceives adequate resources to deal with the situation. Another theory, the Theory of Challenge and Threat States in Athletes (Jones, Meijen, McCarthy, & Sheffield, 2009), which builds

on Lazarus and Folkman's (1984) transactional model and the BPS model of challenge and threat (Blascovich et al., 2000), further specified that achievement goals and self-efficacy determine threat and challenge appraisals. Particularly, threat appraisal occurs when an individual has a negative goal and low self-efficacy; in contrast, challenge appraisal occurs when an individual has a positive goal and high self-efficacy.

Components of appraisal. The transactional theory of stress (Lazarus, 1991a; Lazarus & Folkman, 1984) postulated two judgements of personal resources and of situational demands as determinants of appraisals. Threat appraisal and challenge appraisal can be distinguished in terms of these two judgements: when individuals judge their resources as inadequate to meet the demands of a stressful situation, they may engage in threat appraisal; in contrast, when individuals judge their resources as adequate to deal with the stressful situation, they may engage in challenge appraisal. The BPS model of challenge and threat (Blascovich et al., 2000; Blascovich & Tomaka, 1996) also posited that the evaluation of personal resources and the evaluation of situational demands determine to what extent individuals engage in threat appraisal or challenge appraisal: people with threat appraisal tend to perceive inadequate resources to meet the demands, whereas people with challenge appraisal tend to perceive adequate resources to meet the situational demands. Furthermore, the TCTSA model (Jones et al., 2009) specified that, the evaluation of self-competence, as well as the perception of control and achievement goals are three determinants of an individual's threat and challenge appraisals. In particular, when people have negative self-evaluation, low perception of control, and an avoidance goal, they would engage in threat

appraisal; in contrast, when people have positive self-evaluation, perception of control, and an approaching goal, they would engage in challenge appraisal. Therefore, it can be assumed that the evaluation of self-competence and the evaluation of consequence and achievement goal may determine threat and challenge appraisals.

Measurements of appraisals. The Stress Appraisal Measure (SAM; Peacock & Wong, 1990) adopts a multidimensional approach to measure stress appraisal. It assesses several important appraisal dimensions of primary appraisal and secondary appraisal, including centrality (referring to the perception of the importance of the situation), threat (consisting of threatening situation, feeling anxious, negative outcomes, and negative impact), challenge (consisting of positive impact, eager to tackle, can become stronger, and excited about outcome), controllability by self and by others, as well as uncontrollability. Furthermore, to measure appraisals in the specific stressful situations, some single-item assessments of appraisals have been employed in the past research, with ratings of the degree to which the specific upcoming stressful situation was perceived as exceeding self-competence. For example, primary appraisal is measured by items like “how threatening/demanding do you think the upcoming task will be”, and secondary appraisal is measured by items like “how able are you to cope with the task” or “how well do you think you will perform this task” (e.g., Kelsey et al., 2000; Tomaka et al., 1993). Given that threat appraisal being the perception of task demands exceeding the perception of the self’s competence to cope with the task, while challenge appraisal occurs when individuals perceive adequate abilities to meet the task demands, the cognitive appraisal ratio of primary appraisal to secondary

appraisal (Tomaka et al., 1993) are used to reflect threat appraisal and challenge appraisal.

Operational definition of appraisal and the choice of measurement.

In the current research, I define threat appraisal as a negative interpretation of stress as damage, and challenge appraisal as a positive interpretation of stress as an opportunity. Also, threat and challenge appraisals consist of evaluation of situational characteristics (possibility of positive or negative consequences), evaluation of goals (approaching or avoiding the situation), and evaluation of self-competence (adequate or inadequate to meet the situational demands).

Threat appraisal and challenge appraisal in the present thesis are conceptualized as the ways in which an individual makes sense of a stressful event: perceiving stress as failure and damage, or as an opportunity for self-growth. In this sense, the traditional appraisal measures (e.g., SAM) might not well fit our operational definitions. Nonetheless, the items in the Chinese Making Sense of Adversity Scale (CMSAS) developed by Pan, Wong, Chan, and Chan (2008) could reflect our operational definitions of threat and challenge appraisals. The CMSAS includes items for the positive sense-making of stress as “normal”, “opportunity for learning”, “motivation”, “accumulating life experience”, “indispensable”, and “self-growth”, as well as the items for negative sense-making of stress as “end of the world”, “meaningless life”, “lost”, and “a waste of time”. Hence, the CMSAS can be employed in the present study to measure threat and challenge appraisals. Moreover, to measure the threat and challenge appraisals in an actual stressful situation, the items of the CMSAS can be adopted and modified to rate the degree to which the particular upcoming stressful task is

perceived as a challenge (e.g., opportunity of self-growth) or a threat (e.g., damage).

Experimental manipulation of appraisal. Threat appraisal and challenge appraisal are viewed as two motivational states with cognitive, affective, and physiological components, and reflect the ways in which individuals engage in meaningful situations (Blascovich & Mendes, 2000). The Cognitive Bias Modification (CBM) programs, which aim to modify information-processing biases, have been widely used to modify cognitive bias including negative attention and negative interpretation, through reinforcing adaptive processing and thus potentially changing how individuals interpret a situation. CBM programs are usually delivered via computer-based tasks, with descriptions leading participants to resolve the outcome of the scenarios that initially appeared ambiguous in either a negative or benign way. Broadly speaking, CBM programs have been used to modify attention bias and interpretation bias. A CBM for attention biases (CBM-A) program focuses on decreasing selective attention to negative stimuli, such as threat-related stimuli (Hertel & Mathews, 2011). Also, the CBM-A program could decrease the selective attention to threat-related stimuli (Hertel & Mathews, 2011). A CBM for interpretation biases (CBM-I) program aims to modify interpretation biases. Negative interpretation bias, referring to the tendency to interpret ambiguous stimuli in a negative manner (Butler & Mathews, 1983), can be modified by CBM-I (Mathews & Mackintosh, 2000; Mathews & MacLeod, 2002). During a CBM-I, participants are encouraged to repeatedly practice positive interpretation of emotionally ambiguous scenarios (Hallion & Ruscio, 2011; Telman, Holmes, & Lau, 2013). Indeed, a meta-analysis on CBM-I (Menne-

Lothmann et al., 2014) revealed that CBM-I could decrease negative mood state and increase positive interpretation. Given that threat/challenge appraisal is defined as the way (negative or positive) to interpret a stressful situation, the CBM-I could potentially be used to manipulate or even train threat/challenge appraisal.

Coping Flexibility

Although an individual can use many strategies to cope with stress, recent work have shown that the number of coping strategies is not the most important: a particular coping strategy is not necessarily more adaptive than others (Janoff-Bulman, 1989), and there is no single coping strategy which is always adaptive (Bonanno & Burton, 2013). Rather the key is how adaptive a particular strategy is for a particular situation. Coping flexibility is characterized as adaptive response to changing environment. Previous research work have put forward various conceptualizations and measurements of coping flexibility.

Coping strategies. Folkman and her colleagues (Folkman, 1984, 1997, 2008; Lazarus & Folkman, 1984; Park & Folkman, 1997) categorized coping strategies into three types: (a) problem-focused, (b) emotion-focused, and (c) meaning-focused. Problem-focused coping involves active coping and planning to solve problems (Park & Fenster, 2004; Wild & Paivio, 2004); emotion-focused coping includes emotional support coping and religious coping (Park, Fenster, Suresh, & Bliss, 2006; Thornton & Perez, 2006); while meaning-focused coping draws on personal beliefs and values to find benefits and positive points from stressful experiences (Tennen & Affleck, 2002). According to the transactional model of the stress process, coping can change

over time, and the effectiveness of certain coping strategies is determined by situational characteristics (Lazarus & Folkman, 1984).

Conceptualizations of coping flexibility. Researchers define coping flexibility in different ways. According to the meta-analysis by Cheng, Lau, and Chan (2014), coping flexibility has been conceptualized from different perspectives, including a broad coping repertoire, a balanced profile, cross-situational variability in strategy deployment, a good strategy-situation fit, and the perceived ability. The *broad repertoire* perspective (Lykes, 1983; Pearlin & Schooler, 1978) emphasizes that coping effectiveness is determined by the number of coping strategies. A wider array of coping strategies reflects greater potential for flexible coping behaviors. The *balanced profile* conceptualization (Herman-Stabl, Stemmler, & Petersen, 1995; Persons, 1997) posits that coping flexibility is linked to the moderate and well-balanced deployment of various coping strategies. The *cross-situational variability* conceptualization is derived from Lazarus and Folkman's (1987) transactional theory of coping, and it emphasizes the dynamic process and changing nature of coping in reaction to various stressful situations, as well as a low within-person consistency across diverse types of stressors (Folkman et al., 1986). The *strategy-situation fit* conceptualization is derived from Person-Situation Interactionist Theories (Mischel & Shoda, 1995), highlighting the match between the characteristics of coping strategies and the nature of a stressful situation. Both the *cross-situational variability* conceptualization and the *strategy-situation fit* conceptualization focus on the interplay between strategy and environment. Finally, the *perceived ability* perspective reflects individuals' subjective perception of their ability to deploy diverse coping strategies to deal with

environmental changes. Kato (2012) defined coping flexibility as the ability to modify and deploy coping behavior according to the nature of every stressful event.

Measurements of coping flexibility. The meta-analysis by Cheng, Lau, and Chan (2014) also summarized a variety of coping flexibility measures in line with the conceptualization of coping flexibility. Based on the *broad coping repertoire* conceptualization, the Ways of Coping Questionnaire/Checklist (WCQ/WCC; Folkman & Lazarus, 1988a) and the COPE inventory (Carver, Scheier, & Weintraub, 1989) can be used to indicate respondents' engagement in each coping strategy, and the sum score reflects the range of coping strategies that they engage in. In terms of the *balanced profile* perspective, profile analysis and cluster analysis can be adopted (Kaluza, 2000). From the *cross-situational variability* perspective, to measure coping flexibility, the earlier research (e.g., Lester, Smart, & Baum, 1994) modified WCQ/WCC by including a variety of stressful vignettes and an index of coping flexibility, while some recent research developed situation-based measures, such as the Coping Styles and Flexibility Inventory (CSFI; Williams, 2002), with a variety of hypothetical stressful scenarios. In the *strategy-situation fit* conceptualization, the Coping Flexibility Questionnaire (CFQ; Cheng, 2001), which is an open-ended situation-based measure, was used to assess an individual's appraisal of situational characters (e.g., controllability) and his or her own coping strategies in controllable or uncontrollable situations. The goodness-of-fit score indicated coping flexibility. Regarding the *perceived ability* conceptualization, a phenomenological approach was used to assess individuals' subjective perception of their own coping flexibility. For example,

Kato (2012) developed the Coping Flexibility Scale (CFS) to assess individuals' perceived coping flexibility.

Operational definition of coping flexibility and the choice of measurement. In the current research, I define coping flexibility as the ability to deploy adaptive coping strategies according to the nature of stressful situations. Higher coping flexibility is referred to as the ability to change the coping strategies so as to effectively meet the demands of different situations, whereas lower coping flexibility is regarded as the inability to select the effective coping strategies according to the nature of situation, or the stickiness to one single strategy across various situations. In particular, adaptive coping is characterized as a strategy-situation fit. The goodness-of-fit is derived from Lazarus and Folkman's (1987) transactional theory of coping. Folkman and Lazarus (Folkman, 1984, 1997, 2008; Folkman & Lazarus, 1988b; Lazarus, 1993; Lazarus & Folkman, 1984) posited that the effectiveness of coping is determined by situational characteristics such as the controllability of the stressful situation. To be specific, problem-focused strategies should be employed in the situations that are evaluated as controllable, while emotion-focused strategies should be adopted in the situations that are evaluated as uncontrollable. This assumption has been examined in many studies which have revealed that problem-focused coping was effective in reducing anxiety in controllable stressful events (Miller, Rodolletz, Schroeder, Mangan, & Sedlacek, 1996), but increasing anxiety in uncontrollable situations (Cheng, Hui, & Lam, 1999; Holmes & Stevenson, 1990). In contrast, emotion-focused coping was effective in relieving stress in uncontrollable situations (Holmes & Stevenson, 1990). In short, coping flexibility required a good fit between the

nature of the coping pattern and the nature of the stressful events. According to the operationalization of coping flexibility in the current thesis, namely the ability to select the effective and adaptive coping strategies according to the nature of the changing stressful situations, two kinds of measures of coping flexibility have been adopted. Firstly, coping flexibility is viewed as an ability, and thus we can choose the measurement from the perspective of *perceived ability* conceptualization, like Kato's (2012) Coping Flexibility Scale (CFS), to assess people's perceived coping flexibility. The CFS measures whether individuals are able to adapt their coping strategies to the stressful situations. In addition, the operational definition also emphasizes the strategy-situation fit. Hence, a measurement focusing on the goodness-of-fit such as Cheng's (2001) Coping Flexibility Questionnaire (CFQ) can be employed and modified, to more objectively test individuals' coping flexibility in some hypothetical stressful situations. Together, these two measurements of CFS and CFQ are selected in the current thesis to assess coping flexibility. The self-report measure CFS can be used to reflect one's perceived coping flexibility developed in the long term, while the open-ended measure CFQ with goodness-of-fit index is suitable for reflecting the acute change with regard to coping flexibility under acute stress.

The Relationship between Appraisals and Coping Flexibility

The transactional model of stress emphasizes the crucial role of challenge appraisal and threat appraisal in the determination of coping behaviors. During the coping process, whether individuals appraise the stressful event as challenge (e.g., opportunity for self-growth and available coping strategies) or threat (e.g., leading to failure with no available strategies) may

influence the individuals' coping responses to the situation. I proposed a positive association between challenge appraisal and coping flexibility, and a negative association between threat appraisal and coping flexibility. When an individual appraises a stressful situation as an opportunity for self-growth with available coping strategies, he or she tends to be able to select the adaptive coping strategies from the coping resources to deal with the particular situation. In contrast, when an individual appraises a stressful situation as leading to failure with no available strategies, he or she may not be able to choose an adaptive coping strategy to deal with the stressful situation or replace the ineffective coping strategies with a new and effective strategy.

Several theories have explained the possible roles that appraisal play in the coping process. The Cognitive Interactional Model of Appraisal and Coping (CIMAC; Williams, 2002) suggests that coping patterns are influenced by appraisal patterns. For example, if individuals have consistent patterns of cognitive appraisal, they tend to have relatively consistent coping purposes and coping styles. Lowe and Bennett (2003) specified that appraisal could direct attention towards certain situational features and internal characteristics (e.g., self-competence), and this is a crucial step before taking actions to cope with the particular stressful situation. Furthermore, Brandtstädter's (2009) dual-process theory of coping posited a goal adjustment process in which individuals alter their coping goals to adapt to stressful situation. Before taking actions in response to a particular stressful situation, individuals evaluate the environmental demands and their own competence, and set up the goals that they would need to accomplish. In addition, some recent studies have implied a potential link between appraisal and coping flexibility. Kato (2012) refined

Brandtstädter's dual-process theory by proposing two processes of flexible coping: an evaluation process and an adaptive coping process. In the initial stage, people evaluate whether the current coping strategy works in the current stressful situation. In the second process, the adaptive coping process, people implement an alternative strategy to deal with the stressful situation. In other words, appraisals of situational characters, personal resources, and coping options enable individuals to deploy adaptive coping strategies. Additionally, after execution, evaluating whether the coping strategy meets the situational demands can in turn facilitate adaptive coping behaviors.

With regard to the associations between different types of appraisal (i.e., threat appraisal and challenge appraisal) and coping flexibility, there was relatively little empirical research directly addressing this association. Nevertheless, some existing theories have provided insights to understanding the possible relationships between threat/challenge appraisal and coping flexibility. According to the BPS model (Blascovich et al., 2000), challenge appraisal is associated with adaptive coping, while threat appraisal is associated with maladaptive coping. Some research (e.g., Blascovich & Mendes, 2000; Jones et al., 2009; Penley, Tomaka, & Wiebe, 2002; Skinner, Edge, Altman, & Sherwood, 2003) has supported this hypothesis and revealed that challenge appraisal is associated with adaptive coping whereas threat appraisal is associated with maladaptive coping strategies (e.g., escape). Given that greater level of coping flexibility is associated with adaptive coping, by contrast, lower level of coping flexibility is associated with maladaptive coping, we can infer that challenge appraisal may be associated with higher level of coping flexibility whereas threat appraisal may be associated with lower level of

coping flexibility. Moreover, the CIMAC (Williams 2002) posited that biased cognitive styles might lead to rigid coping styles, namely lower level of coping flexibility. Additionally, a few studies provide supports for the associations between threat/challenge appraisal and coping flexibility. Discriminative facility, as a cognitive process, refers to information processing and one's sensitivity to situational meaning such as self expectation and scripts required in the situation (Cheng, Chiu, Hong, & Cheung, 2001; Chiu, Hong, Mischel, & Shoda, 1995). Cheng further defined discriminative facility as 'active appraisal of situational characteristics, and the choice among alternative behaviors in response to changing contingencies' (Cheng, 2003, p.425), and claimed that the higher level of discriminative facility was related to greater level of coping flexibility. Similar to discriminative facility, threat and challenge appraisals also involve the appraisal of situational characteristics and that of the coping resources. Thus, we can expect that, (1) threat appraisal, which refers to perceived inadequate competence to meet situational demands, may be associated with lower level coping flexibility; and (2) challenge appraisal, which refers to perceived adequate competence to meet situational demands, may be associated with greater coping flexibility.

The above proposals emphasize the potential link between threat/challenge appraisals and coping flexibility: challenge appraisal may enable individuals to perceive adequate coping resources and adopt effective coping strategies in response to changing situations, whereas threat appraisal may lead individuals to perceive inadequate coping resources and adopt ineffective coping strategies in diverse situations. In short, threat appraisal may diminish coping flexibility while challenge appraisal may facilitate coping

flexibility. However, what is to be further explored is how threat and challenge appraisals and coping flexibility influence one another. Therefore, this thesis aims to address this research gap and to provide more theoretical insights to understanding the influence of threat and challenge appraisals on coping flexibility.

Impacts of Stress on Emotional Outcomes

From a traditional view, stress usually causes negative emotions and mental illnesses such as depression and anxiety. However, not everyone falls into maladaptive adjustment after experiencing stress. On the contrary, some people may achieve adaptive psychological adjustment outcomes. Thus, it is important to understand the determinants of adjustment outcomes under stress, and the process concerning how stress influences adjustment outcomes.

Lazarus's theories including the transactional model of stress (Lazarus, 1991a) and the models of emotion (Lazarus, 2006a) recognized coping and appraisal as the determinants of emotions and the mediators in the relation between stressors and adjustment outcomes. Specifically, in Lazarus's (2006) book, emotions explain "how a person has appraised what is happening in an adaptational transaction and how that person is coping with it" (Lazarus, 2006, p. 34). Hence, through different types of appraisals and coping strategies, stress would lead people to different emotional outcomes. An actual stressful event may have immediate effects on individuals' affective response, and chronic stress may have long-term effects on individuals' psychological well-being, depending on mediating processes including appraisal and coping.

Emotional Outcomes

In a specific situation, a person might struggle to adapting with acute emotional response, while long-term emotional outcomes reflect one's psychological well-being and mental health. In the consensual two-factor model (Watson & Tellegen, 1985), positive affect and negative affect represent two distinctive dimensions of mood or affective state. According to Lazarus (2006), in a specific stressful situation, each affective state, such as anger, sadness, anxiety, happiness, excitement, or hope, reflects the ongoing relationship between an individual and the environment. Furthermore, Tellegen (1985) linked low positive affect to depression and high negative affect to anxiety. A few recent studies (e.g., Parrish, Cohen, & Laurenceau, 2011) also showed that the negative affective reactivity to daily stressors act as a vulnerable factor to long-term emotional outcomes like depression. Hence, in the long run, with the accumulation of experienced stress, the emotional responses to cumulative stressful situations may influence individuals' emotional conditions of depression and anxiety, and their psychological well-being and mental health.

Measurements of emotional outcomes. The Positive Affect and Negative Affect Schedule (PANAS) was developed by Watson, Clark and Tellegen (1988) to assess positive and negative affect, based on the posit of two-dimensional structure of mood. The Beck Depression Inventory (BDI; Beck, Steer, & Brown, 1996; Beck, Ward, Mendelson, Mock, & ERBAUGH, 1961) and the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988) are widely used to measure depression and anxiety in clinical samples. The Depression Anxiety and Stress Scale (DASS) which was developed by Lovibond and Lovibond (1993) has been carried out in both clinical and

nonclinical populations, to measure three negative affective syndromes namely depression, anxiety, and stress/tension.

Operational definition of emotion and the choice of measurement.

Throughout the current thesis, emotion acts as the outcome variable in the conceptual model, under both chronic stress and acute stress. In the context of acute stress, emotional outcome is defined as affectivity, the extent to which a person feels positive or negative as an acute affective response to a particular stressful situation. To be specific, positive affect and negative affect are viewed as two independent dimensions (Watson, Clark, & Tellegen, 1988). In the context of chronic stress, emotional outcome is defined as emotional state including depression, anxiety and stress, which is more stable within a period of time. In accordance with the operational definitions, different measures of emotion are selected for acute stress and chronic stress. In the context of acute stress, the Positive Affect and Negative Affect Schedule (PANAS) which measures positive affect and negative affect, is adopted immediately after a stressful event to assess the positive emotional outcomes and negative emotional outcomes in response to an actual stressful situation. To measure the emotional outcomes under chronic stress, the Depression Anxiety and Stress Scale (DASS) which is suitable for assessing negative emotional states in nonclinical population, is selected to reflect the longer-term emotional outcomes.

Long-Term Effects of Chronic Stress on Psychological Well-Being

The long-term effects of chronic stress on psychological well-being and mental health have been well established in previous research. Appraisal

processes and coping processes have been recognized as the determinants of adjustment outcomes under chronic stress.

Depending on appraisals, chronic stress influences psychological well-being. The important role of appraisal in mental health has been shown in some early theories of stress such as the transactional theory of stress (Folkman & Lazarus, 1980) and Beck's cognitive-clinical model of emotional disorders (Beck & Clark, 1997). Quite a few studies have indicated the influence of threat and challenge appraisals on long-term adjustment outcomes. In terms of the negative influence of threat appraisal on adjustment outcomes, previous work have also suggested that threat appraisal has potential negative impacts on one's well-being (e.g., Carver et al., 1989; Richard & Folkman, 1984; Rapee & Heimberg, 1997; Sarason, 1990; Smith, 1991). Specifically, people with negative appraisal tend to feel low self-esteem in their ability to deal with stress (Bandura, 1997; Morris, Davis, & Hutchings, 1981). A study conducted among child and adolescent survivors of physical assaults revealed that negative appraisal predicted the development and maintenance of post-traumatic stress symptoms (PTSD) over six months (Meiser-Stedman, Dalgleish, Glucksman, Yule, & Smith, 2009). Regarding the influence of challenge appraisal on adjustment outcomes, a large amount of research has suggested that challenge appraisal has potential positive effects on one's well-being (e.g., Lazarus, 1991a; Lazarus & Folkman, 1984; Rapee & Heimberg, 1997; Sarason, 1990; Smith, 1991). Fortin and colleagues (Fortin, Doucet, & Damant, 2011) have found that children's appraisal mediates between stressor (e.g., domestic violence) and long-term adjustment outcomes. To conclude, for individuals who are suffering from chronic stress, threat appraisal may aggravate their

maladaptive adjustment outcomes, whereas challenge appraisal may alleviate their negative emotional outcomes such as depression and anxiety, and facilitate adaptive adjustment outcomes.

Depending on coping, chronic stress influences psychological well-being. The relationship between coping and emotional outcomes under chronic stress has been well discussed in previous work. For example, adaptive coping has been found to be associated with decreased depression and distress and enhanced well-being (Blalock & Joiner, 2000; Cheng et al., 2014; Cuijpers, Muñoz, Clarke, & Lewinsohn, 2009; Fleming, Baum, & Singer, 1984; Recklitis & Noam, 1999). Coping flexibility which occurs within individuals' cognitive and behavioral systems has also been shown to play an important role on well-being and adjustment outcomes. Coping flexibility can foster positive adjustment to life changes (Fresco et al., 2006; Mischel & Shoda, 1995), and it is positively associated with one's well-being (Bonanno & Burton, 2013; Compas et al., 1988; Fresco et al., 2006). A series of studies conducted by Cheng and her colleagues (Cheng, 2001; Cheng et al., 1999; Cheng, Hui, & Lam, 2000) revealed that individuals with higher coping flexibility showed less anxiety and psychosomatic symptoms as compared to those who keep adopting one particular coping strategy across all stressful events or change their coping strategies randomly. Kato's (2016) study revealed that coping flexibility was associated with lower risks of depression among adults. Coping flexibility is also associated with resilience outcomes among college students (Galatzer-Levy, Burton, & Bonanno, 2012). Moreover, coping flexibility shows a crucial role in protecting clinical populations from suffering from negative emotional outcomes. For example, when the number of traumatic events increased, people

with lower coping flexibility may exhibit higher levels of PTSD symptoms (Park, Chang, & You, 2015); among chronic headache sufferers, coping flexibility is associated with reduced depressive symptoms (Kato, 2015). Furthermore, coping flexibility intervention conducted by Cheng, Kogan, and Chio (2012) showed long-term (4 months) effectiveness on the reduction of depression in the workplace. Hence, coping flexibility can facilitate individuals' well-being under chronic stress.

Immediate Effects of Acute Stress on Emotion

The immediate effects of acute stress on affective response have also been shown in previous research, and this influence is determined by appraisals of the particular encounter and coping abilities in the situation.

Depending on appraisals, acute stress influences emotion. How a stressful encounter shapes emotions depends on the views which individuals take of the situation. In the Cognitive-Motivational-Relational (CMR) Theory, Lazarus (1991b) posits that different patterns of cognitive appraisal account for differential emotional experiences. The meaning an individual makes of a particular stressful situation shapes his or her emotions (Lazarus, 2006a). The TCTSA model also emphasizes the important roles of threat and challenge appraisals on emotions. Regarding the negative influence of threat appraisal on emotions, existing theories have suggested that threat appraisal may lead individuals to negative emotions (Lazarus, 1991a; Lazarus & Folkman, 1984). This argument was supported by a few studies among various populations. Among athletes, threat appraisal was associated with negative emotions such as anxiety (Cerin, 2003). Among children and adolescents, those who were engaged in negative appraisals showed more acute stress and depression

symptoms compared to those engaged in positive appraisals (Ellis, Nixon, & Williamson, 2009). Additionally, negative appraisal accounted for the variance of their acute subjective stress reported (Bryant, Salmon, Sinclair, & Davidson, 2007). In terms of the positive influence of challenge appraisal on emotions, Lazarus, Folkman and colleagues (Lazarus & Folkman, 1984; Lazarus, Kanner, & Folkman, 1980) claimed that challenge appraisal might produce positive emotions such as enjoyment and satisfaction. They also argued that the positive emotions might result from the anticipation of personal growth or benefits, which is represented by challenge appraisal. The majority of findings support this motion. Blascovich, Tomaka and colleagues (Blascovich et al., 2000; Blascovich & Tomaka, 1996; Tomaka et al., 1993) conducted a few studies to suggest that challenge appraisal may lead individuals to lower negative emotions. Further, Smith and colleagues (Smith, 1991; Smith & Ellsworth, 1985, 1987) found that challenge appraisal may produce positive emotions (e.g., happiness and hope). Cerin (2003) extended the research into the sports context and showed that individuals with challenge appraisal tended to experience positive emotions such as excitement and hope. To summarize, under acute stress, people with threat appraisal tend to display negative emotions (e.g., depressive symptoms, anxious feeling, and subjective stress), whereas those with challenge appraisal tend to display positive emotions (e.g., happiness, excitement, and hope).

Depending on coping, acute stress influences emotion. The relationship between coping and emotions under acute stress has also been discussed in a few studies. In motivated performance situations (e.g., a test), adaptive coping is associated with positive emotion, whereas maladaptive

coping is associated with negative emotion (Matthews, Hillyard, & Campbell, 1999; Zeidner, 1995). Thus, adaptive coping behaviors could protect individuals from negative emotions under acute stress. Coping flexibility which is characterized by adaptive coping strategies could also have positive influence on emotions, although relatively little empirical research has been conducted in an actual stressful situation to examine the roles of coping flexibility in the emotional response under acute stress. Hence, to confirm the mediating role that coping flexibility plays in the influence of acute stress on positive emotions, more empirical evidence is required.

In short, acute stress exerts immediate effects on one's emotions through acute appraisal of the particular encounter and the coping behaviors in the particular situation. In addition, chronic stress impacts a person's mental health through appraisals and coping processes in the long run. However, little research has addressed the mechanism regarding how different types of appraisals (i.e., threat and challenge appraisals) and coping flexibility influence one another, and how the interaction of appraisals and coping flexibility determines the emotional outcomes under stress. Hence, it requires further exploration of the relationship between different types of appraisals and coping flexibility, as well as the whole process in which stress influences emotional outcomes through the two mediation processes, namely, threat and challenge appraisals as well as coping flexibility. This research gap motivates researchers to further explore the possible mechanism for explaining how stress influences emotional outcomes through threat/challenge appraisals and coping flexibility.

Summary

Taken together, stressful life events are significant to individuals' emotional and mental health, furthermore, appraisal and coping flexibility play crucial roles in the relationship between stress and psychological adjustment. However, the process of how stressors influences adjustment outcomes through mediation processes is complex. Full understanding of the complex process will require further exploration of the working mechanism regarding how threat and challenge appraisals interact with coping flexibility to exert effects on psychological adjustment outcomes, under stress. To address the research gap, further empirical evidence is required, to explain the relationship between different types of appraisals (i.e., threat and challenge appraisals) and coping flexibility, as well as the specific roles of these two mediation processes in the relationship.

Therefore, the present thesis proposes a possible working mechanism regarding how stress determines emotional outcomes: threat appraisal and challenge appraisal may serve as the mediator in the influence of stress on emotional outcomes, and coping flexibility may serve as the secondary mediator in the influence of threat/challenge appraisal on emotional outcomes. The conceptual model is expected to explain the mechanism under both chronic stress and acute stress.

To examine the proposed conceptual model and to address the research gap, three studies have been designed in this thesis. A correlational study is necessary in the first step to test the conceptual model by examining the associations among the variables, the significant level of each path, and the mediating effects. Furthermore, it is crucial to employ an experimental

approach to verify the specific links separately by experimentally manipulating the predictor and observing the changes of mediators and outcome variables. To be specific, two experiments may be required. To verify the mediating effects of threat/challenge appraisal, the first experiment should manipulate stress and observe the changes of threat/challenge appraisal, coping flexibility, and emotion; to verify the secondary mediating effect of coping flexibility, a second experiment should manipulate or train threat/challenge appraisal and observe the changes of coping flexibility and emotion. Given that the proposed model is a multi-mediator and multi-path mediation model, the mediation analyses such as Structure Equation Modeling (SEM) and longitudinal mediation analysis are required throughout this thesis.

College students are most commonly involved in questionnaire-based research. Given that college students possess relatively stable cognitive and behavioral patterns, and personality-related attributes compared to youth and elders, the current thesis proposes to examine the proposed conceptual model in this population. In addition, young adulthood is a critical stage, through which individuals accumulate their experiences in exploring the environment in different new areas, and they may have relatively more plasticity in their cognitive process compared to the middle adults. Thus college students can be considered an appropriate population to receive the stress manipulation and appraisal training. Moreover, college students experience various stressors in their daily life (e.g., exams, dealing with professors and classmates, time management) and face new challenges (e.g., romantic relationship, jobs hunting), and thus a lot of research desire to develop measures in the area of stress in the college students sample (e.g., Kohn et al., 1990). Hence, college

students can be an appropriate or even desirable population to test the model in the current thesis across three studies.

Study 1 was designed for an initial test of the proposed conceptual model, by examining the correlations among all the variables and examining the proposed mediation effects. In the next chapter, the detailed study design, statistics, results and discussion of Study 1 will be reported.

CHAPTER 3

STUDY ONE: THE MEDIATING EFFECTS OF APPRAISALS AND COPING FLEXIBILITY ON THE RELATION BETWEEN SELF- REPORTED EXPERIENCED STRESS AND EMOTIONAL OUTCOMES

Introduction

Facing a stressful event, some people may appraise it as a threat, while others may appraise it as a challenge. Threat appraisal refers to the negative interpretation of a stressful event as a damage leading them to failure, while challenge appraisal refers to positive interpretation of a stressful event as an opportunity for self-growth. Individuals are engaged in challenge appraisal when they perceive that they have adequate coping resources to meet the situational demands, whereas individuals experience threat appraisal when they estimate their coping resources to be inadequate in dealing with the situation.

Based on previous work, Study 1 aimed to obtain a better understanding of the working mechanism by which cumulatively experienced stress influences psychological adjustment outcomes, and to investigate what roles threat and challenge appraisals as well as coping flexibility play in this relationship. The main objective of the current study was to examine the conceptual model and provide an overall picture of the relationships among experienced stress, challenge appraisal, threat appraisal, coping flexibility, and emotional outcomes. In particular, this study seeks to examine the degree to which challenge appraisal, threat appraisal, and coping flexibility determine emotional outcomes. It also aims to explore the mediating roles of appraisals in the influence of experienced stress on emotional outcomes, as well as the mediating

role of coping flexibility in the relation between appraisals and negative emotional outcomes.

Figure 2. The proposed mediation model in Study 1: threat and challenge appraisals mediate the relation between self-reported experienced stress and negative emotional outcomes; and coping flexibility mediates the relation between threat and challenge appraisals and negative emotional outcomes.

Hypotheses

As summarized in Chapter 2, Given that threat and challenge appraisals are recognized as mediators between stressors and responses to stress (Fortin, Doucet, & Damant, 2011; Lazarus, 1991b) and being associated with emotional outcomes (Bryant, Salmon, Sinclair, & Davidson, 2007; Cerin, 2003; Ellis, Nixon, & Williamson, 2009), it was hypothesized for the current research that threat appraisal and challenge appraisal should partially mediate the influence of stress on emotional outcomes. Additionally, based on previous findings regarding the association between appraisal and coping flexibility (e.g., Williams, 2002) and the positive association between coping flexibility and well-being (e.g., Bonanno & Burton, 2013; Cheng, 2001; Cheng, Hui, & Lam, 2000; Fresco et al., 2006; Kato, 2016), it was expected that coping flexibility

should partially mediate the relation between threat/challenge appraisal and emotional outcomes. Figure 2 illustrates a graphic of the conceptual model.

In particular, the hypotheses in the current study included the following elements:

H1: Experienced stress should increase negative emotion outcomes.

H2: Threat appraisal should partially mediate the relation between experienced stress and negative emotional outcomes.

H2.1: Experienced stress should increase threat appraisal.

H2.2: Threat appraisal should increase negative emotional outcomes.

H3: Challenge appraisal should partially mediate the relation between experienced stress and negative emotional outcomes.

H3.1: Experienced stress should decrease challenge appraisal.

H3.2: Challenge appraisal should decrease negative emotional outcomes.

H4: Coping flexibility should partially mediate the relation between threat appraisal and negative emotional outcomes.

H4.1: Threat appraisal should decrease coping flexibility.

H4.2: Coping flexibility should decrease negative emotional outcomes.

H5: Coping flexibility should partially mediate the relation between challenge appraisal and negative emotional outcomes.

H5.1: Challenge appraisal should increase coping flexibility.

Method

Participants

A total of 167 undergraduate students¹ (70 male and 97 female), aged from 19 to 26 years old ($M = 21.5$, $SD = 1.59$), were recruited from the research pool of Nanyang Technological University in Singapore. They participated in the study for extra course credits.

Measurements

Measure of experienced stress. Experienced stress was assessed by the Inventory of College Students' Recent Life Experiences (ICSRLE; Kohn et al., 1990), which reflects 7 domains of stress in college students: 10 items for Developmental Challenge (e.g., "*Dissatisfaction with your ability at written expression*"), 7 items for Time Pressure (e.g., "*Not enough time to meet your obligations*"), 3 items for Academic Alienation (e.g., "*Disliking your studies*"), 3 items for Romantic Problems (e.g., "*Conflicts with boyfriend's/girlfriend's/spouse's family*"), 5 items for Assorted Annoyances (e.g., "*Having your contributions overlooked*"), 6 items for General Social

¹ The total sample size is required to be estimated for the goodness-of-fit test in this study. Effect size $w = 0.3$, the threshold probability for rejecting the null hypothesis α (two-tailed) = 0.05, power $(1 - \beta) = 0.95$, $df = 2$. With the above parameters, the total sample size in this study should be $N = 172$, and the actual power would be 0.95. Data were collected intensively above 172, but extra data were dropped due to invalid response. The current study with a sample size $n = 167$ can be considered as adequately powered [power $(1 - \beta) = 0.94$].

Mistreatment (e.g., “*Social isolation*”), and 3 items for Friendship Problems (e.g., “*Being let down or disappointed by friends*”). Participants were required to rate each item from 1 (*not at all part of my life*) to 4 (*very much part of my life*). The 49-item ICSRLE (Kohn et al., 1990) showed a good alpha reliability ($\alpha = .88$) in a general college students sample, and the good alpha reliability was across gender (male: $\alpha = .88$; female: $\alpha = .89$). Moreover, the ICSRLE has a good validity by showing a positive correlation ($r = .59, p < .0005$) with the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) which is a reliable, valid and widely used measure of subjective appraised stress. In this way, Kohn et al. (1990) proposed an indirect relationship between ICSRLE and the stress-appraisal process described by Folkman and Lazarus (e.g., Folkman, 1984; Lazarus & Folkman, 1987). Hence, ICSRLE is a suitable measure to assess college students’ daily stressors.

Measure of threat and challenge appraisals. To measure threat appraisal and challenge appraisal in the present study, the Threat and Challenge Appraisals Scale (TCAS) was developed by modifying the Chinese Making Sense of Adversity Scale (CMSAS; Pan et al., 2008). The CMSAS (Pan et al., 2008) was designed to measure how college students make sense of adversity. This scale exhibited high internal consistency reliability ($\alpha = .89$) and good concurrent validity, with a negative correlation with negative affect ($r = -.27, p < .001$) as well as a positive correlation with positive affect ($r = .31, p < .001$) and life satisfaction ($r = .25, p < .001$), among Chinese students in Hong Kong and Australia. Thus, the CMSAS can reflect the way in which Chinese college students make sense of the stressors, and whether they can find the benefit from the difficulties. Given that the majority of the college students in Singapore are

Chinese, the items in CMSAS may be suitable for the sample in the current study. The TCAS consists of the Threat Appraisal subscale with 4 items (e.g., “*Stress means the end of world and I am not able to resolve it*”), and the Challenge Appraisal subscale with 8 items (e.g., “*Stress provides a good opportunity for learning*”). The response was rated on a 4-point Likert-type scale ranging from 1 (*totally disagree*) to 4 (*totally agree*).

Measure of coping flexibility. The Coping Flexibility Scale (CFS; Kato, 2012) was used to measure perceived coping flexibility. It is comprised of 10 items. Participants are required to indicate, how much each item applied to their life, on a 4-point scale that ranged from 1 (*not applicable at all*) to 4 (*very applicable*). There are 8 regular items (e.g., “If a stressful situation has not improved, I use other ways to cope with the situation”) and 2 reserve items (e.g., “*I only use certain ways to cope with stress*”). The CFS has been shown in Kato’s (2012) study to possess a good two-factor structure ($CFI = .95$) with factor 1 Evaluation Coping and factor 2 Adaptive Coping. Over a 6-week period, the alpha coefficients (Evaluation Coping: .73, .72, .76, .82, .83, .88; Adaptive Coping: .87, .87, .83, .89, .89, .78) and test–retest reliability estimates (Evaluation Coping: .71; Adaptive Coping: .71) indicated good internal consistencies and stability. The CFS also displayed good convergent validity by showing positive correlations with assimilative and accommodative coping ($r = .37$), cognitive flexibility, social problem solving, and constraint relaxation (observing behavior). In this case, the CFS is a reliable and valid measure to reflect people’s perceived coping flexibility.

Measure of negative emotional outcomes. The Depression Anxiety Stress Scale (DASS; Lovibond & Lovibond, 1996) was selected in the present

study to assess the negative emotional outcomes. DASS is a 42-item self-report measure consisting of three 14-item subscales: depression subscale (e.g., “*I couldn’t seem to experience any positive feeling at all*”), anxiety subscale (e.g., “*I felt scared without any good reason*”), and stress/tension subscale (e.g., “*I was in a state of nervous tension*”), with each statement on a 4-point scale that ranged from 1 (*did not apply to me at all*) to 4 (*applied to me very much or most of the time*). This measurement showed a good reliability and validity among both clinical (Brown, Chorpita, Korotitsch, & Barlow, 1997) and nonclinical populations (Crawford & Henry, 2003). Lovibond and Lovibond (1995) evaluated the DASS in a student sample, and concluded that this measure possessed satisfactory psychometric properties. The DASS exhibited good reliability by showing good internal consistencies (Depression: $\alpha = 0.91$; Anxiety: $\alpha = .84$; Stress/Tension: $\alpha = .90$) as well as adequate convergent validity by showing high correlations (Depression: $r = .71$; Anxiety: $r = .81$) with the Beck Depression Inventory (BDI; Beck, Ward, Mendelsohn, Mock, & Erbaugh, 1961) which has been a widely used depression scale. Furthermore, some researchers (e.g., Crawford & Henry, 2003) evaluated the DASS in the general adult population, and also found excellent internal consistency reliabilities (total scale: $\alpha = 0.97$; Depression: $\alpha = 0.95$; Anxiety: $\alpha = 0.90$; Stress/Tension: $\alpha = 0.93$), adequate convergent validity [with good correlations with the Hospital Anxiety and Depression Scale (HADS; r s range: .66-.78) and the Personal Disturbance Scale (sAD; $r = .72$)], as well as best-fitting latent structure (CFI = .93). In addition to the nonclinical samples, the DASS showed good psychometric properties in clinical samples (e.g., Brown et al., 1997) as well. The DASS displayed

excellent internal consistency reliabilities (Depression: $\alpha = 0.96$; Anxiety: $\alpha = 0.89$; Stress: $\alpha = 0.93$) and temporal stability (test-retest reliability) with $r_s = 0.71-0.81$. Therefore, DASS is a reliable, valid, and well-constructed measurement of negative emotional states. It has been increasingly used in diverse settings, and is especially suitable for the college student sample in this study.

Study Design and Data Analyses Plan

In the proposed conceptual model, negative emotional outcome (depression, anxiety, and stress) serves as the outcome variable, stress acts as the predictor, while threat and challenge appraisals as well as coping flexibility function as the mediators. As the initial test for the proposed mediation model, with multiple mediators and paths, Study 1 was designed as a correlational study under cumulative stress. In this correlational design, all data about experienced stress, threat appraisal, challenge appraisal, coping flexibility, and emotional outcome will be collected. To examine the proposed mediation model, the Structural Equation Modeling (SEM) will be employed as the data analyses method. Specifically, path analyses will be used to examine the significant level of each path, and mediation analyses will be used to reflect the direct and indirect mediating effects.

Procedure

Data in this study were collected from participants' self-reports during a single administration. All participants were informed that this study aimed to investigate the ways in which college students cope with stress. After completing the informed consent form, participants provided demographic data including age and gender. All participants responded to a battery of self-

reported questionnaires on experienced stress, threat and challenge appraisals, perceived coping flexibility, and negative emotional outcomes (i.e., depression, anxiety and stress). The whole study took approximately 30 minutes.

The design, procedure, and measurements in this study were approved by the Institutional Review Board (IRB) in Nanyang Technological University.

Results

Preliminary Analyses

Internal consistency of study measures. As shown in Table 2, the scores of depression, anxiety, and stress subscales were positively associated with each other, so the sum of three subscales' scores can indicate negative emotional outcomes. Cronbach's alpha coefficient of the negative emotional outcomes measure was excellent ($\alpha = .94$). As for other measures, the internal consistency of self-reported experienced stress measure (Cronbach's $\alpha = .88$) was good, that of perceived coping flexibility (Cronbach's $\alpha = .68$) was acceptable, and those of the threat appraisal subscale (Cronbach's $\alpha = .68$) and the challenge appraisal subscale (Cronbach's $\alpha = .84$) fell in the range between acceptable and good.

Table 2
Results for Descriptive Statistics of Negative Emotional Outcomes in Study 1

	Depression	Anxiety	Stress	NEO	<i>M</i>	<i>SD</i>
Depression	-				1.52	0.42
Anxiety	.38***	-			1.55	0.36
Stress/ Tension	.65***	.55***	-		1.81	0.51
NEO	.83***	.74***	.91***	-	4.88	1.08

Note. $N = 167$. * $p < .05$. ** $p < .01$. *** $p < .001$.

NEO = negative emotional outcomes.

Levels of negative emotional states. According to Lovibond and Lovibond's (1995) cut-off score, we view scores 0-78 as "normal", 78-87 as "mild", 87-96 as "moderate", 95-98 as "severe", and 98-100 as "extremely severe". The primary difference between clinical sample and nonclinical sample is in the severity of depression, anxiety, and stress (Lovibond & Lovibond, 1995). In particular, clinical disorders, such as emotional disorders (depression, anxiety, and tension/stress), represent the severe and chronic manifestation of syndromes. After matching the current rubrics of the DASS in the present study rating from '1' to '4' with that of the DASS in Lovibond and Lovibond's (1995) study rating from '0' to '3', the average score of the DASS was 26.32 (converted from the original average score 68.32) with $SD = 15.12$ in the present study. Hence, the college students' negative emotional states levels lie in the middle, within the normal range. The large SD suggested individuals' differences in negative emotional states. It is significant to examine the correlates to the negative emotional outcomes as well as the conceptual model in the college students sample.

Correlations among measured variables. Table 3 listed the correlations between experienced stress, threat appraisal, challenge appraisal, coping flexibility, and negative emotional outcomes. Threat appraisal and challenge appraisal were revealed to be independent of each other, with a nonsignificant correlation ($r = .10, ns$). Self-reported experienced stress was correlated only with threat appraisal ($r = .33, p < .001$) but not with challenge appraisal ($r = .10, ns$); additionally, perceived coping flexibility was correlated only with challenge appraisal ($r = .39, p < .001$) but not with threat appraisal ($r = -.10, ns$). As a dependent variable, negative emotional outcomes showed

positive correlation with experienced stress ($r = .48, p < .001$) and threat appraisal ($r = .41, p < .001$), negative correlation with perceived coping flexibility ($r = -.22, p = .006$), but none with challenge appraisal ($r = -.06, ns$).

Table 3
Results for Descriptive Statistics and Correlations of Measures in Study 1

	1	2	3	4	5	<i>M</i>	<i>SD</i>
1. NEO	-					4.88	1.08
2. Experienced stress	.48*** ($<.001$)	-				1.89	0.31
3. Threat Appraisal	.41*** ($<.001$)	.33*** ($<.001$)	-			1.47	0.37
4. Challenge Appraisal	-.06 (.43)	.10 (.19)	.10 (.20)	-		3.12	0.47
5. Coping Flexibility	-.22** (.006)	-.001 (.99)	-.10 (.19)	.39*** ($<.001$)	-	2.78	0.42

Note. $N = 167$. Numbers in parentheses denote p values. * $p < .05$. ** $p < .01$. *** $p < .001$. NEO = negative emotional outcomes.

Gender difference. To understand the gender differences in all the main variables in the current sample, a MANOVA was run with gender as a fixed factor, and the dependent factors included experienced stress, appraisals, coping flexibility, and negative emotional outcomes. The results showed that there was no gender difference in experienced stress [$F(1, 166) = 0.12, p = .73$], threat appraisal [$F(1, 166) = 0.66, p = .42$], challenge appraisal [$F(1, 166) = 0.78, p = .38$], coping flexibility [$F(1, 166) = 0.37, p = .55$], or negative emotional outcomes [$F(1, 166) = 1.08, p = .30$].

Structural Equation Modeling: Mediating Roles of Appraisals and Coping Flexibility

To examine the proposed mediation model that connects experienced stress, threat appraisal, challenge appraisal, coping flexibility, and negative emotional outcomes, structural equation modeling (SEM) was used with the

software Mplus version 7.31 (Muthén & Muthén, 1998-2012). As Hooper, Coughlan and Mullen (2008) summarized, the Chi-Square value (χ^2), the root mean square error of approximation (RMSEA), and the root mean square residual (RMR) or standardized root mean square residual (SRMR) can indicate the absolute fit which represents how well a proposed model fits the sample data. In particular, the Chi-Square value is regarded as a ‘badness of fit’ (Kline, 2015) and has been used as the traditional indicator for overall model fit, thus a good model fit should possess a nonsignificant Chi-Square value at a 0.05 threshold (Barrett, 2007). The RMSEA was developed by Seiger and co-worker (e.g., Steiger & Lind, 1980; Steiger, 1990), and a value above 0.10 indicated poor model fit (MacCallum, Browne, & Sugawara, 1996). Hence a good model fit should provide a RMSEA value below 0.08 or even 0.07 (Steiger, 2007). The standardized root mean square residual (SRMR) suggests ‘the difference between the residuals of the sample covariate matrix and the hypothesized covariance model’ (Hooper et al., 2008), and thus the values ranging from 0 to 1.0 indicate a good fit (e.g., Byrne, 2013). Moreover, the comparative fit index (CFI; Bentler, 1990) which is used to compare the chi-square value to a baseline model, has become a popularly used fit index in SEM due to its good performance in small sample size. A CFI value above 0.95 presents a good fit. Therefore, the Chi-Square value, RMSEA, SRMR, and CFI will be reported.

The path analysis results (see Table 4) demonstrated that the path from experienced stress to threat appraisal ($\beta = 0.33, p < .001$) was significant, whereas that from experienced stress to challenge appraisal ($\beta = 0.10, p = .18$) was not significant. In terms of the effects of predictors on outcome variable, the path from experienced stress to negative emotional outcomes ($\beta = 0.40, p$

< .001), that from threat appraisal to negative emotional outcomes ($\beta = 0.26, p < .001$), as well as that from coping flexibility to negative emotional outcomes ($\beta = -0.16, p = .02$) were significant; however, a non-significant path from challenge appraisal to negative emotional outcomes ($\beta = -0.07, p = .34$) was observed. As for the effects of appraisal on coping flexibility, there was one significant path from threat appraisal to coping flexibility ($\beta = -0.14, p = .04$), and one from challenge appraisal to coping flexibility ($\beta = 0.41, p < .001$).

Table 4
Coefficients and Significance Levels for the Mediation Model Paths in Study 1

Parameter estimate	β	<i>SE</i>	<i>p</i>
Experienced stress → Threat appraisal	.33	.07	<.001
Experienced stress → Challenge appraisal	.10	.08	.18
Experienced stress → NEO	.40	.06	<.001
Threat appraisal → NEO	.26	.07	<.001
Challenge appraisal → NEO	-.07	.07	.34
Threat appraisal → Coping Flexibility	-.14	.07	.04
Challenge appraisal → Coping Flexibility	.41	.07	<.001
Coping Flexibility → NEO	-.16	.07	.02

Note: $\chi^2(2) = .85, p = .65$; CFI = 1.00; TLI = 1.05; RMSEA < .001, 90%CI[0, 0.12]; SRMR = 0.02. NEO = negative emotional outcomes.

To examine whether both threat appraisal and challenge appraisal mediate the association between experienced stress and negative emotional outcomes, and whether coping flexibility mediates the relationship between appraisals and negative emotional outcomes, the decomposition of model effects into direct, indirect, and total effects was requested. Direct effects represent the effects of the predictor (i.e., experienced stress) on the outcome variable (i.e., negative emotional outcomes) that are exerted independently of the mediators (i.e., threat appraisal, challenge appraisal, and coping flexibility); indirect effects are the mediated effects of the predictor on dependent variable through mediators; total effects are the sum of direct and indirect effects. In the

full model (shown in Figure 3), threat appraisal was found to partially mediate the link between experienced stress and negative emotional outcomes with a significant indirect effect ($\beta = 0.30$, $SE = 0.10$, $p = .003$); coping flexibility was reveal to fully mediate the effect of challenge appraisal on negative emotional outcomes with a significant indirect effect ($\beta = -0.15$, $SE = 0.07$, $p = .03$), but it did not mediate the relation between threat appraisal and negative emotional outcomes with a nonsignificant indirect effect ($\beta = 0.03$, $SE = 0.02$, $p = .15$). The mediational model demonstrated a good model fit of the data: $\chi^2(2) = 0.85$, $p = .65$.

Figure 3. Path coefficients in the mediation model in Study 1, linking self-reported experienced stress, threat appraisal, challenge appraisal, coping flexibility, and negative emotional outcomes ($N = 167$). $*p < .05$. $**p < .01$. $***p < .001$.

Figure 4. The final model in study 1. Threat appraisal mediates the relation between self-reported experienced stress and negative emotional outcomes; coping flexibility mediates the relation between challenge appraisal and negative emotional outcomes. +: positive correlation. -: negative correlation.

To summarize, two paths could explain how experienced stress influences negative emotional outcomes. The final model is presented in Figure 4. In the first path, experienced stress could directly increase negative emotional outcome, and it could also indirectly aggravate negative emotional outcomes through increasing threat appraisal. In the second path, challenge appraisal, uninfluenced by experienced stress, could reduce negative emotional outcomes fully through enhancing coping flexibility.

Discussion

Based on the literature review in Chapter 2, it was hypothesized that appraisal and coping flexibility should act as the mediators in the relation between experienced stress and emotional outcomes. Study 1 sought to understand the general mechanism regarding how experienced stress influences negative emotional outcomes via threat and challenge appraisals as well as coping flexibility. To be specific, I investigated whether threat and challenge

appraisals mediate the relation between experienced stress and emotional outcomes, and whether coping flexibility mediate the relationship between threat and challenge appraisals and emotional outcomes.

The findings, which are presented in Figure 5, included the following:

H1 was supported. Experienced stress increased negative emotional outcomes.

H2 was supported. Threat appraisal mediated the relation between experienced stress and negative emotional outcomes.

H2.1 was supported. Experienced stress increased threat appraisal.

H2.2 was supported. Threat appraisal increased negative emotional outcomes.

H3 was rejected. Challenge appraisal did not mediate the relation between experienced stress and negative emotional outcomes.

H3.1 was rejected. Experienced stress did not change challenge appraisal.

H3.2 was rejected. Challenge appraisal did not decrease negative emotional outcomes.

H4 was rejected. Coping flexibility did not mediate the relation between threat appraisal and negative emotional outcomes.

H4.1 was rejected. Threat appraisal did not change coping flexibility.

H4.2 was supported. Coping flexibility decreased negative emotional outcomes.

H5 was supported. Coping flexibility mediated the relation between challenge appraisal and negative emotional outcomes.

H5.1 was supported. Challenge appraisal increased coping flexibility.

Figure 5. The final model: the proposed model in study 1 was partially supported. Solid lines indicated the hypothesized paths that were supported. +: positive correlation. -: negative correlation.

In summary, experienced stress not only directly aggravates negative emotional outcomes, but also aggravates threat appraisal through which further intensifies negative emotional outcomes. On the other hand, both challenge appraisal and coping flexibility are not influenced by experienced stress, but exert positive effects on emotional outcomes. Challenge appraisal enhances coping flexibility which further alleviates negative emotional outcomes. What's more, two paths were discovered to explain the mechanism: (a) one negative path, from a traditional view, that explains the negative influence of stress on emotion through threat appraisal, and (b) one positive path, from a positive

perspective, that highlights the positive roles of challenge appraisal and coping flexibility in reducing negative emotion under stress.

Given the focus of the thesis, the current section mainly discusses the findings associated with the mediating roles of appraisals and coping flexibility in the relation between stress and negative emotional outcomes.

Threat Appraisal Mediates the Influence of Experienced stress on Negative Emotional Outcomes

Hypothesis 1, that experienced stress has direct effects on negative emotional outcomes, was supported in this study. The association between experienced stress and negative emotional outcomes aligned with previous research work that has shown the negative influence of cumulative stress on emotional outcomes like depression (Carver et al., 1989; Lazarus & Folkman, 1984; Monroe & Harkness, 2005; Rapee & Heimberg, 1997; Sarason, 1990; Smith, 1991). Moreover, in line with Hypothesis 2, threat appraisal acts as the mediator in the relation between experienced stress and emotional outcomes, and partially mediates the influence of experienced stress on negative emotional outcomes. The results indicated that experienced stress could not only directly increase negative emotional outcomes, but also aggravate threat appraisal which further intensifies negative emotional outcomes. This mediating path can be viewed as a negative path.

Experienced stress increases threat appraisal. In support of Hypothesis 2.1, experienced stress was shown to be associated with increased threat appraisal. Threat appraisal reflects the negative interpretation of stress. The impact of stress on threat appraisal has been discussed in the previous research, which argued that individuals tend to anticipate damage and failure if

they consistently experience stressful encounters in various contexts, such as social interaction (Rapee & Heimberg, 1997), educational context (Sarason, 1990) and sports context (Tomaka et al., 1993). In other words, individuals with higher experienced stress are more likely to display threat appraisal of stress.

Threat appraisal aggravates negative emotional outcomes. In addition, the results supported Hypothesis 2.2, showing that threat appraisal was associated with aggravated negative emotional outcomes. This finding suggested that college students who tend to view stress as damaging to their life, namely possessing threat appraisal, are more likely to suffer negative emotional outcomes such as depression, anxiety and stress. This finding was consistent with previous work which has revealed the positive association between threat appraisal and self-reported negative emotions such as subjective stress (Tomaka et al., 1993), anxiety (Cerin, 2003), depression (Bryant et al., 2007; Ellis et al., 2009), and low self-esteem (Schlenker & Leary, 1982).

Therefore, we can conclude that threat appraisal acts as the mediator in the process where stress aggravates negative emotional outcomes. As discussed above, cumulative stress can directly cause negative emotional outcomes, and it can also indirectly aggravate negative emotional outcomes through a negative path with threat appraisal as the mediator. The findings suggested that college students who experience more cumulative daily stressors are more likely to interpret stress as a threat, and this threat appraisal may further lead them to negative emotional outcomes such as depression, anxiety, and stress. Hence, experienced stress may work as a risky factor to increase individuals' threat appraisal and aggravate their negative emotional outcomes.

Challenge Appraisal Does Not Mediate the Influence of Experienced stress on Negative Emotional Outcomes

Contrary to Hypothesis 3, challenge appraisal did not mediate the influence of experienced stress on negative emotional outcomes. It is especially interesting that challenge appraisal was not affected by experienced stress. Although this finding did not support the hypothesis 3.1, it extended the literature by revealing that experienced stress does not necessarily decrease individuals' challenge appraisal which reflects positive interpretation of stress. In this sense, challenge appraisal might be more resistant to environmental changes, compared to threat appraisal. In addition, Hypothesis 3.2 was also rejected: challenge appraisal did not directly reduce negative emotional outcomes. The positive influence of challenge appraisal on emotional outcomes and psychological well-being has been well established in previous work (e.g., Blascovich et al., 2000; Blascovich, Mendes, Hunter, Lickel, & Kowai-Bell, 2001; Blascovich & Tomaka, 1996; Lazarus & Folkman, 1984). However, in the present study, with coping flexibility entered as the mediator, the direct effect of challenge appraisal on negative emotional outcomes was not significant. We can infer that other factors might play mediating roles in the influence of challenge appraisal on emotional outcomes.

Coping Flexibility Does Not Mediate the Influence of Threat Appraisal on Negative Emotional Outcomes

Contrary to Hypothesis 4, coping flexibility did not mediate the negative influence of threat appraisal on emotion. In particular, coping flexibility was not affected by experienced stress, but it could reduce negative emotional outcomes.

Coping flexibility was not influenced by experienced stress, and thus Hypothesis 4.1 was rejected. The nonsignificant association between experienced stress and coping flexibility suggested that stressful experience might not necessarily reduce coping flexibility. More importantly, coping flexibility could reduce negative emotional outcomes. Hypothesis 4.2 was supported by the finding that coping flexibility was associated with reduced negative emotional outcomes such as depression, anxiety and stress. This finding is in line with previous findings (e.g., Kato, 2012) which illustrated that flexible coping was positively related to improved psychological health, and was specifically associated with reduced anxiety and depression symptoms (Cheng, 2001; Cheng et al., 1999, 2000; Fresco et al., 2006).

The mediating effect of coping flexibility on the relation between negative appraisal and emotion has been examined by relatively little research. Williams's (2002; 2006) studies have shown that coping flexibility could moderate the negative impact of cognitive vulnerabilities on anxiety and depression symptom. These studies implied that coping flexibility might not be associated with cognitive vulnerabilities but could reduce negative emotions. Hence, coping flexibility, although not correlated with threat appraisal, is able to alleviate negative emotional outcomes such as depression and anxiety under stress.

Together, the findings suggested a protective role that coping flexibility plays in alleviating negative emotional outcomes under stress.

Coping Flexibility Mediates the Influence of Challenge Appraisal on Negative Emotional Outcomes

Hypothesis 5 was supported by the finding that coping flexibility serves as the mediator in the relation between challenge appraisal and reduced negative emotional outcomes. The results indicated that the positive influence of challenge appraisal on reduced negative emotional outcomes was through enhancing coping flexibility. This mediating path can be viewed as a positive path.

Challenge appraisal enhances coping flexibility. Supporting Hypothesis 5.1, coping flexibility was positively associated with challenge appraisal. The significant association between challenge appraisal and enhanced coping flexibility suggested that, college students who tend to view stress as an opportunity for self-growth, namely possessing challenge appraisal, are more likely to deploy effective coping strategies according to the characteristics of changing situations. A number of researchers (e.g., Blascovich & Mendes, 2000; Jones et al., 2009) claimed a positive association between challenge appraisal and adaptive coping. Coping flexibility is characterized by adaptive coping across various situations; thus we can infer an association between challenge appraisal and coping flexibility. Additionally, challenge appraisal is a motivational state (Blascovich & Mendes, 2000), which comprises evaluation of coping options and evaluation of the effectiveness of coping strategies an individual deploys. Challenge appraisal may motivate individuals to evaluate their coping resources accurately and adjust their coping behaviors effectively in response to changing situations; and the deployment of adaptive coping strategies according to the nature of various stressful situations

is presented as coping flexibility. Hence, the results extended the literature by revealing the positive association between challenge appraisal and coping flexibility.

Coping flexibility reduces negative emotional outcomes. The positive influence of coping flexibility on emotional outcomes under stress has been discussed in the previous section. Although challenge appraisal did not directly reduce negative emotional outcomes, it could indirectly reduce negative emotional outcomes fully by promoting coping flexibility. Previous research has shown that challenge appraisal is positively associated with positive emotions such as excitement and hope (Cerin, 2003; Dewar & Kavussanu, 2012; Kavussanu, Dewar, & Boardley, 2014). More importantly, these findings extended the literature by proposing coping flexibility as a mediator in the positive influence of challenge appraisal on emotional outcomes. In summary, challenge appraisal can enhance coping flexibility, which further enables individuals to deploy adaptive coping strategies to deal with various stressful situations, and to reduce negative emotional outcomes.

As discussed above, cumulative stressors may not influence college students' challenge appraisal or coping flexibility, both of which may protect them from suffering negative emotional outcomes directly or indirectly. Coping flexibility acts as a mediator in the positive influence of challenge appraisal on reducing negative emotional outcomes. Hence, this is a positive path through which negative emotional outcomes could be reduced. Challenge appraisal and coping flexibility may function as protective factors to alleviate individuals' negative emotional outcomes and to promote their positive adjustment outcomes under stress.

Summary

To conclude all the main findings of this study, two paths and two mediators may explain how stress influence individuals' emotional outcomes and why different people reach different adjustment outcomes. The two paths include a negative path and a positive path, and the two mediators are threat appraisals and coping flexibility. In the negative path, experienced stress aggravates negative emotional outcomes through increasing threat appraisal. In the positive path, challenge appraisal alleviates negative emotional outcomes through enhancing coping flexibility. Therefore, the proposed mediation model was supported. Specifically, appraisals and coping flexibility act as the mediators in the influence of experienced stress on adjustment outcomes.

Limitations and Future Directions

Several limitations of the current study should be cautioned when interpreting the two-process mediation model.

First of all, all the variables in the present study, including experienced stress, threat and challenge appraisals, coping flexibility, and negative emotional outcomes, were assessed by self-reported measures. Although some significant relationships were found in the current study, the relationships for self-reported data might result from individuals' consistent patterns of response to the self-reported questionnaires. Some researchers suggest that self-reports cannot fully reflect how individuals process conscious and unconscious evaluations of a stressor (Blascovich et al., 2000). Hence, in future studies, we can adopt other measurements to assess the above variables. For example, coping flexibility can be assessed in hypothetical stressful scenarios, while appraisals can be measured by the response to real-life stressful events, and a

stress induction can take the place of the self-reported measure of experienced stress.

Second, the Inventory of College Students' Recent Life Experiences (ICSRLE) is a widely used measure to reflect college students' experienced stress; nonetheless, some of the items might not be entirely suitable for Asian cultures. For example, "conflict with professor(s)" might not be common in Asian colleges. Moreover, some additional items that are specific to the Asian cultures would have provided more insight to the daily stressors in the present population. For example, parental expectations, which might not contribute much to academic stress in the Western context (Akgun & Ciarrochi, 2003), are particularly important in Asian cultures (especially Chinese culture). Parental expectation has been shown to be highly correlated to college students' anxiety and stress in some Asian countries such as Taiwan (Wang & Heppner, 2002), Hong Kong (Lee, Wong, Chow, & McBride-Chang, 2006) and Singapore (Ang et al., 2009), as well as Chinese American college students (Kobayashi, 2005). Hence, the inclusion and exclusion of culture-specific items can be further addressed in future research.

Additionally, the present study was a correlational study, and the direction of causality between stress and emotional outcomes through appraisals and coping flexibility cannot be confirmed. To test the causal relationships among the variables, an experimental approach is needed, in which the independent variable should be manipulated. The mediation model revealed in the present study comprises two paths through which stress influences emotional outcomes. The first path describes the negative influence of experienced stress on emotional outcomes, with threat appraisal as the

mediator. The second path represents the positive influence of challenge appraisal on emotional outcomes, with coping flexibility as the mediator. To verify these two mediating paths, two experiments should be conducted to manipulate stress and appraisals respectively in the following two studies.

Moreover, the current study examined the model linking experienced stress, appraisals, coping flexibility, and emotional outcomes. The proposed mediation model reflects the process through which cumulatively experienced stress influences individuals' adjustment outcomes; however, it cannot fully reflect how acute stress influences immediate appraisals, coping flexibility and emotions. In an actual stressful situation, the characteristic of a particular stressor might also affect individuals' immediate cognitive, behavioral, and affective response to stress. To further verify the proposed paths, a future study should examine the effects of acute stress on emotions via appraisals and coping flexibility in a stress-evoking situation.

Lastly, I only considered negative emotional outcomes as the indicator of adjustment outcomes in this study, with a traditional view of stress. However, stress could also affect positive emotions. Hence, in future studies, positive emotion should also be included as an indicator to investigate the effects of stress on adjustment outcomes from a comprehensive perspective.

Implications

Study 1 not only supports the existing theories, but also advances our theoretical understanding of mechanism regarding how stress determines emotions through appraisals and coping flexibility. The current study extends the previous research (e.g., the transaction model of stress and the cognitive

interactional model of appraisal and coping) by proposing a two-mediator and two-process conceptual model. In particular, this mediation model revealed the interaction between different types of appraisals and coping flexibility in the process where stress influences emotional outcomes.

This study also provides some practical implications. Attention should be paid to the risky factors and the protective factors revealed in this study, especially in the educational and counselling context. Cumulatively experienced stress, which can be viewed as a risky factor to aggravate one's threat appraisal and intensify negative emotional outcomes, implies that sufficient support could be provided to the populations suffering from certain stress to remove their stressors. From a positive perspective, challenge appraisal and coping flexibility, functioning as protective factors, showed their positive roles in alleviating negative emotional outcomes under stress. Hence, challenge appraisal and coping flexibility can be utilized as important components in future intervention or training programs, and to promote adaptive psychological adjustment outcomes such as reduced depression, anxiety and distress.

Taken together, the current study provides a new direction for future research in the area of stress from both theoretical and practical perspectives.

Conclusion

The present study tested, through a correlational study design, the conceptual model regarding how stress, threat and challenge appraisals, as well as coping flexibility determine emotional outcomes. The findings suggest that two paths with two mediators may explain the mechanism in which cumulative stress influences emotional outcomes. In the two-mediator mediation model,

experienced stress increases negative emotional outcomes, and this aversive effect is partially mediated by threat appraisal; challenge appraisal reduces negative emotional outcomes, and this positive effect is fully mediated by coping flexibility. As challenge appraisal and coping flexibility were not influenced by experienced stress, they can serve as protective factors. Despite some limitations to be addressed in interpreting the conceptual model, the findings provide both theoretical and practical implications to future research.

The uncertain causalities of variables in this correlational study motivated us to further verify the conceptual model by using an experimental approach. The two paths, one negative path and one positive path, are experimentally tested in the next two studies respectively. Study 2, which was designed to test the negative path with concerns to the mediating role of threat appraisal in the relation between stress and emotions, is reported in the next chapter.

CHAPTER 4

STUDY TWO: THE MEDIATING EFFECT OF THREAT APPRAISAL ON THE RELATION BETWEEN STRESS AND EMOTION

Introduction

It is essential to understand why, faced with the same stressful encounter, some people achieve adaptive outcomes whereas others fall into maladaptive outcomes. In Study 1, which was a correlational study, I examined a mediation model linking self-reported cumulative stress, threat and challenge appraisals, coping flexibility, and emotional outcomes. The findings suggested that two paths and two mediators might explain how stress determines emotional outcomes through appraisals and coping flexibility. In the negative path, threat appraisal mediated the negative influence of cumulatively experienced stress on emotional outcomes; in the positive path, coping flexibility mediated the positive influence of challenge appraisal on emotional outcomes. Additionally, Study 1 investigated the effects of self-reported cumulatively experienced stress on subjective appraisals, perceived coping flexibility as well as self-reported emotional outcomes. It is unclear how an actual stressful situation may influence individuals' immediate responses to stress, including appraisals of the encounter, coping flexibility in hypothetical stressful situations, and emotions. To verify the stress process revealed in Study 1, it is necessary to experimentally induce participants to experience stress, engage in threat and challenge appraisals, and display different levels of coping flexibility and emotions. Hence, the main purpose of Study 2 is to verify the

negative path concerning the mediating role of threat appraisal in the relation between acute stress and emotion, using an experimental approach.

Study 1 suggested a mediating role that threat appraisal plays in the path from cumulatively experienced stress to emotional outcomes, thus it is expected that, different types of actual stressful events (i.e., positive stress and negative stress) that an individual experienced, may lead to different emotions through threat appraisal. Positive stressful events may lead individuals to positive emotions like happiness, hope, and excitement by lowering down threat appraisal, whereas negative stressful event may lead individuals to negative emotions like sadness, anxiety, and distress by aggravating threat appraisal.

As described in Chapter 2 Literature Review, the stressor in the context of acute stress is defined as a particularly stressful situation that exceeds individuals' competence. Specifically, positive stressful events usually lead to positive feelings of happiness or excitement, whereas negative stressful events typically lead to negative feelings like sadness or anxiety. Moreover, these emotions may be produced by the thoughts, beliefs, and meanings that an individual attaches to the specific events. To evoke different types of stress, namely positive stress and negative stress, we may use various methods that have been documented in previous research work to create stressful situations. As discussed in Chapter 2, motivated performance situations are effective in evoking stress, in order to explore the process with regard to how acute stress influences cognitive, behavioral and affective responses. Specifically, different instructions of a forthcoming stressful task may be able to induce different types of stressful situations, and further elicit different levels of threat appraisal and challenge appraisal. The effects of acute stress on appraisals and

adjustment outcomes have also been shown in previous studies, a majority of which have been conducted in the sports context (Adie, Duda, & Ntoumanis, 2008; Jones et al., 2009). Nonetheless, the exploration of the influence of acute stress on appraisals, coping flexibility and adjustment outcomes is still in a relatively early stage. It is important to extend the research to college students who are often required to prepare for stressful tasks such as examinations, presentations, and interviews. Furthermore, Chapter 2's literature review indicated that threat and challenge appraisals are comprised of the evaluation of situational characters such as the possibility of a negative or positive consequence, an approaching or avoidance goal, and the evaluation of personal resources such as self-competence (Lazarus & Folkman, 1984).

Therefore, Study 2 aims to experimentally manipulate the types of stressful situations into positive, negative or neutral, by manipulating both situational characteristics and personal characteristics, so as to induce threat and challenge appraisals and thus study their further effects on coping flexibility and emotions.

Hypotheses

The current study sought to examine whether evoked stress influences threat and challenge appraisals, coping flexibility and emotions among college students. More importantly, this study aimed to verify the negative path revealed in Study 1 by examining the mediating effect of threat appraisal on the relation between evoked stress and emotion. I expected that threat appraisal should mediate the influence of evoked stress on positive emotion. Additionally, evoked stress is expected to have effects on threat and challenge appraisals, coping flexibility, and positive emotion.

The hypotheses in this study included the following elements:

H5: Evoked stress should influence threat and challenge appraisals.

H5.1: Evoked stress should influence threat appraisal.

H5.1.1: There should be between-subject difference in threat appraisal: participants in the negative stress condition should report more threat appraisal compared to those in the positive stress condition who should report less threat appraisal.

H5.1.2: There should be within-subject difference in threat appraisal: compared to pre-manipulation measures, after manipulation, (a) participants in the negative stress condition would report more threat appraisal; (b) participants in the positive stress condition would report less threat appraisal; and (c) participants in the neutral stress condition would not change their threat appraisal.

H5.2: Evoked stress should influence challenge appraisal;

H5.2.1: There should be between-subject difference in challenge appraisal: participants in the negative stress condition should report less challenge appraisal compared to those in the positive stress condition who should report more challenge appraisal.

H5.2.2: There should be within-subject difference in challenge appraisal: compared to pre-manipulation measures, after manipulation, (a) participants in the negative stress condition would report less challenge appraisal; (b) participants in the positive stress condition would report

more challenge appraisal; and (c) participants in the neutral stress condition would not change their challenge appraisal.

H6: Evoked stress should influence coping flexibility.

H6.1: There should be between-subject difference in coping flexibility: participants in the positive stress condition should show higher coping flexibility compared to those in the negative stress condition who should show lower coping flexibility.

H6.2: There should be within-subject difference in coping flexibility: compared to pre-test, after manipulation, (a) participants in the positive stress condition would show higher coping flexibility; (b) participants in the negative stress condition would show lower coping flexibility; and (c) participants in the neutral stress condition would not change their coping flexibility.

H7: Evoked stress should influence positive and negative emotions.

H7.1: Evoked stress should influence positive emotion.

H7.1.1: There should be between-subject difference in positive emotion: participants in the negative stress condition should report less positive emotion compared to those in the positive stress condition who should report more positive emotion.

H7.1.2: There should be within-subject difference in positive emotion: compared to pre-manipulation measures, after manipulation, (a) participants in the negative stress condition would report less positive emotion; (b) participants in the positive stress condition would report more positive emotion;

and (c) participants in the neutral stress condition would not change their positive emotion.

H7.2: Evoked stress should influence negative emotion.

H7.2.1: There should be between-subject difference in negative emotion: participants in the negative stress condition should report more negative emotion compared to those in the positive stress condition who should report less negative emotion.

H7.2.2: There should be within-subject difference in negative emotion: compared to pre-manipulation measures, after manipulation, (a) participants in the negative stress condition would report more negative emotion; (b) participants in the positive stress condition would report less negative emotion; and (c) participants in the neutral stress condition would not change their negative emotion.

H8: Threat appraisal should mediate the relation between stress and emotion;

H8.1: negative stress => increased threat appraisal => decreased positive emotion.

H8.1: negative stress => increased threat appraisal => decreased positive emotion.

H8.2: negative stress => increased threat appraisal => increased negative emotion.

H8.3: positive stress => decreased threat appraisal => increased positive emotion.

H8.4: positive stress => decreased threat appraisal => decreased negative emotion.

H9: Challenge appraisal should mediate the relation between stress and emotion;

H9.1: negative stress => decreased challenge appraisal => decreased positive emotion.

H9.2: negative stress => decreased challenge appraisal => increased negative emotion.

H9.3: positive stress => increased challenge appraisal => increased positive emotion.

H9.4: positive stress => increased challenge appraisal => decreased negative emotion.

Figure 6 provided the proposed model in this study.

Figure 6. The proposed mediation models in Study 2: threat appraisal should mediate the relation between negative stress and emotion (A) and the relation between positive stress and emotion (B); challenge appraisal should mediate the relation between negative stress and emotion (C) and the relation between positive stress and emotion (D).

Method

Participants

Ninety-seven undergraduate students² (37 male and 60 female) with a mean age of 21.3 years ($SD = 1.78$; range 18-27) participated in the study. They were recruited from the research pool of Nanyang Technological University in Singapore. Each participant obtained three course credits for the participation in this study. Participants were randomly assigned into one of three stress conditions: negative stress ($N = 31$; 13 male and 18 female), positive stress ($N = 31$; 14 male and 17 female), and neutral stress ($N = 35$; 10 male and 25 female).

Instruments

Threat and challenge appraisals. To assess how a participant evaluates an upcoming task, a measure of threat and challenge appraisals was used. Participants were asked to think how they perceived the forthcoming task by responding to two threat appraisal items (*“the task may damage my self-esteem”* and *“I may lose a lot because of this task”*) and two challenge appraisal items (*“the task is an opportunity for learning”* and *“the task is normal, and everyone has to face it here and there”*). The above items were selected and

² The sample size required in this repeated measures within-between mixed design was estimated. Effect size $f = 0.25$, the threshold probability for rejecting the null hypothesis α (two-tailed) = 0.05, power $(1 - \beta) = 0.95$, the number of groups = 3, repetitions = 2, correlations among repeated measures $r = 0.5$, nonsphericity correction $\epsilon = 1$. With the above parameters, the minimum total sample size in this study should be $N = 66$, and the actual power would be 0.95.

modified from the Threat and Challenge Appraisals Scale (TCAS), which was used in Study 1. Participants rated the extent to which they agreed with each statement, ranging from 1 (*does not fit at all*) to 4 (*fits extremely well*). This scale was used twice respectively prior to and after manipulation.

Positive and negative emotion. Participants were required to rate their positive emotion (4 items; “*happy*” “*cheerful*” “*energetic*” “*inspired*”) and negative emotion (4 items; “*helpless*” “*tense*” “*nervous*” “*upset*”) from 1 (*does not fit at all*) to 4 (*fits extremely well*). The words were selected from the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). This scale was also used twice respectively before and after manipulation. The PANAS, consisting of Positive Affect (PA) subscale and Negative Affect (NA) subscale, was developed and evaluated in a college student sample (Watson et al., 1988). It exhibited good reliabilities with high alpha coefficients (ranging from .86 to .90 for PA and from .84 to .87 for NA), and stability with good test-retest reliabilities (.86 for PA, and .87 for NA) over 2-month time period. In a psychiatric inpatient sample, the PANAS scales still displayed good internal consistency reliabilities (PA: $\alpha = 0.85$; NA: $\alpha = 0.91$) and appropriate stability indicated by good test-rest reliabilities (PA: .79, NA: .81). The PANAS also showed excellent factorial validity with convergent correlations ranging from .89 to .95, and good external validity by showing high correlations with commonly used measures of distress and psychopathology including the Hopkins Symptom Checklist (HSCL; Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974), Beck Depression Inventory (BDI; Beck, Ward, Mendelsohn, Mock, & Erbaugh, 1961) and STAI State Anxiety Scale (A-State; Spielberger,

Gorsuch & Lushene, 1970). The PANAS has been a commonly and widely used measurement to assess positive and negative affectivity.

Working memory (WM) task. The digit span task, which is a WM span task (Conway et al., 2005), was adopted to assess WM performance. Forward digit span task was administrated by software Inquisit 4.0, where participants are presented with a series of digits (e.g., “9, 3, 5”) and required to repeat them immediately by entering the digits in the given order. If they repeat the numbers successfully, they will be given a longer list. The maximum span of numbers they are successful in repeating indicates their WM performance. WM was measured twice. The measure before manipulation reflected participants’ baseline performance, and the measure after manipulation served to create a stressful situation.

Coping flexibility. To test participants’ coping flexibility, a coping flexibility questionnaire (in hypothetical scenarios) was designed based on the coping flexibility questionnaire (CFQ; Cheng, 2001). This measure was designed according to strategy-situation fit conceptualization, which highlights the match between the characteristics of coping strategies (e.g., problem-focused or emotion-focused) and the nature of stressful situations (e.g., controllability). Coping flexibility was assessed in hypothetical stressful situations. Two versions of coping flexibility measure, each with two hypothetical scenarios, were used for pre-test and post-test, respectively. In total four stressful scenarios were provided, including lay-off, business dinner, ballgame, and early cancer. They were selected from the Extended Miller Behavioral Style Scale (EMBSS) developed by Cheng, Chiu, Hong and Cheung (2001). The EMBSS is a coping measure with eight hypothetical stressful

situations with distinct nature (i.e., Dentist, Hostage, Layoff, Plane, Business Dinner, Ballgame, Early Cancer, and Terminal Cancer), with adequate internal consistency ($\alpha = .84$ for monitoring subscale and $\alpha = .75$ for blunting subscale). It has been adopted in a few studies to provide a set of stressful events instead of getting participants to report stressful events. Among the 8 stressful scenarios, the four scenarios I selected are relevant to college students' daily life: Layoff is relevant to students' part-time jobs or student committees work and their future career, Business Dinner is relevant to students' social life and events, Ballgame is relevant to their extracurricular activities and competitions, and Early Cancer is relevant to their health condition. Participants in this study were given three minutes to respond to each scenario. They were required to read the description and vividly imagine themselves in the situation, then indicate the controllability (controllable vs. uncontrollable) of each situation. After that, participants were instructed to write down as many coping strategies as possible to overcome the stressful experience, and then classify each strategy into one of two categories (problem-focused and emotion-focused) by indicating the primary goal of each strategy (to solve the problem vs. to change the feelings and thinking). Participants' responses were coded according to the Coping Flexibility Index (Cheng, 2001), in which each correctly matching pair of situation and strategy (i.e., controllable situation matches problem-focused strategies, and uncontrollable situation matches emotion-focused strategies) was given one mark. Pre- and post-manipulation coping flexibility was assessed.

Cover stories. Participants' baseline WM task performance was recorded before manipulation. All participants were required to do the WM task

again, and this time a cover story was used to evoke stress. A short description of the upcoming WM task was given for all the three conditions. Three components, including the consequence of the task, the goal of the task, and self-efficacy, were adopted to manipulate the stressful situation into positive, negative, and neutral conditions. As Table 5 showed, positive consequence, positive goal, and positive self-efficacy were encouraged in the positive condition, whereas negative consequence, negative goal and negative self-efficacy were emphasized in the negative condition. As a reference group, the neutral stress condition focused on neutral consequence, neutral goal and neutral self-efficacy. The instructions for the WM task in each condition are presented in Table 6.

Table 5
Components of Instruction in Three Stress Conditions

	Negative Stress	Positive Stress	Neutral Stress
Conditions			
Components			
Consequence of the task	-	+	0
Self-efficacy in the task	-	+	0
Goal of the task	-	+	0

Note. -: negative. +: positive. 0: neutral.

Table 6
Instruction for Task in Three Stress Conditions

Components	Conditions	Negative Stress	Positive Stress	Neutral Stress
Task description	<p>Now you are required to do it again. The upcoming task is basically the same as the previous one.” Working memory is a very important cognitive capacity in our daily life. “The previous computer-based task you did was a working memory task.</p>			
Consequence of the task	<p>Punishment: “We are looking for students performing badly in working memory. We target those who rank the bottom 10%. They will receive an interview from the course TA to figure out why they perform worse than others” Bonus: “We are looking for students with talents in working memory. We target those who rank in the top 10%. They will be given one more research course credit as bonus.” Neutral: “We are investigating what factors influence working memory.”</p>			
Self-efficacy	<p>Inadequate: “So far, the participants in this task were of amazingly high standards. According to your previous score, you may have to try harder in the actual task if you don’t want to lie in the bottom 10%.” Adequate: “So far, the participants in this task were of quite high standards. You did very well in the previous task, and I have great confidence that you can rank the top 10% in the actual task.” Neutral: “You have done this task before.”</p>			
Goal of the task	<p>Avoiding: “Please try to avoid the punishment.” Approaching: “Please try your best to get the bonus.” Neutral: “Please complete this task.”</p>			

Emotion. Participants were required to indicate their feeling at the end of experiment, on an item consisting of eight emotional facial icons, ranging from 1 (*very sad*) to 8 (*very happy*).

Study Design and Data Analyses Plan

The present study aims to verify the negative path in the conceptual model, and the mediating roles of appraisals in the association between stress and emotions. As appraisals were proposed as the mediator in the relation between stress and emotions, it is of significance to observe how appraisal levels change with the changes in stress levels, and how emotions change with the changes of appraisal levels. Therefore, an experimental approach is employed in Study 2, where stress will be manipulated so as to observe its influence on appraisals and emotions. Specifically, stress will be evoked by emphasizing the importance of an upcoming WM task, and manipulated into three conditions (negative, positive vs. neutral) by describing the consequence of the task (punishment, bonus vs. neutral), emphasizing the task goal (avoidance, approaching vs. neutral), and encouraging participants to evaluate their self-competence (inadequate, adequate vs. neutral). Participants are randomly assigned to one of the three conditions. Prior to manipulation, all participants are required to evaluate how harmful or beneficial they perceive the upcoming WM task to be, report how positive and negative their feelings are, then complete the WM task which is followed by a coping flexibility measure; after manipulation, namely a stress induction, all participants are required to respond to the measures again, including appraisals of the WM task, emotions, and coping flexibility.

This is a between- and within-subject repeated measures mixed design. Stress condition (negative, positive vs. neutral) was designed as the between-subject factor, time acted as the within-subject factor. Dependent variables included threat appraisal, challenge appraisal, coping flexibility, and emotions. Additionally, two versions (A and B) of coping flexibility measures were respectively administered to all participants before or after manipulation. The presentation order of these two versions of coping flexibility measures was counterbalanced.

In accordance with the between- and within-subject repeated measures mixed design, repeated measures analyses of variance (ANOVAs) will be adopted, to examine the effects of condition (stress) on appraisals and emotions, the effects of time (before and after stress induction) on appraisals and emotions, and to compare the changes of appraisals and emotions with time between different stress conditions. Moreover, in order to verify the mediation model, a longitudinal mediation analyses will be used to reflect the mediating effects of appraisals and coping flexibility in the associations between stress and emotions.

Procedure

The whole experiment was conducted in a quiet laboratory room. The procedure (see Figure 7) lasted less than 60 minutes. After indicating informed consent for this study, participants provided their demographic information about their age, gender, and ethnicity. Before manipulation (T1), all participants were instructed to complete a baseline WM task. Before doing the task, they reported their threat and challenge appraisals of the upcoming task, and their positive and negative emotion; after completing the baseline WM task,

participants responded to the coping flexibility measure. To evoke stress, participants were required to do the WM task again with a rationale: experimenter emphasized the importance of the forthcoming task and the significant roles of working memory on students' academic and career life. Stress was manipulated into negative, positive, and neutral conditions by a cover story that contained three components: consequence of the task (negative, positive vs. neutral), evaluation of self-competence (inadequate, adequate vs. neutral), and goal of completing the task (avoiding, approaching vs. neutral). After manipulation (T2), participants again reported their threat and challenge appraisals of the coming task as well as their positive and negative emotion. They then completed the stressful WM task, which was followed by a coping flexibility measure. At the end of experiment (T3), emotion was recorded.

Figure 7. Procedure of Study 2.

The design, procedure, and measurements in this study were approved by Institutional Review Board (IRB) in Nanyang Technological University.

Results

Preliminary Analyses

Internal consistency of study measures, descriptive statistics, and correlations among the study variables were tested.

Internal consistency of study measures. The internal consistency of appraisal measures was acceptable: the Cronbach's alphas for pre-manipulation

2-item threat appraisal subscale and 2-item challenge appraisal subscale were 0.68 and 0.70 respectively, and those for post-manipulation threat appraisal and challenge appraisal subscales were 0.70 and 0.73 respectively. The internal consistency of emotion measures was good: the Cronbach's alphas for pre-manipulation 4-item positive emotion subscale and 4-item negative emotion subscale were 0.82 and 0.79 respectively, and those for post-manipulation positive emotion and negative emotion subscales were 0.87 and 0.83 respectively.

Correlations among measured variables. The results for descriptive statistics and correlations of study measures are presented in Table 7. There was nonsignificant association between threat appraisal and challenge appraisal at both T1 ($r = -.01, p = .92$) and T2 ($r = .07, p = .58$), indicating that threat appraisal and challenge appraisal were independent of each other. The correlation between positive emotion and negative emotion was also not significant at both time points (T1: $r = .006, p = .95$; T2: $r = .04, p = .70$); T3 emotion was positively associated with T1 positive emotion ($r = .30, p = .003$) and T2 positive emotion ($r = .41, p < .001$). It was also negatively associated with T1 negative emotion ($r = -.34, p = .001$) and T2 negative emotion ($r = -.21, p = .04$). In terms of the relationship between threat appraisal and emotions, threat appraisal was associated positively with negative emotion ($r = .59, p < .001$) and negatively with positive emotion ($r = -.24, p = .02$) at T1. It was also positively correlated with negative emotion ($r = .40, p < .001$) at T2. In terms of the relationship between challenge appraisal and emotions, challenge appraisal showed positive correlation with positive emotion at both T1 ($r = .42, p < .001$) and T2 ($r = .45, p < .001$). At the end of the experiment,

T3 emotion was negatively correlated with T2 threat appraisal ($r = -.28, p = .005$) but not with challenge appraisal. Lastly, a positive association was found within each pair of pre- and post-manipulation measures including challenge appraisal ($r = .81, p < .001$), threat appraisal ($r = .57, p < .001$), positive emotion ($r = .77, p < .001$), negative emotion ($r = .61, p < .001$), and coping flexibility ($r = .36, p < .001$).

Gender difference. To understand the gender differences in the main variables in Study 2, a MANOVA was run with gender as a fixed factor, and the dependent factors included baseline threat and challenge appraisals, coping flexibility, positive emotion and negative emotion. The results showed nonsignificant gender difference in all the above variables [threat appraisal: $F(1,96) = 0.19, p = .67$; challenge appraisal: $F(1,96) = 0.32, p = .57$; coping flexibility: $F(1,96) = 1.20, p = .28$; positive emotion: $F(1,96) = 0.17, p = .68$; negative emotion: $F(1,96) = 0.29, p = .59$].

Table 7
Results for Descriptive Statistics and Correlations of Measures in Study

	1. T1 TA	2. T1 CA	3. T1 PE	4. T1 NE	5. T1 CF	6. T2 TA	7. T2 CA	8. T2 PE	9. T2 NE	10. T2 CF	11. T3	Mean	SD
1	-	-.01 (.92)	-.24* (.02)	.59*** ($<.001$)	.11 (.30)	.57*** ($<.001$)	.009 (.93)	-.08 (.45)	.27** (.008)	.07 (.48)	-.17 (.10)	1.19	0.39
2		-	.42*** ($<.001$)	.04 (.67)	-.03 (.80)	.02 (.90)	.81*** ($<.001$)	.42*** ($<.001$)	.09 (.38)	.02 (.84)	.03 (.79)	2.82	0.65
3			-	.006 (.95)	-.03 (.75)	-.12 (.24)	.39*** ($<.001$)	.77*** ($<.001$)	.16 (.13)	-.02 (.82)	.30** (.003)	2.44	0.85
4				-	.19 (.07)	.43*** ($<.001$)	-.04 (.70)	.04 (.72)	.61*** ($<.001$)	.11 (.28)	-.34** (.001)	1.52	0.66
5					-	.13 (.19)	-.02 (.84)	.08 (.42)	.008 (.94)	.36*** ($<.001$)	-.06 (.55)	5.58	1.88
6						-	.07 (.61)	.45*** ($<.001$)	-.003 (.97)	.02 (.82)	.09 (.41)	2.30	0.93
7							-	-.17 (.10)	.40*** ($<.001$)	.13 (.22)	-.28** (.005)	1.59	0.63
8								-	.04 (.70)	-.03 (.77)	.41*** ($<.001$)	2.74	1.25
9									-	.009 (.93)	-.21* (.04)	0.68	0.41
10										-	-.16 (.12)	5.22	2.26
11											-	5.53	1.32

Note. $N = 97$. p values were shown in parenthesis. * $p < .05$. ** $p < .001$. *** $p < .0001$.

TA = threat appraisal. CA = challenge appraisal. PE = positive emotion. NE = negative emotion. CF = coping flexibility. T1 = Time 1. T2 = Time 2.

Comparable baseline among three conditions. Several one-way ANOVAs were conducted with stress condition as the group factor, and all the baseline measures (including threat appraisal, challenge appraisal, coping flexibility, and positive and negative emotions) as the dependent variables. Nonsignificant difference was observed in baseline working memory ($F = 1.08$, $p = .35$), threat appraisal ($F = 0.60$, $p = .55$), challenge appraisal ($F = 0.42$, $p = .66$), coping flexibility ($F = 2.22$, $p = .12$), and negative emotion ($F = 0.91$, $p = .41$) among the three conditions; but there was significant difference across conditions in baseline positive emotion ($F = 4.05$, $p = .02$). The post hoc test results showed that the difference existed between positive stress condition and neutral stress condition: participants in the positive stress condition showed more baseline positive emotion than those in the neutral stress condition ($\Delta M = 0.52$, $SE = 0.20$, $p = .03$). The above results demonstrated a comparable baseline with respect to threat appraisal, challenge appraisal, coping flexibility, and negative emotion. Given that the difference in baseline positive emotion might influence participants' subsequent responses to stress, baseline positive emotion was controlled while analyzing the effects of stress manipulation on appraisal, coping flexibility, and positive and negative emotion. The descriptive statistical results for study measures at T1 and T2 across three conditions are presented in Table 8.

Table 8
Descriptive Statistics for Study Measures at T1 and T2 in Three Stress
Conditions in Study 2

	Positive Stress (n = 31)		Negative Stress (n = 31)		Neutral Stress (n = 35)		Min	Max
	T1	T2	T1	T2	T1	T2		
Working Memory	8.42 (1.09)	9.03 ^{a**} (1.30)	8.16 (0.90)	8.35 (1.25)	8.57 (1.36)	8.49 (1.07)	6	11
Threat Appraisal	1.15 (0.32)	1.10 (0.20)	1.16 (0.35)	1.39 ^{a**} (0.38)	1.24 (0.48)	1.26 (0.52)	1	4
Challenge Appraisal	2.81 (0.73)	2.69 (0.73)	2.90 (0.51)	2.89 (0.59)	2.76 (0.69)	2.64 (0.71)	1	4
Positive Emotion	2.60 (0.77)	2.46 (0.89)	2.64 (0.57)	2.35 ^{b***} (0.93)	2.12 (0.93)	2.13 (0.97)	1	4
Negative Emotion	1.39 (0.48)	1.39 (0.35)	1.55 (0.73)	1.74 (0.64)	1.60 (0.73)	1.63 (0.76)	1	4
Coping Flexibility	5.14 (1.68)	4.93 (2.07)	6.39 (2.09)	5.90 (2.61)	5.09 (1.54)	4.82 (1.96)	0	-

Note. Standard deviations were shown in parenthesis.

^a-significantly higher than baseline. ^b-significantly lower than baseline. * $p < .05$.

** $p < .01$. *** $p < .001$.

Manipulation Check for the WM Task Performance

To measure whether the manipulation for the WM task was successful or not, a repeated measures 3 (Conditions: positive, negative vs. neutral stress) * 2 (Time: pre- vs. post-test) ANOVA was conducted, with WM score as the dependent variable, and T1 positive emotion as a covariate. There were not significant main effects for Time [$F(1, 93) = 0.30, p = .59, \eta_p^2 = .003$] or for Condition [$F(2, 93) = 1.62, p = .20, \eta_p^2 = .03$] on WM task performance, and the interaction effect of Time and Condition [$F(2, 93) = 2.81, p = .07, \eta_p^2 = .06$] was also not significant. As for the covariate, the main effect of T1 positive emotion and the interaction effect of Time and T1 positive emotion on task performance was not significant. The interaction effect of Time and Condition indicated that the change of task performance from T1 to T2 was caused by stress conditions. Paired samples t-tests further revealed that participants in the positive stress condition significantly improved their WM task performance

after manipulation ($\Delta M = 0.62$, $t = 2.98$, $p = .006$), but changes of task performance were not observed in the negative stress condition or neutral stress condition. In terms of the between-subject differences in post-test WM task performance, participants in the positive stress condition showed near-significantly higher WM task scores than those in the negative stress condition ($\Delta M = 0.47$, $SE = .26$, $p = .08$). The results revealed that positive stress could improve participants' task performance compared to their baseline level, also, participants who experienced positive stress had better WM performance than those who experienced negative stress. Hence, the manipulation was successful. The changes of WM scores with time in three conditions were presented in Figure 8.

Figure 8. The changes of working memory (WM) scores with time in three stress conditions

Effects of Evoked Stress on Appraisals

Two repeated measures ANOVAs, 3 (Conditions: negative, positive vs. neutral stress) * 2 (Time: pre- vs. post-test), were respectively conducted with

threat appraisal and challenge appraisal as dependent variables, and T1 positive emotion was entered as a covariate.

Effects of evoked stress on threat appraisal. There was neither significant main effect of Time [$F(1, 93) = 0.13, p = .72, \eta_p^2 = .001$] nor that of stress condition [$F(2, 93) = 1.59, p = .21, \eta_p^2 = .03$] on threat appraisal, but the interaction effect of Time and Condition was found to be significant [$F(2, 93) = 4.78, p = .01, \eta_p^2 = .09$]. As for the covariate, the main effect of T1 positive emotion on threat appraisal [$F(1, 93) = 3.78, p = .06, \eta_p^2 = .04$] and the interaction effect of Time and T1 positive emotion [$F(1, 93) = 0.94, p = .34, \eta_p^2 = .01$] were not significant. The significant interaction effect of Time and Condition on threat appraisal suggests that the change of threat appraisal from T1 to T2 differed in three stress conditions. To further examine the interaction effect, three paired samples t-tests were run to make post hoc comparisons between conditions. The significant level for alpha value was adjusted to $.05/3 = .017$. The t-test results showed that, in the negative stress condition, participants' threat appraisal increased after manipulation ($\Delta M = 0.23, SD = 0.34, SE = .06, t = 3.72, p = .001$), but no significant change of threat appraisal was observed in the positive stress condition ($t = 0.77, p = .45$) or neutral stress condition ($t = -0.23, p = .82$). Regarding the between-subject differences in post-test threat appraisal, there was no significant difference between conditions ($ps > .10$). The changes of threat appraisal with time in three conditions were presented in Figure 9a.

Effects of evoked stress on challenge appraisal. The main effect of Time [$F(1, 93) = 0.24, p = .88, \eta_p^2 < .001$], main effect of Condition [$F(2, 93) = 0.45, p = .64, \eta_p^2 = .009$], and the interaction effect of Time and Condition [$F(2,$

93) = 0.68, $p = .51$, $\eta_p^2 = .014$] were all found to be nonsignificant on challenge appraisal. As for the covariate, the main effect of T1 Positive emotion on challenge appraisal [$F(1, 93) = 19.5$, $p < .001$, $\eta_p^2 = .17$] was significant, but the interaction effect of Time and T1 Positive emotion [$F(1, 93) = 0.24$., $p = .63$, $\eta_p^2 = .003$] was not significant. The nonsignificant interaction effect between time and condition on challenge appraisal indicates that the stress manipulation did not influence participants' challenge appraisal. In terms of the between-subject differences, participants' post-test challenge appraisal did not vary between conditions ($ps > .10$). The changes of challenge appraisal with time in three conditions were presented in Figure 9b.

Figure 9a. The changes of threat appraisal with time in three stress conditions

Figure 9b. The changes of challenge appraisal with time in three stress conditions

The above results suggested that evoked stress had an impact on threat appraisal; in particular, participants in a negative stress condition increased their threat appraisal compared to baseline level, and they showed near-significantly more threat appraisal than those in a positive stress condition. However, evoked stress did not influence participants' challenge appraisal.

Effects of Evoked Stress on Emotion

To examine the effects of stress manipulation on positive and negative emotion, two repeated measures ANOVAs, 3 (Conditions: negative, positive vs. neutral stress) * 2 (Time: pre- vs. post-test), were conducted, with positive emotion and negative emotion as the dependent variables, respectively.

Effects of evoked stress on positive emotion. A significant main effect of Time [$F(1, 94) = 5.17, p = .03, \eta_p^2 = .05$] was found on positive emotion, but the main effect of Condition [$F(2, 94) = 2.43, p = .09, \eta_p^2 = .06$] and the interaction effect of Time and Condition [$F(2, 94) = 1.96, p = .15, \eta_p^2 = .04$] were not significant. Concerning the main effect of Time, post-hoc test results

showed that participants' positive emotion decreased after manipulation ($\Delta M = -0.14$, $SE = 0.62$, $p = .03$) in general. The nonsignificant interaction effect of Time and Condition suggested that the changes of positive emotion from T1 to T2 did not vary in different conditions. In terms of the within-subject difference, paired t-test as post hoc test results showed that participants in the negative stress condition reduced their positive emotion compared to pre-test ($\Delta M = -0.13$, $t = -2.16$, $p = .03$), but no changes of positive emotion were observed in the positive stress condition or the neutral stress condition. In terms of the between-subject differences, post-hoc test with Tukey's HSD showed that participants in the positive stress condition had higher post-test positive emotion than those in the neutral stress condition ($\Delta M = 0.40$, $SE = 0.20$, $p = .05$). The changes of positive emotion with time in three conditions were presented in Figure 10a.

Effects of evoked stress on negative emotion. T1 positive emotion was entered as a covariate in the repeated measures ANOVA on negative emotion. The main effect of Time [$F(1, 93) = 1.04$, $p = .31$, $\eta^2 = .01$], the main effect of Condition [$F(2, 93) = 1.25$, $p = .27$, $\eta^2 = .01$] and the interaction effect of Time and Condition [$F(2, 93) = 0.88$, $p = .42$, $\eta^2 = .02$] were found nonsignificant on negative emotion. As for the covariate, the main effect of T1 Positive emotion [$F(1, 93) = 1.25$, $p = .27$, $\eta^2 = .01$] and the interaction effect of Time and T1 Positive emotion [$F(1, 93) = 2.26$, $p = .14$, $\eta^2 = .02$] on negative emotion was not significant either. The nonsignificant interaction effect of Condition and Time on negative emotion suggested that evoked stress might not cause changes of negative emotion from pre- to post-test. In terms of the within-subject difference, there was no change in the positive stress condition

($\Delta M = 0$, $SE = .08$, $p > .99$), the negative stress condition ($\Delta M = -0.19$, $SE = .12$, $p = .11$), or the neutral stress condition ($\Delta M = -0.03$, $SE = .10$, $p = .78$). Regarding the between-subject differences in post-test negative emotion, no significant difference was observed between conditions. The changes of negative emotion with time in three conditions were presented in Figure 10b.

Figure 10a. The changes of positive emotion with time in three stress conditions

Figure 10b. The changes of negative emotion with time in three stress conditions

The above results showed that participants in both the positive stress condition and the negative stress condition had slightly more post-test positive emotion than those in neutral stress condition; additionally, participants in the negative stress condition decreased their positive emotion after manipulation compared to baseline level; moreover, participants who experienced positive stress had slightly less post-test negative emotion than those who experienced negative stress and neutral stress.

Effects of Evoked Stress on Coping Flexibility

To examine the effects of evoked stress on coping flexibility, a 3 (Condition: negative, positive vs. neutral stress) * 2 (Time: pre- vs. post-test) repeated measures ANOVA, was carried out with coping flexibility as dependent variable. T1 positive emotion was entered as a covariate.

The main effect of Condition [$F(2, 93) = 5.96, p = .004, \eta_p^2 = .12$] was significant, but both the main effect of Time [$F(1, 93) = 0.82, p = .37, \eta_p^2 = .009$] and the interaction effect of Time and Condition [$F(2, 93) = 0.16, p = .86, \eta_p^2 = .003$] were not significant. As for the covariate, the main effect of T1 Positive emotion [$F(1, 93) = 1.92, p = .17, \eta_p^2 = .02$] and the interaction effect of Time and T1 Positive emotion [$F(1, 93) = 0.27, p = .60, \eta_p^2 = .003$] on coping flexibility were not significant. The significant main effect of Condition indicated between-subject differences in post-test coping flexibility. Post hoc test results further showed that participants in the positive stress condition showed significantly lower level of post-test coping flexibility than those in the negative stress condition ($\Delta M = -1.15, SE = .42, p = .008$) after manipulation. The nonsignificant interaction effect of Time and Condition suggested that the difference in coping flexibility between conditions did not vary across two time

points. The changes of coping flexibility with time in three conditions were presented in Figure 11.

The results indicated that the evoked stress did not influence coping flexibility.

Figure 11. The changes of coping flexibility with time in three stress conditions

Mediating Effects of Appraisals on the Relation between Stress and Emotion

The main goal of Study 2 was to examine the mediating roles that threat and challenge appraisals play in the relation between stress and emotion. In particular, the current study aimed to verify the negative path revealed in Study 1 regarding how stress increased negative emotional outcomes via threat appraisal. Given that various types of stress had different effects on threat appraisal and emotion, according to the results of repeated measures ANOVAs, the mediating role of threat appraisal was further examined in the influence of different types of evoked stress (i.e., positive and negative stress) on emotions. The SEM was deployed via Mplus 7.4 to examine the longitudinal mediation

model linking evoked stress as well as threat appraisal and emotions at three time points. The proposed longitudinal mediation model (controlling for T1 positive emotion) is presented in Figure 12. Stress condition (negative, positive vs. neutral) was dummy coded into two variables (d1 = negative stress, d2 = positive stress) with the neutral stress condition serving as the reference group.

Figure 12. The proposed mediation model in Study 2.

Mediating effects of threat appraisal on the relation between stress and emotion. To examine the mediating effects of threat appraisal on the association between evoked stress and emotion, two longitudinal mediation models were tested, controlling for T1 positive emotion.

Threat appraisal mediates the negative influence of negative stress on positive emotion. The longitudinal mediation analysis results concerning the mediating effects of threat appraisal on the associations between negative stress and emotion were presented in Table 9, and the final model with coefficients was presented in Figure 13. Regarding the contemporaneous relationship, after

manipulation, the path from negative stress to T2 threat appraisal ($\beta = 5.93, p < .001$), that from T2 threat appraisal to T2 positive emotion ($\beta = -0.32, p < .001$), as well as that from negative stress to T2 positive emotion ($\beta = -0.54, p = .001$) were all significant. The indirect effect of negative stress on T2 positive emotion was significant ($\beta = -1.92, SE = 0.43, \beta' = -.37, SE' = .07, p < .001$), indicating that threat appraisal partially mediates the negative influence of negative stress on immediate positive emotion. In terms of the longitudinal relationships, the path from negative stress to T3 positive emotion was not significant ($p > .10$), but the path from T2 threat appraisal to T3 positive emotion ($\beta = -0.16, p = .002$) and that from T2 positive emotion to T3 positive emotion ($\beta = 0.65, p < .001$) were both significant. The direct effect of negative stress on T3 positive emotion was not significant, however, the indirect effect of negative stress on T3 positive emotion was significant ($\beta = -2.17, SE = 0.05, \beta' = -.38, SE' = .08, p < .001$). To be specific, both the indirect effect of negative stress on T3 positive emotion via T2 threat appraisal ($\beta = -0.92, SE = 0.36, \beta' = -.16, SE' = .06, p = .009$), and that via T2 threat appraisal and T2 positive emotion ($\beta = -1.24, SE = 0.39, \beta' = -.22, SE' = .07, p = .001$) were significant, suggesting that negative stress-evoking situations could have longer-term negative effects on individuals' positive emotion, and these negative effects were mediated by the acute threat appraisal and positive emotion back in the stressful situation. However, when replacing T2 positive emotion by T2 negative emotion, the mediating effects were no longer significant ($ps > .10$). Together, a negative stressful event not only reduces individuals' immediate positive emotion by intensifying their threat appraisal,

but also reduces their positive emotion after the stressful event fully through the increased acute threat appraisal and reduced positive emotion during the event.

Table 9

Coefficients and Significance Levels for the Paths of the Mediation Model of Negative Stress in Study 2

Parameter estimate	β	SE	Standardi zed β	Standardi zed SE	p
NS $\rightarrow$ T2TA	5.93	1.30	.42	.08	<.001
T1TA $\rightarrow$ T2PE	-0.55	0.16	-.11	.03	<.001
NS $\rightarrow$ T2PE	-0.54	0.17	-.11	.03	.001
T2TA $\rightarrow$ T2PE	-0.32	0.01	-.90	.02	<.001
T1TA $\rightarrow$ T3PE	-0.009	0.24	-.002	.04	.97
NS $\rightarrow$ T3PE	-0.43	0.26	-.08	.05	.09
T2TA $\rightarrow$ T3PE	-0.16	0.05	-.39	.13	.002
T2PE $\rightarrow$ T3PE	0.65	0.15	.58	.13	<.001

Note: $\chi^2(1) = .05$, $p = .83$; CFI = 1.00; TLI = 1.02; RMSEA < .001, 90%CI[0, 0.16]; SRMR = 0.007. NS = negative stress. TA = threat appraisal. PE = positive emotion. NE = negative emotion. T1 = Time 1 (Pre-manipulation). T2 = Time 2 (Post-manipulation).

Figure 13. The mediation model of negative stress in Study 2.

Note. T1 = Time 1 (Pre-manipulation). T2 = Time 2 (Post-manipulation).

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

Threat appraisal mediates the positive influence of positive stress on positive emotion. The longitudinal mediation analysis results concerning the

mediating effects of threat appraisal on the associations between positive stress and emotion were presented in Table 10, and the final model with coefficients was presented in Figure 14. Regarding the contemporaneous relationship, after manipulation, the path from positive stress to T2 threat appraisal ($\beta = -0.11, p < .001$), that from T2 threat appraisal to T2 positive emotion ($\beta = -0.31, p < .001$), as well as that from positive stress to T2 positive emotion ($\beta = -0.01, p = .001$) were all significant. The indirect effect of positive stress on T2 positive emotion was significant ($\beta = 0.03, SE = 0.007, \beta' = .43, SE' = .06, p < .001$), indicating that threat appraisal partially mediates the positive influence of positive stress on immediate positive emotion. In terms of the longitudinal relationships, the path from positive stress to T3 positive emotion was not significant ($p > .10$), but the path from T2 threat appraisal to T3 positive emotion ($\beta = -0.15, p = .03$) and that from T2 positive emotion to T3 positive emotion ($\beta = 0.66, p = .001$) were both significant. The direct effect of positive stress on T3 positive emotion was not significant, however, the indirect effect of positive stress on T3 positive emotion was significant ($\beta = 0.04, SE = 0.008, \beta' = .45, SE' = .07, p < .001$). To be specific, both the indirect effect of positive stress on T3 positive emotion via T2 threat appraisal ($\beta = 0.02, SE = 0.009, \beta' = .19, SE' = .10, p = .05$), and that via T2 threat appraisal and T2 positive emotion ($\beta = 0.02, SE = 0.007, \beta' = .26, SE' = .08, p = .001$) were significant, suggesting that positive stress-evoking situations could have longer-term positive effects on individuals' positive emotion, and these positive effects were mediated by the acute threat appraisal and positive emotion back in the stressful situation. However, when replacing T2 positive emotion by T2 negative emotion, the mediating effects were no longer significant ($ps > .10$).

Together, a positive stressful event not only enhances individuals' immediate positive emotion by reducing their threat appraisal, but also promotes their positive emotion after the stressful event through the reduced acute threat appraisal and increased positive emotion during the event.

Table 10
Coefficients and Significance Levels for the Paths of the Mediation Model of Positive Stress in Study 2

Parameter estimate	β	SE	Standardi zed β	Standardi zed SE	p
PS → T2TA	-0.11	0.02	-.50	.08	<.001
T1TA → T2PE	-0.55	0.15	-.10	.03	<.001
PS → T2PE	0.01	0.002	.15	.03	<.001
T2TA → T2PE	-0.31	0.01	-.86	.03	<.001
T1TA → T3PE	-0.008	0.24	-.001	.04	.97
PS → T3PE	0.006	0.04	.07	.05	.17
T2TA → T3PE	-0.15	-0.05	.38	.13	.003
T2PE → T3PE	0.66	0.16	.59	.14	<.001

Note: $\chi^2(1) = .03$, $p = .86$; CFI = 1.00; TLI = 1.02; RMSEA < .001, 90%CI[0, 0.14]; SRMR = 0.005. TA = threat appraisal. PS = positive stress. PE = positive emotion. T1 = Time 1 (Pre-manipulation). T2 = Time 2 (Post-manipulation).

Figure 14. Mediation Model of Positive Stress in Study 2.

Note. T1 = Time 1 (Pre-manipulation). T2 = Time 2 (Post-manipulation).

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

Mediating effects of challenge appraisal on the relation between stress and emotion. To examine the mediating effects of threat appraisal on the association between evoked stress and emotion, two longitudinal mediation models were run in different stress conditions. However, among the paths examined, only the path from T2 positive emotion to T3 positive emotion was significant ($\beta = 0.59$, $SE = 0.14$, $\beta' = .41$, $SE' = .11$, $p < .001$), and the rest were not significant ($ps > .10$). Hence, challenge appraisal did not mediate the associations between evoked stress and emotions.

To summarize, threat appraisal served as a mediator in the relation between evoked stress and positive emotion regardless of the type of stress (negative and positive). However, challenge appraisal did not mediate the influence of evoked stress on emotion. Specifically, negative stress decreased positive emotion through increasing threat appraisal, while positive stress increased positive emotion through reducing threat appraisal.

Discussion

By evoking stress and manipulating stress into positive, negative, and neutral conditions, the main purpose of the current study was to verify the negative path revealed in Study 1, concerning the mediating role of threat appraisal in the relation between stress and emotion.

The discoveries include:

H5 was partially supported. Evoked stress had effects on threat appraisal but not on challenge appraisal.

H5.1 was supported. Evoked stress influenced threat appraisal.

H5.1.1 was supported. There was between-subject difference in threat appraisal; in particular, participants in the negative stress condition reported more threat appraisal, compared to those in the positive stress condition who reported less threat appraisal.

H5.1.2 was partially supported. The within-subject difference in threat appraisal was observed only in the negative stress condition; that is, compared to pre-manipulation measures, after manipulation, (a) participants in the negative stress condition reported more threat appraisal, (b) participants in the positive stress condition did not change their threat appraisal, and (c) participants in the neutral stress condition did not change their threat appraisal.

H5.2 was rejected. Evoked stress did not influence challenge appraisal.

H5.2.1 was rejected. There was no between-subject difference in challenge appraisal; that is, participants in the negative stress condition did not report significantly less challenge appraisal than those in the positive stress condition.

H5.2.2 was rejected. There was no within-subject difference in challenge appraisal; that is, compared to pre-manipulation measures, participants in all the three conditions including the negative, positive, and neutral stress conditions did change their challenge appraisal after manipulation.

H6 was rejected: evoked stress did not influence coping flexibility.

H6.1 was rejected. There was no between-subject difference in coping flexibility; that is, participants in the negative stress condition did not show lower coping flexibility than those in the positive stress condition.

H6.2 was rejected. There was no within-subject difference in coping flexibility; that is, compared to pre-test, participants in all the three conditions including negative, positive, and neutral stress conditions did not change their coping flexibility after manipulation.

H7 was partially supported. Evoked stress influenced positive and negative emotion.

H7.1 was supported. Evoked stress influenced positive emotion.

H7.1.1 was partially supported. There was near-significant between-subject difference between positive stress condition and neutral stress condition; in particular, participants in the positive stress condition reported near-significantly more positive emotion compared to those in the neutral stress condition who reported less positive emotion; but there was no significant difference between the positive and negative stress conditions.

H7.1.2 was partially supported. The within-subject difference in positive emotion was only observed in the negative stress condition; in particular, compared to pre-manipulation measures, after manipulation, (a) participants in the negative stress condition reported less positive emotion, (b)

participants in the positive stress condition did not report more positive emotion, and (c) participants in the neutral stress condition did not change their positive emotion.

H7.2 was partially supported. Evoked stress influenced negative emotion.

H7.2.1 was supported. There was between-subject difference; in particular, participants in the negative stress condition reported more negative emotion compared to those in the positive stress condition who reported near-significantly less negative emotion.

H7.2.2 was rejected. There was no within-subject difference in negative emotion; that is, compared to pre-manipulation measures, in all the three conditions including the negative, positive, and neutral stress conditions, participants did not change their negative emotion after manipulation.

H8 was partially supported. Threat appraisal only mediated the relation between stress and positive emotion.

H8.1 was supported. Threat appraisal mediated the relation between negative stress and positive emotion; in particular, negative stress reduced positive emotion by increasing threat appraisal.

H8.2 was supported. Threat appraisal mediated the relation between positive stress and positive emotion; in particular, positive stress increased positive emotion by lowering threat appraisal.

H8.3 was rejected. Threat appraisal did not mediate the relation between negative stress and negative emotions.

H8.4 was rejected. Threat appraisal did not mediate the relation between negative stress and positive emotions.

H9 was rejected. Challenge appraisal did not mediate the relation between stress and emotion.

H9.1 was rejected. Challenge appraisal did not mediate the relation between negative stress and positive emotion.

H9.2 was rejected. Challenge appraisal did not mediate the relation between positive stress and positive emotion.

H9.3 was rejected. Challenge appraisal did not mediate the relation between negative stress and negative emotion.

H9.4 was rejected. Challenge appraisal did not mediate the relation between positive stress and negative emotion.

The final mediation models are presented in Figure 15.

Figure 15. The final models in study 2: the proposed models were partially supported. Solid lines indicated the proposed paths that were supported.
Note. NS = negative stress. PS = positive stress. TA = threat appraisal. PE = positive emotion.

In summary, the negative path in which threat appraisal mediates the influence of stress on emotion was verified in the present study. Evoked stress successfully altered participants' threat appraisal. In particular, a negative stressful situation increased participants' threat appraisal, whereas a positive stressful situation lowered their threat appraisal. More importantly, threat

appraisal served as a mediator in the influence of acute stress on positive emotion, regardless of the types of stress (positive or negative). Specifically, negative stress decreased positive emotion by increasing threat appraisal, while positive stress enhanced positive emotion by lowering threat appraisal. Together, Study 2 not only verified the negative path revealed in Study 1, but also showed that the negative path could be converted to be positive when positive instruction was provided.

Evoked Stress Influences Threat Appraisal but Not Challenge Appraisal

Our results suggested that both the negative and positive stress-evoking situations affected threat appraisal but not on challenge appraisal. In this sense, Hypothesis 5 was partially supported. In particular, participants in the positive stress condition reported a lower level of threat appraisal compared to the baseline level. In contrast, participants in the negative stress condition reported a higher level of threat appraisal compared to the baseline level. However, neither type of evoked stress influenced challenge appraisal. Given that acute stress was manipulated by providing different instructions in terms of situational and personal characteristics, this section also discusses the effects of instructions on appraisals.

Negative evoked stress increases threat appraisal whereas positive evoked stress reduces threat appraisal. In support of Hypothesis 5.1, compared to the baseline level, participants who experienced negative stress increased their threat appraisal, while those who experienced positive stress lowered down their threat appraisal. Additionally, the findings demonstrated that threat appraisal could be altered by instruction before a stressful task. Specifically, negative instruction that focuses on an avoidance goal, negative

consequences, and negative evaluation of self-competence may increase one's threat appraisal, whereas positive instruction that encourages an approaching goal, positive consequences, and positive evaluation of self-competence may reduce one's threat appraisal. Here I mainly discuss the possible effects of an approaching/avoidance goal and adequate/inadequate self-competence on threat appraisal. Task goal (avoidance vs. approaching) was selected as a component to manipulate stress, based on the premise that achievement goals work as an interpretative framework for appraisals (McGregor & Elliot, 2002). Early in 1992, the Achievement Goal Theory (Ames, 1992) emphasized the important role of achievement motivation in cognitive, emotional, and behavioral outcomes. Threat appraisal is a motivational status (Blascovich et al., 2000), and the avoidance goal encouraged in a motivational performance situation may reduce individuals' motivation to respond to stress. McGregor and Elliot's (2000) study specified that achievement goals could explain half of the variance in threat appraisal and challenge appraisal in a sport competition context. Our finding was consistent with previous research, which revealed that people with a focus on personal involvement in a task are less likely to view stressful situation as a threat (Roberts, 1986), and that negative appraisal involves avoiding the stressful experiences (Kelly, Mansell, Sadhnani, & Wood, 2012). Thus, an avoidance goal might increase threat appraisal, while an approaching goal of an upcoming stressful task may lower threat appraisal. Additionally, evaluation of self-competence (inadequate vs. adequate) was selected as another component of stress manipulation, based on the posit that evaluation of self-competence is also part of appraisal (Lazarus, 1991b; Lazarus, 1999). Our finding was consistent with previous studies on the relationship between self-

efficacy and appraisal, a majority of which were conducted in a sports context. For example, athletes with threat appraisal have lower levels of self-efficacy (Blascovich, Seery, Mugridge, Norris, & Weisbuch, 2004; Jones et al., 2009) and have less confidence in their competence (Taylor et al., 2010). Thus, perception of adequate self-competence in a stressful task may lower threat appraisal, whereas perception of inadequate self-competence may increase threat appraisal.

Evoked stress does not influence challenge appraisal. Contrary to Hypothesis 5.2, participants in three conditions did not show changes in challenge appraisal. Regarding the influence of a task goal on challenge appraisal, Kelly et al. (2012) claimed that positive appraisal involves approaching the stressful experiences. Adie and co-workers' (2008) study also showed that people with approaching goal tend to view a stressful situation as an opportunity for personal growth. Contrary to the previous findings, our results demonstrated that college students' challenge appraisal was not changed by the short instruction which encourages an avoidance goal or an approaching goal. As for the effect of evaluation of self-competence on challenge appraisal, challenge appraisal has been found in previous work to be positively associated with greater self-esteem (Adie et al., 2008), higher levels of self-efficacy (Blascovich et al., 2004; Jones et al., 2009), and more confidence in one's competence (Taylor et al., 2010). However, according to our results, instruction that aims to emphasize adequate or inadequate self-competence did not change college students' challenge appraisal. Hence, challenge appraisal may not be altered by simply providing an instruction for an actual stressful situation.

As discussed above, acute stress could alter individuals' threat appraisal but may not change their challenge appraisal. This finding was consonant with the finding of Study 1, which suggested that cumulative stress might increase one's threat appraisal but might not impact challenge appraisal. In this case, it is plausible that both cumulative stress and acute stress might have influences on threat appraisal but not on challenge appraisal. Moreover, the present study extended the research by emphasizing the essential role of positive instruction in educational context. Given that appraisal refers to making sense of stressful situation in terms of the nature of situation and personal competence (Lazarus & Folkman, 1984). Instruction about an upcoming task such as an examination, presentation and competition, in terms of the situational characteristics and personal resources, may influence college students' threat appraisal. Threat appraisal could be decreased by the positive instruction which aims to guide students to positively evaluate the goal and consequence of the task as well as their self-competence; and it could be increased by the negative instruction which aims to lead students to negatively evaluate the goal and consequence of the task as well as self-competence. Nonetheless, challenge appraisal could not be altered by instruction. To conclude, providing instruction associated with the situational characters and personal resources might have changed the degree to which an individual interprets the situation as a threat, but did not influence the degree to which an individual appraises the situation as an opportunity.

Evoked Stress Does Not Influence Coping Flexibility

Hypothesis 6 was rejected, nevertheless, the nonsignificant finding about the influence of evoked stress on coping flexibility provides important implications. Coping flexibility is a competence—which is developed over a

long period of time, and is stable in a person—to effectively deal with changing stressful situations. Thus, this competence might not be affected easily by the characteristic of a particular stressful event. Previous studies have established the relationship between coping flexibility and some individual difference factors. Cheng (2001) summarized the roles of personality in coping flexibility from previous research work. The patterns of using problem-focused coping across various stressful situations might be linked to neuroticism (Bolger & Zuckerman, 1995) and Type A personality (e.g., competitive, ambitious, impatient, and/or aggressive personality; Clark & Miller, 1990); while the patterns of using emotion-focused coping across various stressful situations might be linked to pessimism and helplessness (Aldwin, Sutton, & Lachman, 1996). In Cheng's further studies (e.g., Cheng, 2003), cognitive process (e.g., discriminative facility referring to the sensitivity to subtle cues) and motivational process (e.g., need for closure) were believed to account for the individual difference in coping flexibility. In this case, coping flexibility can be viewed as an individual difference variable which might have taken time to develop, and it is resistant to changes in stressful environment.

Additionally, coping flexibility could not be affected by evoked stress, but it was associated with positive emotion under acute stress. This finding was consonant with Study 1, which demonstrated that coping flexibility could not be affected by cumulatively experienced stress but it could reduce an individual's negative emotional outcomes. Hence, the protective role of coping flexibility in enhancing positive emotion in an actual stressful situation was highlighted. Previous work (e.g., Matthews et al., 1999; Zeidner, 1995) claimed that, in a motivated performance situation, adaptive coping is associated with

positive emotion, whereas maladaptive coping is associated with negative emotion. Coping flexibility which is characterized as adaptive coping, has also shown its protective role in reducing anxiety and depression symptoms (Cheng, 2001; Cheng et al., 1999, 2000; Fresco et al., 2006). In line with these findings, we can again infer that coping flexibility may serve as a protective factor for individuals to achieve positive emotion under stress.

Evoked Stress Influences Positive and Negative Emotions

In support of Hypothesis 7.1, positive stress-evoking events could increase positive emotion whereas negative stress-evoking events could reduce positive emotion. Hypothesis 7.2 was partially supported, by the finding that people experienced negative stress-evoking events reported more negative emotion than those who experienced positive stress-evoking events. The results supported the previous findings which argued that positive stressful events usually lead to positive feelings of happiness or excitement, whereas negative stressful events typically lead to negative feelings like sadness or anxiety (e.g., Adie et al., 2008; Ellis et al., 2009).

Threat Appraisal Mediates the Influence of Evoked Stress on Positive Emotion

In support of Hypothesis 8, the mediating effect of threat appraisal on the relation between evoked stress and positive emotion was verified in both the negative and positive stress conditions. Consistent with the findings of Study 1, the current study revealed that negative stress could decrease participants' positive emotion through increasing their threat appraisal. The negative impacts of threat appraisal on emotion under acute stress have been shown in many studies (Adie et al., 2008; Bryant et al., 2007; Cerin, 2003; Ellis et al., 2009;

Giacobbi, Tuccitto, & Frye, 2007). Moreover, our results suggested that stress could have positive effects on emotion, and this influence was also mediated by threat appraisal. To be specific, positive stress could increase participants' positive emotion through reducing their threat appraisal. The different effects of different types of stress on emotion may be explained by the components of instruction. Achievement goals in a motivational performance situation can influence individuals' emotions. An approaching goal was associated with positive emotion such as excitement and hope (Cerin, 2003; Dewar & Kavussanu, 2012; Kavussanu et al., 2014), and an avoidance goal was negatively associated with well-being (Adie et al., 2008); and this influence was mediated by appraisal (Kavussanu et al., 2014). Our findings extend the research by suggesting that an actual stressful event could exert positive or negative effects on emotions through lowering down or increasing threat appraisal. Hence, the instruction for an actual stressful event could have a different influence on emotion by altering threat appraisal.

Challenge Appraisal Does Not Mediate the Influence of Evoked Stress on Emotion

Contrary to Hypothesis 9, challenge appraisal did not mediate the relation between evoked stress and emotions, but it was associated with positive emotion. This finding was consistent with the finding of Study 1, which showed that challenge appraisal was not affected by cumulatively experienced stress but was associated with reduced negative emotional outcomes. The positive effects of challenge appraisal on emotion have been discussed in previous work (Blascovich et al., 2000; Blascovich & Tomaka, 1996; Cerin, 2003; Tomaka et al., 1993). A number of recent studies in sport context (e.g., Adie et al., 2008)

and academic context (e.g., Giacobbi et al., 2007) have showed that challenge appraisal is associated with positive emotions in an actual stressful situation. More importantly, our findings suggested that challenge appraisal might not be affected by the actual stressful situation regardless of types of instruction provided. It highlights the protective role of challenge appraisal, independent of threat appraisal, in enhancing positive emotion under acute stress.

A Negative Path and a Converted Positive Path

One interesting finding in Study 2 demonstrated that not all the stressful events result in negative emotional outcomes, on the contrary, some stressful events may lead individuals to positive emotional outcomes. Negative stressful events may aggravate one's threat appraisal which could further reduce positive emotion, suggesting that the negative path in the conceptual model was verified; in contrast, positive stressful events may lower one's threat appraisal and thus enhance positive emotion, indicating that the negative path could be converted to be a positive path. Threat appraisal acts as the mediator in both the negative path and the converted positive path. More importantly, the instruction for an upcoming stressful task plays an essential role in this process.

Instructions for an upcoming stressful situation may determine college students' threat appraisal and emotions. Specifically, positive instruction that emphasizes positive consequences, encourages approaching goals and adequate self-competence can lower down college students' threat appraisal and enhance their positive emotional outcomes. Our findings suggest that if educators lead students to worry about negative consequences (e.g., punishment), set up an avoidance goal, and negatively evaluate their self-competence, students may increase their threat appraisal and have more negative feelings. According to

Elliot and Church's (1997) hierarchical model of approach and avoidance achievement motivation, performance-avoidance goals direct individuals to fear of failure, low competence expectancies, poor graded performance as well as negative emotion (e.g., anxiety), whereas performance-approach goals direct individuals to high competence expectancies and thus enhance graded performance and positive emotion (e.g., excitement). Numerous studies have discussed the important roles of positive classroom instruction in promoting students' achievement outcomes. For example, Flink, Boggiano and Barrett's (1990) study showed that teachers' negative instruction with pressure may lead to impairment of students' self-determination and performance, by contrast, instruction supporting autonomy facilitate students' motivation and desire for challenge. Martin, Marsh, Williamson, and Debus' (2003) study emphasized the important roles of teachers' feedback and instruction delivery in students' performance and perceived control. In addition, in the sporting contexts, positive instruction for the upcoming sport task also show positive effects on athletes' emotions (Adie et al., 2008; Adie, Duda, & Ntoumanis, 2010). Therefore, in the educational context, when preparing for an upcoming task such as an examination, presentation, and competition, educators should encourage students to focus on the potential benefit of the task, guide them to building an approaching goal and evaluate their competence positively, in order to assist them in achieving positive adaptive adjustment.

Summary

The negative path of the conceptual model was verified: with threat appraisal as a mediator, different types of stress lead to different emotional outcomes. Negative stress exerts negative effects on positive emotion by

aggravating threat appraisal, whereas positive stress exerts positive effects on positive emotion by lowering threat appraisal. Instruction for an upcoming stressful task plays important roles in this process. In addition, not being affected by acute stress but being positively associated with positive emotion, challenge appraisal may act as a protective factor in an acute stressful situation to enhance positive emotion. The mediating role of threat appraisal and the protective role of challenge appraisal in the influence of stress on positive emotion, supported the literature which indicated that threat and challenge appraisals are relevant to psychological and emotional functioning. Hence, different levels of threat and challenge appraisals may explain why individuals have different emotional responses in the same objective situation. Lastly, consistent with the findings of Study 1, coping flexibility was not affected by evoked stress but associated with positive emotion, thus it may play a protective role in enhancing positive emotion under acute stress.

Limitations and Future Directions

There are some limitations that should be addressed when interpreting the effectiveness of stress manipulation in the current study.

First of all, in the present study, I only used task performance, positive and negative emotions, and threat and challenge appraisals as indicators to evaluate the effectiveness of manipulation. The manipulation check on the type of stress (negative or positive) was not included to evaluate whether the manipulation was successful, and the manipulation check on the three components including the goals, consequences, and self-competence could also be involved in this study. To be specific, I did not collect the data regarding the

extent to which participants perceived the upcoming task as “negative” or “positive”, the consequence as “negative” or “positive”, the extent to which they regarded goals as “avoidance” or “approaching”, or the extent to which they perceived their competence as “inadequate” or “adequate”. In future studies, we should do manipulation check of each component during instructions.

Additionally, although stress manipulation was effective in changing individuals’ threat appraisal and emotion, we cannot make a conclusion about which of the three components (i.e., goals, consequences, and self-competence) determines threat and challenge appraisals. To differentiate the effective components of appraisal and understand the appraisal process, future studies are required to separately manipulate each component.

Furthermore, in this study, stress-evoking situations elicited only threat appraisal but did not challenge appraisal as measured through a self-reported questionnaire. One reason to explain the nonsignificant effect of stress-evoking on challenge appraisal could be the different nature of threat appraisal and challenge appraisal reflected in self-reported measures. Another reason could be that threat and challenge appraisals are indeed influenced by or sensitive to different factors. Threat appraisal and challenge appraisal are characterized by negative or positive interpretation styles. To investigate the effects of challenge appraisal on behavioral and emotional response to stress, we can either adopt other measures (e.g., implicit measures and biological measures) to reflect threat and challenge appraisals, or adopt other methods (e.g., altering individuals’ interpreting styles) to induce threat and challenge appraisal in future studies.

Lastly, some measurements could be designed more carefully in future studies. The alpha coefficients for threat and challenge appraisals measures only lay on the low side of acceptable level (.68 and .70 for pre- and post-test threat appraisal; .70 and .73 for pre- and post-test challenge appraisal). The limited number of measurement items may account for the low but acceptable alpha coefficients. Threat appraisal and challenge appraisal in this study were only respectively measured by 2 items that were selected from the TCAS. In future studies, more items should be included in the threat and challenge appraisals measures to increase the internal consistency reliabilities. Moreover, in the coping flexibility measure, the hypothetical stressful scenarios were selected from the EMBSS which was a measure of coping by providing hypothetical stressful situations. However, some scenarios such as lay-off might not be highly relevant to college students. For future research, we can collect and design stressful scenarios which are more relevant to college students' daily stressors.

Implications

The present study not only supports the literature but also theoretically advances our understanding of the stress-appraisal-emotion link. First of all, this study extends the research by verifying the negative path in the conceptual model, especially the mediating roles of threat appraisal in the associations between stress and emotion. Secondly, this study filled in the gap concerning how characteristics of stressful situations influence threat and challenge appraisals as well as emotions among college students. Moreover, the current study provides a positive angle to look at stress by highlighting the positive

effects that stress could have on individuals' cognitive, behavioral, and emotional outcomes. Together, our findings inspire researchers to continue exploring from a positive perspective, the mechanism through which stress influences emotions; and from a comprehensive perspective, to investigate more protective factors that can facilitate positive psychological outcomes under stress.

From the practical perspective, this study also provides insights into future research and practice in various areas. The essential role of an instruction for a particular task in determining one's interpretation of stress (especially threat appraisal) and their emotions, is highlighted in this study. This study thus encourages a positive instruction in the educational, sporting, and workplace context. Most importantly, educators should guide students to focus on positive consequence (e.g., opportunities for growth), set up an approaching goal, and positively evaluate their self-competence in a stressful event, so as to reduce students' threat appraisal and enhance their positive feelings when facing stress. Moreover, challenge appraisal and coping flexibility, should be fostered in future interventions and training programs, in order to promote positive emotional outcomes under stress.

Conclusion

The main objective of Study 2 was to verify, through an experimental approach, the negative path in the conceptual model revealed in Study 1, specifically with regard to the mediating role of threat appraisal in the association between stress and emotions. The findings suggested that, various types of stress (positive and negative) have different influence on individuals'

appraisals and emotions; more importantly, our findings supported the negative path of the conceptual model revealed in Study 1. Threat appraisal serves as the mediator in the influence of stress on emotion, regardless of the type of stress. A negative stressful situation aggravates threat appraisal, which further intensifies negative emotion, whereas a positive stressful situation enhances positive emotion through which threat appraisal is reduced. Furthermore, it is interesting to discover that, instruction for an upcoming stressful task could determine the type of stress and thus influence students' appraisals and emotions. Negative consequence, negative goal, and low self-efficacy may induce a negative stressful situation, where threat appraisal and negative emotion may increase; on the other hand, positive consequence, positive goal, and high self-efficacy may induce a positive stressful situation, where threat appraisal may reduce and positive emotion may increase. Lastly, challenge appraisal and coping flexibility, both of which are not influenced by stress, may serve as the protective factors to facilitate positive emotion.

The negative path in the conceptual model, concerning the mediating role of threat appraisal in the influence of stress on emotions, has been verified in Study 2 through an experimental approach. The positive path in the conceptual model regarding the mediating role of coping flexibility in the influence of appraisals on emotions, also needs to be experimentally verified in Study 3. Hence, the next chapter reports Study 3, which aims to test, through an experimental approach, the positive path in the conceptual model.

CHAPTER 5

STUDY THREE: THE MEDIATING EFFECT OF COPING FLEXIBILITY ON THE RELATION BETWEEN CHALLENGE APPRAISAL AND EMOTION

Introduction

Study 1 revealed a mediation model showing that cumulative stress could influence individuals' emotional states via two paths, a negative path and a positive path. In the negative path, experienced stress aggravates negative emotional outcomes partially through increasing threat appraisal; in the positive path, challenge appraisal, which is not affected by experienced stress, reduces negative emotional outcomes fully through enhancing coping flexibility. Study 2 and Study 3 were designed to verify the two paths respectively. The negative path was verified in Study 2 using an experimental approach by manipulating stress, demonstrating that threat appraisal functioned as the mediator in the association between evoked stress and positive emotion regardless of the type of stress: negative stress decreased subjects' positive emotion through decreasing threat appraisal, while positive stress increased subjects' positive emotion through decreasing threat appraisal. The positive path needs to be tested in Study 3 experimentally. Hence, the main purpose of Study 3 is to verify the positive path in the conceptual model, to address the mediating role of coping flexibility in the relation between challenge appraisal and emotion. To be specific, Study 3 adopts an experimental approach to manipulate the levels of challenge appraisal, and investigate the effects of generated challenge appraisal on coping flexibility and emotions.

As discussed in the Chapter 2 literature review, CBM-I paradigms may be effective in generating challenge appraisals. The CBM-I program showed effectiveness in altering interpretation bias, reducing negative interpretation and enhancing positive interpretation (e.g., Hallion & Ruscio, 2011; Mathews & Mackintosh, 2000; Mathews & MacLeod, 2002; Menne-Lothmann et al., 2014; Telman et al., 2013). Hence, it is also expected that the CBM-I can modify the interpretation bias associated with stressful events. In other words, the effectiveness of CBM-I in enhancing challenge appraisal and reducing threat appraisal is expected. A large body of CBM research has shown the positive effects of CBM on reduced anxiety in clinical populations, such as a highly socially anxious population (Amir et al., 2009; Beard & Amir, 2009), people with trait anxiety (Salemink, van den Hout, & Kindt, 2009), people with Generalized Anxiety Disorder (Hayes, Hirsch, Krebs, & Mathews, 2010), and high worriers (Hirsch, Hayes, & Mathews, 2009). Moreover, modifying threat-related biases in interpretation can reduce global anxiety symptoms in clinically anxious populations, and in vulnerable samples prevent anxiety about an upcoming real-life stressful event (Hoppitt et al., 2014). Additionally, a few CBM programs that were conducted in nonclinical populations showed effectiveness in reducing negative reactions to upcoming stressful events. For example, a study discovered that participants in threat interpretation condition increased their anxiety level while responding to a film containing scenes of real-life accidents, compared to non-threat interpretation condition (Wilson, MacLeod, Mathews, & Rutherford, 2006), and the effects lasted more than 24 hours (Mackintosh, Mathews, Yiend, Ridgeway, & Cook, 2006). More importantly, the positive effects of CBM-I on reduced anxiety can be

transferred to changing environment and a later stressor, and thus CBM-I can modify stress vulnerability (Mackintosh et al., 2006).

Taken together, CBM-I is an effective preventive tool to modify cognitive response (i.e., interpretation bias) and emotional responses (e.g., anxiety) for both vulnerable populations and nonclinical populations. However, very few studies investigated the effects of CBM-I programs on behavioral response such as coping patterns and coping flexibility. Hence, the effects of CBM-I on coping behaviors need further investigation. Given the mediating role of coping flexibility in the influence of challenge appraisal and coping flexibility shown in Study 1, we can expect that when positive interpretation is fostered, coping flexibility may be promoted consequently, before the negative emotion decreases. Indeed, the positive association between positive appraisal and adaptive coping has been discussed in numerous studies (e.g., Blascovich & Mendes, 2000; Jones et al., 2009; Penley et al., 2002; Skinner et al., 2003), as has the negative association between adaptive coping and negative emotion (e.g., Blalock & Joiner Jr, 2000; Cheng, 2001; Cheng et al., 1999, 2000; Compas et al., 1988; Fleming et al., 1984; Fresco et al., 2006; Recklitis & Noam, 1999). It is thus expected that the positive effects of CBM-I can be extended to behavioral levels especially coping flexibility. In other words, the CBM-I program designed in the current study is expected to promote coping flexibility. Therefore, the present study aims to examine the effectiveness of cognitive bias modification program in boosting challenge appraisal, reducing threat appraisal, enhancing positive emotion and reducing negative emotion, as well as promoting coping flexibility.

Hypotheses

The main objective of this study was to verify the positive path revealed in Study 1. To be specific, this study aimed to examine the mediating effect of coping flexibility on the relation between challenge appraisal and emotions. The second aim of this study was to evaluate the effectiveness of a single-session training which was modified from the CBM-I program, in increasing challenge appraisal, coping flexibility, as well as positive emotion. Specifically, this study aimed to investigate whether CBM-I training program can enhance college students' challenge appraisal, and consequently lead to greater level of coping flexibility and more adaptive outcomes like positive emotion. A modified single-session CBM-I training condition was used to activate higher level of challenge appraisal in participants; additionally, as reference conditions, a negative training condition (which was used to induce lower level of challenge appraisal) and a mixed training condition (which was used to induce middle level of challenge appraisal) were included. A 3 (Training Condition: positive, negative vs. mixed) x 2 (Time: pre- vs. post-test) between- and within-subject mixed design was used.

The hypotheses included:

H10: The CBM-I training program should alter appraisals.

H10.1: The CBM-I training program should alter challenge appraisal.

H10.1.1: There should be between-subject difference in challenge appraisal: participants in the positive training condition should report more challenge appraisal compared

to those in the negative training condition who should report less challenge appraisal.

H10.1.2: There should be within-subject difference in challenge appraisal: compared to pre-training measures, after manipulation, (a) participants in the positive training condition would report more challenge appraisal; (b) participants in the negative training condition would report less challenge appraisal; and (c) participants in the mixed training condition would not change their challenge appraisal.

H10.2: The CBM-I training program should alter threat appraisal.

H10.2.1: There should be between-subject difference in threat appraisal: participants in the positive training condition should report less threat appraisal compared to those in the negative training condition who should report more threat appraisal.

H10.2.2: There should be within-subject difference in threat appraisal: compared to pre-training measures, after manipulation, (a) participants in the positive training condition would report less threat appraisal; (b) participants in the negative training condition would report more threat appraisal; and (c) participants in the mixed training condition would not change their threat appraisal.

H11: The CBM-I training program should influence coping flexibility.

H11.1: There should be between-subject difference in coping flexibility: participants in the positive training condition should show higher coping flexibility compared to those in the negative training condition who should show lower coping flexibility.

H11.2: There should be within-subject difference in coping flexibility: compared to pre-test, after manipulation, (a) participants in the positive training condition would show higher coping flexibility; (b) participants in the negative training condition would show lower coping flexibility; and (c) participants in the mixed training condition would not change their coping flexibility.

H12: CBM-I training should alter positive and negative emotions.

H12.1: CBM-I training should alter positive emotion.

H12.1.1: There should be between-subject difference in positive emotion: participants in the positive training condition should report more positive emotion compared to those in the negative training condition who should report less positive emotion.

H12.1.2: There should be within-subject difference in positive emotion: compared to pre-training measures, after manipulation, (a) participants in the positive training condition would report more positive emotion; (b) participants in the negative training condition would report less positive emotion; and (c) participants in the mixed training condition would not change their positive emotion.

H12.2: CBM-I training should alter negative emotion.

H12.2.1: There should be between-subject difference in negative emotion: participants in the positive training condition should report less negative emotion compared to those in the negative training condition who should report more negative emotion.

H12.2.2: There should be within-subject difference in negative emotion: compared to pre-training measures, after manipulation, (a) participants in the positive training condition would report less negative emotion; (b) participants in the negative training condition would report more negative emotion; and (c) participants in the mixed training condition would not change their negative emotion.

H13: Coping flexibility should mediate the relation between challenge appraisal and emotion.

H13.1: Challenge appraisal => increased coping flexibility => increased positive emotion.

H13.2: Challenge appraisal => increased coping flexibility => decreased negative emotion.

H14: Coping flexibility should mediate the relation between threat appraisal and emotion.

H14.1: Threat appraisal => decreased coping flexibility => decreased positive emotion.

H14.2: Threat appraisal => decreased coping flexibility => increased negative emotion.

Figure 16 provided the proposed models in this study.

Figure 16. The proposed mediation models in study 3: the mediating role of coping flexibility between challenge appraisal and positive emotion (A) and between challenge appraisal and negative emotion (B), the mediating role of coping flexibility between threat appraisal and positive emotion (C) and between threat appraisal and negative emotion (D).

Method

The first part of Study 3 was a pilot study to design training materials, and the second part was the formal training study.

Participants

Pilot study. To ensure that stressful scenarios in CBM-I training program are relevant to college students' concerns, a total of 20 undergraduate students (9 male and 11 female) were recruited for the pilot study. The mean age of the sample was 20.8 ($SD = 1.35$) with a range of 19-24 years. All participants were recruited from the research pool of Nanyang Technological University in Singapore, and received extra course credits for their participation in the pilot study.

Training study. Subjects were 86 undergraduate students³ (37 male and 49 female) with a mean age of 21.2 years ($SD = 1.24$, range 19-25) from Nanyang Technological University in Singapore. They received nominal financial compensation (SGD\$10) for their participation in the actual study. Participants were randomly assigned to one of three conditions: positive

³ The sample size required in this repeated measures within-between mixed design was estimated. Effect size $f = 0.25$, the threshold probability for rejecting the null hypothesis α (two-tailed) = 0.05, power $(1 - \beta) = 0.95$, the number of groups = 3, repetitions = 2, correlations among repeated measures $r = 0.5$, nonsphericity correction $\epsilon = 1$. With the above parameters, the minimum total sample size in this study should be $N = 66$, and the actual power would be 0.95.

condition ($N = 28$; 12 male and 16 female), negative condition ($N = 30$; 14 male and 16 female), and control condition ($N = 28$; 11 male and 17 female).

Instruments

Threat and challenge appraisals. Threat and challenge appraisals were assessed by the Threat and Challenge Appraisals Scale (TCAS), which was used in study 1. They were presented twice respectively before and after training.

Coping flexibility. Coping flexibility was measured by the coping flexibility questionnaire (in hypothetical scenarios) which was used in Study 2. Pre- and post-training coping flexibility was assessed.

Positive and negative emotion. Positive emotion was assessed by 4 items (“*happy*” “*cheerful*” “*energetic*” “*inspired*”), and negative emotion was assessed by 6 items (“*helpless*” “*tense*” “*nervous*” “*upset*” “*scared*” “*worried*”). They were ranked on four-point scales with “1” indicating “*does not fit at all*” and “4” indicating “*fits extremely well*”. The words were selected from the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). Participants reported their positive and negative emotions prior to and after training.

Cognitive bias modification for interpretation (CBM-I) materials. A modified CBM-I, based on the original program by Mathews and co-workers (Holmes & Mathews, 2005; Holmes, Mathews, Dagleish, & Mackintosh, 2006; Mathews & Mackintosh, 2000), was delivered online as a training program. Each participant was presented with 50 fictitiously stressful scenarios relevant to college students’ concerns (as discovered in the pilot study) which can be interpreted in either a positive or negative manner. The vignettes remained

ambiguous as to their outcomes until the final few words, which were presented as word fragments. By completing the to-be-completed words, the ambiguity of the stressful situation is resolved in a positive or a negative direction. All participants were required to read each vignette, vividly imagine themselves in, and complete the to-be-completed words. In the positive training condition, the word fragments resolved the ambiguity of each scenario in a benign way; in the negative training condition, the fragmentary words resolved the ambiguity in a negative way; in the mixed training condition, there were an equal number of positive resolutions and negative resolutions. The 25 scenarios in each direction were randomly selected from the scenarios in positive and negative training conditions. The examples of scenarios are presented in Table 11.

Table 11
Examples of Scenarios in Each Training Condition in Study 3

Condition	Positive Training	Negative Training	Mixed Training
Direction of Resolutions	The vignettes yielded consistently positive resolutions	The vignettes yielded consistently negative resolutions	
Example	Scenario: <i>“It is the first day of term, your new teacher asks everyone to stand up and introduce yourselves. After you have finished, you guess the others thought you sounded cl_v_r.”</i> Answer: <i>“clever”</i>	Scenario: <i>“It is the first day of term, your new teacher asks everyone to stand up and introduce themselves. After you have finished, you guess the others thought you sounded st_p_d.”</i> Answer: <i>“stupid”</i>	Half of the vignettes yielded positive resolutions, and the other half yielded negative resolutions

Study Design and Data Analyses Plan

The pilot study was designed to collect stressful scenarios relevant to college students’ daily life, which will be modified as CBM-I materials. All

participants in the pilot study are required to recall and report ten stressful events that they had experienced. The valid scenarios were used for the formal study.

The formal study mainly aims to verify the positive path in the conceptual model, and the mediating roles of coping flexibility in the association between appraisals and emotions. As coping flexibility was proposed as the mediator in the relations between appraisals and emotions, it is necessary to observe how the levels of coping flexibility change with the changes of challenge appraisal levels, and how emotions change with the changes of coping flexibility levels. Therefore, an experimental approach will be employed in Study 3, where challenge appraisal will be manipulated into three levels (high, low, vs. middle) in order to observe its influence on coping flexibility and emotions. To be specific, higher level of challenge appraisal will be generated by the CBM-I program which can be seen as positive training, whereas lower level and middle level of challenge appraisal will be generated by the negative training and mixed training respectively. Thus participants will be randomly assigned to one of the three training conditions (negative, positive vs. mixed). Prior to and after training, all participants respond to the measures twice, including threat and challenge appraisals, coping flexibility, and emotions.

This is a between- and within-subject repeated measures mixed design. Training condition (negative, positive vs. mixed) was designed as the between-subject factor, time acted as the within-subject factor. Dependent variables included threat and challenge appraisals, coping flexibility, and emotions. In addition, two versions (A and B) of coping flexibility measures were

respectively administered to all participants before or after manipulation. The presentation order of these two versions of coping flexibility measures was counterbalanced.

In accordance with the between- and within-subject repeated measures mixed design, repeated measures ANOVAs will be adopted, to examine the effects of condition (training) on appraisals, coping flexibility and emotions, the effects of time (before and after stress induction) on appraisals, coping flexibility and emotions, and to compare the changes of appraisals, coping flexibility and emotions with time between different stress conditions. Furthermore, to verify the mediation model, a mediation analyses will be used to reflect the mediating effects of coping flexibility in the associations between appraisals and emotions.

Procedure

Pilot study. To design the training materials, each participant was required to write down five positive stressful events that they had ever experienced involving positive feeling, positive thinking and positive resolutions, and five negative stressful events that they had ever experienced involving negative feeling, negative thinking, and negative resolutions. The stressful events collected from participants would be modified for CBM-I scenarios.

Training study. The formal training study was conducted through the Qualtrics survey platform. The pre- and post-tests, as well as the training instruction and materials were delivered online. All 86 participants were randomly assigned to one of the three training conditions (positive, negative, and mixed). They were emailed with the link for the whole study. All

participants indicated their informed consent and provided demographic information that included age, gender, and ethnicity. Prior to training (T1), they completed the threat and challenge appraisals scale, coping flexibility measure, and rated their positive and negative emotions. During training, each participant went through 50 vignettes by completing the fragmentary words. After training (T2), all participants again responded to the threat and challenge appraisals scale, coping flexibility measure, and positive and negative emotion scale. At the end of the experiment, they were presented with a debriefing form regarding the goal of this study. The procedure is presented in Figure 17.

Figure 17. Procedure of Study 3.

The design, procedure, and measurements in this study were approved by Institutional Review Board (IRB) in Nanyang Technological University.

Results

Preliminary Analyses

Internal consistency of study measures, descriptive statistics, and correlations among the study variables were tested.

Internal consistency of study measures. The Cronbach's alphas of pre- and post-training 4-item threat appraisal subscales were respectively 0.81 and 0.88, and those of pre- and post-training 8-item challenge appraisal subscales were respectively 0.81 and 0.86. The internal consistency was good for both threat appraisal and challenge appraisal subscales. The internal

consistency of positive emotion subscale with 4 items was good in both pre-test (Cronbach's $\alpha = 0.84$) and post-test (Cronbach's $\alpha = 0.89$), and the internal consistency of negative emotion scale with 6 items was also very good in both pre-test (Cronbach's $\alpha = 0.92$) and post-test (Cronbach's $\alpha = 0.94$).

Correlations among measured variables. The descriptive statistics results and correlations of the baseline measures in Study 3 are presented in Table 12. The correlation between T1 threat appraisal and T1 challenge appraisal was not significant ($r = -.17, p = .11$), and the result was consistent with the findings of Study 1 and Study 2; after training, the negative association between T2 threat appraisal and T2 challenge appraisal became significant ($r = -.30, p = .005$). The correlation between T1 positive emotion and T1 negative emotion was significant ($r = -.38, p < .001$), but after training, the negative correlation between T2 positive emotion and T2 negative emotion became nonsignificant ($r = -.19, p = .08$). In terms of the relationship between appraisals and emotion, T1 threat appraisal was associated negatively with T1 positive emotion ($r = -.38, p < .001$) and positively with T1 negative emotion ($r = .47, p < .001$), whereas T1 challenge appraisal was negatively associated with T1 negative emotion ($r = -.23, p = .04$). After training, T2 threat appraisal showed significant positive association with T2 negative emotion ($r = .40, p < .001$), but nonsignificant negative association with T2 positive emotion ($r = -.20, p = .07$), whereas T2 challenge appraisal was negatively associated with T2 negative emotion ($r = -.25, p = .02$). Lastly, coping flexibility showed significantly positive associations only with challenge appraisal at both time points (T1: $r = .31, p = .003$; T2: $r = .27, p = .01$).

Gender difference. To examine the gender differences in the main variables in Study 3, a MANOVA was run with gender as a fixed factor, and the dependent factors included baseline threat and challenge appraisals, coping flexibility, positive emotion and negative emotion. The results showed nonsignificant gender difference in all the above variables [threat appraisal: $F(1,85) = 0.24, p = .62$; challenge appraisal: $F(1,85) = 0.46, p = .50$; coping flexibility: $F(1,85) = 0.27, p = .61$; positive emotion: $F(1,85) = 0.40, p = .53$; negative emotion: $F(1,85) = 0.28, p = .60$].

Comparable baseline among three conditions. One-way (condition) ANOVA results showed that there was no difference between conditions in terms of all the baseline measures, including threat appraisal [$F(2, 83) = 0.79, p = .46, \eta_p^2 = .02$], challenge appraisal [$F(2, 83) = 0.38, p = .68, \eta_p^2 = .009$], positive emotion [$F(2, 83) = 1.15, p = .32, \eta_p^2 = .03$], negative emotion [$F(2, 83) = 1.09, p = .34, \eta_p^2 = .03$], and coping flexibility [$F(2, 83) = 0.33, p = .97, \eta_p^2 = .001$]. The above results suggested comparable baselines for all variables among three training conditions. The descriptive statistical results of study measures are shown in Table 13.

Table 12
Results for Descriptive Statistics and Correlations of Measures in Study 3

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	<i>M</i>	<i>SD</i>
	T1 TA	T1 CA	T1 CF	T1 PE	T1 NE	T2 TA	T2 CA	T2 CF	T2 PE	T2 NE		
1	-	-.17 (.11)	.11 (.34)	-.38*** (<.001)	.47*** (<.001)	.81*** (<.001)	-.26* (.02)	-.08 (.45)	-.29** (.008)	.32** (.003)	1.74	0.66
2		-	.31** (.003)	.06 (.57)	-.23* (.04)	-.23* (.04)	.83*** (<.001)	.26* (.02)	-.10 (.37)	-.27* (.01)	2.50	0.72
3			-	-.01 (.91)	-.03 (.76)	-.02 (.83)	.22* (.04)	.55*** (<.001)	-.004 (.97)	-.13 (.24)	3.62	1.60
4				-	-.49*** (<.001)	-.31*** (<.001)	.13 (.24)	-.13 (.22)	.81*** (<.001)	-.36** (.001)	2.80	1.06
5					-	.51*** (<.001)	-.24* (.03)	.12 (.26)	-.28* (.01)	.80*** (<.001)	1.35	0.71
6						-	-.30** (.005)	.27* (.01)	.09 (.42)	-.25* (.02)	2.60	0.68
7							-	-.04 (.75)	-.20+ (.07)	.40*** (<.001)	1.75	0.72
8								-	-.02 (.89)	-.01 (.90)	3.23	1.46
9									-	-.19 (.08)	2.62	1.14
10										-	1.15	0.61

Note. $N = 86$. p values were shown in parenthesis. * $p < .05$. ** $p < .001$. *** $p < 0.001$.

TA = threat appraisal. CA = challenge appraisal. PE = positive emotion. NE = negative emotion. CF = coping flexibility. T1 = Time 1. T2 = Time 2.

Table 13
Descriptive Statistics for Pre- and Post-Manipulation Measures in Study 3

	Positive Training (n = 28)		Negative Training (n = 30)		Mixed Training (n = 28)	
	T1	T2	T1	T2	T1	T2
Threat Appraisal	1.67 (0.53)	1.73 (0.63)	1.78 (0.52)	1.71 (0.61)	1.88 (0.76)	1.77 (0.81)
Challenge Appraisal	2.79 (0.57)	2.96 ^{a*} (0.55)	2.92 (0.53)	2.84 (0.60)	2.82 (0.57)	2.86 (0.55)
Coping Flexibility	3.68 (1.77)	3.89 (1.75)	3.60 (1.71)	2.77 ^{b**} (0.77)	3.57 (1.35)	3.07 (1.51)
Positive Emotion	2.78 (1.15)	2.84 (1.31)	3.02 (0.95)	2.53 ^{b**} (1.03)	2.60 (1.07)	2.49 (1.09)
Negative Emotion	1.51 (0.79)	1.20 ^{b**} (0.64)	1.29 (0.62)	1.10 ^{b*} (0.53)	1.26 (0.71)	1.17 (0.68)

Note. Standard deviations were shown in parenthesis.

^a-significantly higher than baseline. ^b-significantly lower than baseline. * $p < .05$.

** $p < .01$. *** $p < .001$.

Manipulation Check

As CBM-I was expected to generate challenge appraisal, I used challenge appraisal and threat appraisal as the indicators for manipulation check. Two repeated measure ANOVAs were carried out, respectively, on threat appraisal and challenge appraisal with training condition (positive, negative vs. mixed) as the between-subject factor.

Effects of CBM-I on threat appraisal. The main effect of Time [$F(1, 83) = 0.71, p = .40, \eta_p^2 = .009$], the main effect of Condition [$F(2, 83) = 0.28, p = .76, \eta_p^2 = .007$], and the interaction effect of Time and Condition [$F(2, 83) = 1.33, p = .27, \eta_p^2 = .03$] on threat appraisal were not significant. In terms of between-subject differences, there was no significant difference in post-test threat appraisal between conditions ($ps > .10$). In terms of within-subject difference, no change of threat appraisal from pre- to post-test was observed in any of the three training conditions ($ps > .10$). The changes of threat appraisal

with time in the three training conditions are presented in Figure 18a. The results indicated that training programs did not alter threat appraisal.

Effects of CBM-I on challenge appraisal. The main effect of Time [$F(1, 83) = 1.98, p = .16, \eta_p^2 = .02$] and the main effect of Condition [$F(2, 83) = 0.05, p = .95, \eta_p^2 = .001$] were not significant, but the interaction effect of Time and Condition was significant [$F(2, 83) = 4.65, p = .01, \eta_p^2 = .10$] on challenge appraisal. The interaction effect suggested that the degree of changes in challenge appraisal depends on the training condition. In terms of between-subject difference, there was no significant difference in post-test challenge appraisal between conditions ($ps > .10$). To further investigate the interaction effect, paired sample t-tests were conducted. The significant level for alpha value was adjusted to $.05/3 = .017$. The results demonstrated that challenge appraisal increased in the positive training condition ($\Delta M = 0.17, SE = .06, t = 2.66, p = .01$), but no changes were observed in the negative training condition ($\Delta M = -0.08, SE = .05, t = -1.54, p = .13$) or mixed training condition ($\Delta M = 0.05, SE = .47, t = 1.15, p = .26$). The changes of challenge appraisal with time in the three training conditions are presented in Figure 18b. The results suggested that positive training had a positive effect on challenge appraisal.

Figure 18a. The changes of threat appraisal with time in three training conditions

Figure 18b. The changes of challenge appraisal with time in three training conditions

To summarize, CBM-I (i.e., positive training) improved individuals' challenge appraisal. Therefore, the manipulation was successful.

Effects of CBM-I Program on Coping Flexibility

A repeated measure ANOVA was conducted with training condition (positive, negative, vs. mixed) as between-subject variable, and repeated

measured coping flexibility as a dependent variable. The changes of coping flexibility from pre- to post-test in three training conditions are shown in Figure 19. No significant main effect of Condition [$F(2, 83) = 1.59, p = .21, \eta_p^2 = .04$] was found, but there was a significant main effect of Time [$F(1, 83) = 6.05, p = .02, \eta_p^2 = .07$] and a significant interaction effect of Condition and Time [$F(2, 83) = 4.17, p = .02, \eta_p^2 = .09$]. The significant interaction effect between condition and time indicated that changes of coping flexibility from pre- to post-test differed in three training conditions. I therefore investigated the effect of time in each condition. The paired t-test results showed that participants in the negative condition significantly dropped their coping flexibility after training ($\Delta M = -0.83, SE = 0.28, t = 2.93, p = .006$); and no changes of coping flexibility were observed in the positive training condition or the mixed training condition. In terms of between-subject differences in post-test coping flexibility, no significant difference was observed between conditions.

Figure 19. The changes of coping flexibility with time in three training conditions

In summary, negative training reduced participants' coping flexibility, and participants who received positive training maintained their coping flexibility, showing better post-test coping flexibility compared to those who received negative training.

Effects of CBM-I Program on Emotion

Two separate repeated measure ANOVAs with training condition (positive, negative vs. mixed) as the between-subject factor, were applied on positive emotion and negative emotion, respectively.

Effects of CBM-I on positive emotion. There was a significant main effect of Time [$F(1, 83) = 6.34, p = .01, \eta_p^2 = .07$] and a nonsignificant main effect of Condition [$F(2, 83) = 0.52, p = .60, \eta_p^2 = .01$] on challenge appraisal, and the interaction effect of Time and Condition was found to be significant [$F(2, 83) = 5.43, p = .006, \eta_p^2 = .12$]. In terms of between-subject differences, there was no significant difference in post-test positive emotion between conditions ($ps > .10$). The interaction effect suggested that the degree of changes in positive emotion depends on the training condition. To further investigate the interaction effect, three paired sample t-tests were conducted (the significant level of alpha value was adjusted to $.05/3 = .017$). The results demonstrated that positive emotion did not change in positive training condition ($\Delta M = 0.06, SE = .13, t = 0.48, p = .64$) or mixed training condition ($\Delta M = -0.11, SE = .10, t = 1.11, p = .28$), but decreased in negative training condition ($\Delta M = -0.49, SE = .14, t = 3.62, p = .001$). The changes of positive emotion with time in three training conditions are presented in Figure 20a. The results suggested that negative training had a negative impact on positive emotion.

Effects of CBM-I on negative emotion. There was a significant main effect of Time [$F(1, 83) = 18.8, p < .001, \eta_p^2 = .19$] and a nonsignificant main effect of Condition [$F(2, 83) = 0.55, p = .58, \eta_p^2 = .01$]. The interaction effect of Time and Condition [$F(2, 83) = 1.98, p = .15, \eta_p^2 = .05$] was not significant. In terms of between-subject differences, there was no significant difference in post-test negative emotion between conditions ($ps > .10$). In terms of within-subject difference (the significant level for alpha value was adjusted to $.05/3 = .017$), there was a significant reduction of negative emotion in both positive training condition ($\Delta M = -0.32, SE = .10, t = -3.06, p = .005$) and negative training condition ($\Delta M = -0.18, SE = .07, t = -2.50, p = .02$); but no change was observed in the mixed training condition ($\Delta M = -0.09, SE = .05, t = -1.80, p = .08$). The changes of negative emotion with time in the three training conditions are presented in Figure 20b. The results indicated that the three training conditions decreased negative emotion.

Figure 20a. The changes of positive emotion with time in three training conditions

Figure 20b. The changes of negative emotion with time in three training conditions

To summarize, participants who received negative training decreased their positive emotion compared to baseline, and participants in both the positive and negative training conditions decreased their negative emotion after training.

Mediation Effects of Coping Flexibility on the Relation between Appraisals and Emotion

The purpose of Study 3 was to verify the positive path revealed in Study 1 concerning the mediating role of coping flexibility in the influence of challenge appraisal on emotion. The ANOVA results indicated that, challenge appraisal could be improved by positive training, but threat appraisal was not influenced by any training condition. Process procedure (Hayes, 2014) via SPSS 21.0 was used to examine the proposed mediation models separately in three conditions. T2 challenge appraisal and T2 threat appraisal acted as

predictors, T2 coping flexibility was treated as a mediator, and T2 positive emotion and negative emotion were entered as dependent variables.

Mediation models in the positive training condition. In the positive training condition, the path from post-training challenge appraisal to coping flexibility ($\beta = 1.24, p = .04$) was significant, but the path from post-training challenge appraisal to positive emotion ($\beta = 0.86, p = .08$) and that from coping flexibility to positive emotion ($\beta = 0.29, p = .06$) was not significant. The direct effect of challenge appraisal on positive emotion was not significant ($\beta = 0.86, SE = 0.47, t = 1.81, p = .08$) with $CI[-0.11, 1.83]$, but the indirect effect via coping flexibility ($\beta = 0.36, SE = 0.22$) was significant with $CI[0.05, 0.94]$. Regarding the mediating effect of coping flexibility on the relation between challenge appraisal and negative emotion, all the paths were not significant ($ps > .10$). The results suggested coping flexibility only mediated the relation between challenge appraisal and positive emotion. In terms of the mediating effect of coping flexibility on the relation between threat appraisal and positive emotion, all the paths were not significant ($ps > .10$). As for the mediating effects on the relation between threat appraisal and negative emotion, none of the paths was significant. The coefficients are presented in Table 14. Our results (see Figure 21) showed that coping flexibility did not mediate the negative effect of threat appraisal on emotion.

Table 14

Coefficients and Significant Levels for the Paths of Mediation Model in the Positive Training Condition in Study 3

Parameter estimate	β	t	p
Model A: Challenge Appraisal – Coping Flexibility – Positive Emotion			
T2 Challenge Appraisal → T2 Coping Flexibility	1.24*	2.15	.04
T2 Challenge Appraisal → T2 Positive Emotion	0.86	1.82	.08
T2 Coping Flexibility → T2 Positive Emotion	0.29	1.95	.06
Model B: Challenge Appraisal – Coping Flexibility – Negative Emotion			
T2 Challenge Appraisal → T2 Coping Flexibility	1.24*	2.15	.04
T2 Challenge Appraisal → T2 Negative Emotion	-0.07	-0.29	.77
T2 Coping Flexibility → T2 Negative Emotion	-0.02	-0.20	.84
Model C: Threat Appraisal – Coping Flexibility – Positive Emotion			
T2 Threat Appraisal → T2 Coping Flexibility	-0.005	-0.009	.99
T2 Threat Appraisal → T2 Positive Emotion	-0.53	-1.36	.20
T2 Coping Flexibility → T2 Positive Emotion	-0.18	-1.32	.19
Model D: Threat Appraisal – Coping Flexibility – Negative Emotion			
T2 Threat Appraisal → T2 Coping Flexibility	-0.005	-0.009	.99
T2 Threat Appraisal → T2 Negative Emotion	0.37	1.95	.06
T2 Coping Flexibility → T2 Negative Emotion	-0.02	-0.36	.72

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

Table 15

Coefficients and Significant Levels for the Paths of Mediation Model in Negative Training Condition in Study 3

Parameter estimate	β	t	p
Model A: Challenge Appraisal – Coping Flexibility – Positive Emotion			
T2 Challenge Appraisal → T2 Coping Flexibility	-0.29	-1.24	.22
T2 Challenge Appraisal → T2 Positive Emotion	-0.17	-0.50	.62
T2 Coping Flexibility → T2 Positive Emotion	0.08	0.31	.76
Model B: Challenge Appraisal – Coping Flexibility – Negative Emotion			
T2 Challenge Appraisal → T2 Coping Flexibility	-0.29	-1.24	.22
T2 Challenge Appraisal → T2 Negative Emotion	-0.13	-0.80	.43
T2 Coping Flexibility → T2 Negative Emotion	0.24	1.92	.07
Model C: Threat appraisal – Coping Flexibility – Positive Emotion			
T2 Threat Appraisal → T2 Coping Flexibility	0.30	1.28	.21
T2 Threat Appraisal → T2 Positive Emotion	0.06	0.18	.86
T2 Coping Flexibility → T2 Positive Emotion	0.10	0.38	.71
Model D: Threat appraisal – Coping Flexibility – Negative Emotion			
T2 Threat Appraisal → T2 Coping Flexibility	0.30	1.28	.21
T2 Threat Appraisal → T2 Negative Emotion	0.31*	2.12	.04
T2 Coping Flexibility → T2 Negative Emotion	0.20	1.74	.09

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

Figure 21. The final mediation models in the positive training condition: coping flexibility fully mediates the relation between challenge appraisal and positive emotion (A), but it does not mediate the relation between challenge appraisal and negative emotion (B), that between threat appraisal and positive emotion (C) nor that between threat appraisal and negative emotion (D).

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

Mediation models in negative training condition. In the negative training condition, regarding the mediating effect of coping flexibility on the relation between challenge appraisal and positive emotion, all the paths were not significant ($ps > .10$). As for the mediating effect of coping flexibility on the relation between challenge appraisal and negative emotion, none of the paths was significant ($ps > .05$). The results suggested coping flexibility did not mediate the relation between challenge appraisal and emotion in negative training condition. In terms of the mediating effect of coping flexibility on the relation between threat appraisal and positive emotion, none of the paths were significant ($ps > .10$). As for the mediating effects on the relation between threat appraisal and negative emotion, the path from threat appraisal to negative emotion was significant ($\beta = 0.31, p = .04$), but the path from coping flexibility to negative emotion ($\beta = 0.20, p = .09$) and that from threat appraisal to coping flexibility ($\beta = 0.30, p = .21$) were not significant. The direct effect of threat appraisal on negative emotion was significant ($\beta = 0.31, SE = 0.15, p = .04, CI[0.009, 0.61]$), but the indirect effect of threat appraisal on negative emotion via coping flexibility was not significant ($\beta = 0.06, SE = 0.07, CI[-0.02, 0.28]$). The coefficients are presented in Table 15. The results (see Figure 22) showed that coping flexibility did not mediate the relation between appraisal and emotion in negative training condition.

Figure 22. In negative training condition, coping flexibility did not mediate the relation between challenge appraisal and positive emotion (A), between challenge appraisal and negative emotion (B), between threat appraisal and positive emotion (C) nor between threat appraisal and negative emotion (D).
Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Mediation models in the mixed training condition. In the mixed training condition, with regard to the mediating effect of coping flexibility on the relation between challenge appraisal and positive emotion, the path from challenge appraisal to coping flexibility was significant ($\beta = 1.18, p = .02$), and the path from coping flexibility to positive emotion and that from challenge appraisal to positive emotion were not significant ($ps > .10$). As for the mediating effect of coping flexibility on the relation between challenge appraisal and negative emotion, the path from challenge appraisal to coping flexibility ($\beta = 1.18, p = .02$) and the path from challenge appraisal to negative emotion ($\beta = -0.62, p = .02$) were significant, but the path from coping flexibility to negative emotion was not significant ($\beta = 0.05, p = .57$). The results suggested that challenge appraisal directly decreased negative emotion in mixed training condition, but coping flexibility did not mediate the relation between challenge appraisal and emotion. In terms of the mediating effect of coping flexibility on the relation between threat appraisal and positive emotion, while the path from threat appraisal to positive emotion, that from threat appraisal to coping flexibility, as well as that from coping flexibility to positive emotion were not significant ($ps > .05$). As for the mediating effects on the relation between threat appraisal and negative emotion, the path from threat appraisal to negative emotion ($\beta = 0.34, p = .04$) was significant, but the path from threat appraisal to coping flexibility and that from coping flexibility to negative emotion were not significant ($ps > .10$). The coefficients are presented in Table 16. The results (see Figure 23) showed that in mixed training condition, threat appraisal increased negative emotion, but coping flexibility did not mediate the relation between threat appraisal and emotion.

To summarize, the mediating effect of coping flexibility on the relation between challenge appraisal and positive emotion was verified in the positive training condition, and the effects of threat appraisal on increasing negative emotion were found in all the three training conditions.

Table 16
Coefficients and Significant Levels for the Paths of Mediation Model in Mixed Training Condition in Study 3

Parameter estimate	β	t	p
Model A: Challenge Appraisal – Coping Flexibility – Positive Emotion			
T2 Challenge Appraisal → T2 Coping Flexibility	1.18*	2.42	.02
T2 Challenge Appraisal → T2 Positive Emotion	0.19	0.44	.66
T2 Coping Flexibility → T2 Positive Emotion	0.06	0.35	.73
Model B: Challenge appraisal – Coping Flexibility – Negative Emotion			
T2 Challenge Appraisal → T2 Coping Flexibility	1.18*	2.42	.02
T2 Challenge Appraisal → T2 Negative Emotion	-0.62*	-2.55	.02
T2 Coping Flexibility → T2 Negative Emotion	0.05	0.57	.57
Model C: Threat appraisal – Coping Flexibility – Positive Emotion			
T2 Threat Appraisal → T2 Coping Flexibility	-0.35	-0.98	.34
T2 Threat Appraisal → T2 Positive Emotion	-0.45	-1.76	.09
T2 Coping Flexibility → T2 Positive Emotion	0.04	0.29	.78
Model D: Threat appraisal – Coping Flexibility – Negative Emotion			
T2 Threat Appraisal → T2 Coping Flexibility	-0.35	-0.98	.34
T2 Threat Appraisal → T2 Negative Emotion	0.34*	2.21	.04
T2 Coping Flexibility → T2 Negative Emotion	-0.01	-0.13	.89

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

Figure 23. In mixed training condition, coping flexibility did not mediate the relation between challenge appraisal and positive emotion (A), between challenge appraisal and negative emotion (B), between threat appraisal and positive emotion (C) nor between threat appraisal and negative emotion (D). *Note.* * $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

The main purpose of the present study was to assess the mediating role of coping flexibility in the relation between challenge appraisal and emotion, by experimentally manipulating participants' appraisal. This study also aimed to examine the effectiveness of CBM-I program in boosting challenge appraisal and reducing threat appraisal.

I discovered the following:

H10 was partially support. The CBM-I training only altered challenge appraisal but not threat appraisal.

H10.1 was supported. The CBM-I training altered challenge appraisal.

H10.1.1 was rejected. There was no between-subject difference in challenge appraisal, that is, participants in the positive training condition did not report more challenge appraisal compared to those in the negative training condition.

H10.1. 2 was partially supported. The within-subject difference in challenge appraisal was observed only in positive training condition. Compared to pre-manipulation measures, after manipulation, (a) participants in the positive training condition reported more challenge appraisal; (b) participants in the negative training condition did not report less challenge appraisal; and (c) participants in the mixed training condition did not change their challenge appraisal.

H10.2 was rejected. The CBM-I training did not alter threat appraisal.

H10.2.1 was rejected. There was no between-subject difference in threat appraisal; that is, participants in the positive training condition did not report less threat appraisal compared to those in the negative training condition.

H10.2.2 was rejected. There was no within-subject difference in threat appraisal; that is, compared to pre-training measures, participants in all the training conditions including the positive training condition, the negative training condition and the mixed training condition did not change their threat-appraisal after training.

H11 was supported. The CBM-I training affected coping flexibility.

H11.1 was partially supported. There was between-subject difference in coping flexibility; in particular, participants in the positive training condition showed near-significant higher coping flexibility compared to those in the negative training condition who showed lower coping flexibility.

H11.2 was partially supported. The within-subject difference was only observed in coping flexibility. Compared to pre-test, after manipulation, (a) participants in the positive training condition did not change their coping flexibility; (b) participants in the negative training condition showed lower coping flexibility; and (c) participants in the mixed training condition did not change their coping flexibility.

H12 was supported. The CBM-I training influenced positive and negative emotion.

H12.1 was supported. The CBM-I training influenced positive emotion.

H12.1.1 was rejected. There was no between-subject difference in positive emotion; that is, participants in the positive training condition did not report more positive emotion compared to those in the negative training condition.

H12.1.2 was partially supported. The within-subject difference in positive emotion was observed only in the positive training condition; that is, compared to pre-manipulation measures, after manipulation, (a) participants in the positive training condition did not report more positive emotion; (b) participants in the negative training condition reported less positive emotion; and (c) participants in the mixed training condition did not change their positive emotion.

H12.2 was supported. The CBM-I training influenced negative emotion.

H12.2.1 was rejected. There was no between-subject difference in negative emotion; that is, participants in the positive training condition reported less negative emotion compared to those in the negative training condition.

H12.2.2 was partially supported. There should be within-subject difference in negative emotion: compared to pre-

manipulation measures, after manipulation, (a) participants in the positive training condition reported less negative emotion; (b) participants in the negative training condition did not report more negative emotion; and (c) participants in the mixed training condition would not change their negative emotion.

H13 was supported. Coping flexibility mediated the relation between challenge appraisal and emotion.

H13.1 was supported (see Figure 24a). In positive training condition, challenge appraisal increased coping flexibility, and further increased positive emotion.

H13.2 was rejected. Coping flexibility did not mediate the influence of challenge appraisal on negative emotion.

H14 was rejected. Coping flexibility did not mediate the relation between threat appraisal and emotion.

H14.1 was rejected. Threat appraisal did not mediate the influence of threat appraisal on positive emotion.

H14.2 was rejected (see Figure 24b). In all the three training conditions, threat appraisal increased negative emotion, but this effect was not mediated by coping flexibility.

Figure 24. The final mediation models in Study 3: coping flexibility fully mediates the relation between challenge appraisal and positive emotion. Solid lines indicates the hypothesized paths that were supported (A); threat appraisal increased negative emotion, but coping flexibility did not serve as mediator (B).

In line with the hypotheses, participants were successfully trained to enhance challenge appraisal. Consistent with previous work, CBM-I program also had positive effects on emotions. In addition, the present research extended the literature by revealing that CBM-I program could even improve participants' coping flexibility. More importantly, the positive path in which coping flexibility mediates the positive influence of challenge appraisal on positive emotion, was verified in the current study.

CBM-I Program Influences Challenge Appraisal but Not Threat Appraisal

Hypothesis 10 regarding the effects of CBM-I on appraisals was partially supported. In support with Hypothesis 10.1, our results showed that participants in the positive training condition reported higher levels of challenge appraisal compared to baseline levels. In comparison, negative

training and mixed training did not change participants' challenge or threat appraisals. However, Hypothesis 10.2 was rejected, as CBM-I did not alter threat appraisal.

CBM-I program boosts challenge appraisal. Our findings suggested that CBM-I may be effective in enhancing participants' challenge appraisal, which is basically positive interpretation of stressful events. Some recent research has documented the effects of CBM-I on positive interpretation and negative interpretation. For example, Telman, Homes, and Lau (2013) claimed that participants in the CBM-I program not only endorsed more positive interpretation but also less negative interpretation of ambiguous material compared to those in the negative condition. Our findings indicated that, with the assistance of CBM-I—specifically, by providing positive resolutions in hypothetical stressful real-life scenarios—individuals can be trained to interpret stressful events in a positive manner. The positive interpretation induction in each scenario can add up to a greater endorsement of positive “foils” (Telman et al., 2013) and can further transfer to challenge appraisal of general stressful situations. In conclusion, participants in the positive training condition tend to engage in challenge appraisal toward general real-world stressful situations. Thus, challenge appraisal can be promoted by interpretation bias modification training such as CBM-I programs.

CBM-I program does not alter threat appraisal. No changes in threat appraisal were observed in any training condition in the present study. To be specific, the positive training didn't decrease threat appraisal, and the negative training didn't increase threat appraisal. The nonsignificant influence of training on threat appraisal may be explained by the stressful scenarios in the

training program. The scenarios selected in the current training study were modified from the stressful events collected from college students in the pilot study. In this sense, the scenarios relevant to college students' concerns may not be "ambiguous" enough as described by the original CBM paradigm. According to Beck and Clark's information processing theory, a rapid and automatic process occurs after receiving the incoming information. This automatic process involved the image of potential threat and damage of the stimuli, and primary threat appraisal of the stimuli. The findings of Study 1 and Study 2 also suggested that threat appraisal might be more sensitive to environmental characteristics like instruction for an upcoming task as well as the stressful experience. Hence, the stressful scenarios used in the training may immediately induce participants' automatic negative cognitive response, like threat appraisal, before they complete the word fragment which indicates the resolution as positive or negative. On the contrary, challenge appraisal is more sensitive to personal interpretative styles, but not affected by experienced stress or the instruction for a particular stressful event. Additionally, the limited number of training session may account for the limited effectiveness in lowering down threat appraisal. In the previous research (e.g., Hoppitt et al., 2014; Mathews, Ridgeway, Cook, & Yiend, 2007; Salemink et al., 2009; See, MacLeod, & Bridle, 2009), CBM-I programs exert effects on negative interpretation bias, usually over multiple training sessions.

The different effects of the training program on threat and challenge appraisals again support the arguments in the previous two studies, that threat appraisal and challenge appraisal may be independent of each other.

CBM-I Program Exerts Positive Effect on Coping Flexibility

Critically, the effects of a CBM-I program were found to be able to extend to coping flexibility, and thus Hypothesis 11 was supported. Specifically, participants who received positive training reported higher levels of coping flexibility in hypothesized stressful situations, compared to those received negative training and mixed training. In comparison, participants in the negative training condition dropped their levels of coping flexibility compared to baseline levels. Given that negative training reduced participants' coping flexibility, and even mixed training (as a reference group) showed a near-significant reduction of coping flexibility, the finding that positive training could maintain participants' coping flexibility in hypothetical stressful scenarios from pre- to post-manipulation, indeed suggested the positive effects of CBM-I on coping flexibility, despite this one-session CBM-I program not improving coping flexibility. The training materials used in this study were associated with daily stressors that college students are often confronted with. Reading and imagining vividly to oneself in those stressful scenarios may implicitly expose college students to stressful situations. The exposure to negative resolutions of stressful events presented in the negative training condition might lower individuals' coping flexibility in other hypothetical stressful situations, compared to their baseline coping flexibility; in contrast, the exposure to positive resolutions of stressful events that were presented in the positive training condition may maintain individuals' coping flexibility. In other words, CBM-I can assist individuals in fully utilizing their coping potentials to deal with various stressful events. Therefore, we can infer that

coping flexibility can be improved when an individual is trained to interpret stressful situations in a positive manner.

CBM-I Program Enhances Positive Emotion and Reduces Negative Emotion

Hypothesis 12 concerning the effects of CBM-I on emotions was supported. In partial support of Hypothesis 12.1, I found that, when facing hypothetical stressful scenarios, participants in the positive training condition could maintain positive emotion level compared to baseline levels, whereas participants in the negative training condition reported significantly decreased positive emotion. In support of Hypothesis 12.2, participants in the positive training condition reported less negative emotions after training, compared to baseline.

The findings implied that CBM-I program may have positive effects on emotions. The effectiveness of CBM-I on emotions shown in this study, was to some degree fairly consistent with previous research which has suggested the preventive effects of CBM programs on emotional development and emotional outcomes, for both vulnerable populations and nonclinical populations. For example, CBM programs can be effective in reducing global symptoms of anxiety in highly anxious populations over multiple sessions (Beard & Amir, 2008; Mathews et al., 2007; Salemink et al., 2009). CBM program was furthermore found to be effective in reducing anxiety associated with real-life stressors (See et al., 2009), whereas negative conditions predicted elevations in negative emotions (Telman et al., 2013). Moreover, a study conducted by Hoppitt and co-workers (2014) showed that CBM-I could prevent negative emotions, including anxiety and social evaluative fear associated with a

forthcoming real-life stress event (starting university) among college students. This study not only supported the previous findings that CBM-I be delivered effectively online to exert positive effects on emotions (Hoppitt et al., 2014; See et al., 2009), but also further extended the research by revealing the effectiveness of CBM-I in maintaining positive emotion in hypothetical stressful real-life events.

Coping Flexibility Mediates the Influence of Challenge Appraisal on Positive Emotion

The main purpose of the current study was to verify the positive path revealed in Study 1. To be specific, Study 1 aimed to examine the mediating effect of coping flexibility on the relation between challenge appraisal and positive emotion. Aligned with Hypothesis 14, coping flexibility was found to mediate the influence of challenge appraisal on positive emotion, despite this mediating path being only significant in the positive training condition. In particular, it was found that increased challenge appraisal could promote coping flexibility which could further enhance positive emotion. In terms of the influence of challenge appraisal on coping flexibility and emotions suggested in this study, appraisals have been shown in previous work to be able to determine individuals' coping behaviors and emotional outcomes (e.g., Lowe et al., 2008). Several studies (e.g., Blascovich et al., 2000; Jones et al., 2009; Skinner et al., 2003) have revealed the association between challenge appraisal and adaptive coping, and that between threat appraisal and maladaptive coping. Given that coping flexibility is characterized by adaptive coping, the above findings implied an association between challenge appraisal and coping flexibility. There have also been a few studies (e.g., Fresco et al., 2006) suggesting the

roles of coping flexibility in lowering negative emotion, such as anxiety and depression symptoms. Furthermore, Williams's (2002; 2006) studies illustrated that coping flexibility could moderate the negative impact of cognitive vulnerabilities on anxiety and depression symptom. Taken together, it can be expected that the influence of appraisal on emotion may be mediated by coping flexibility. Nonetheless, relatively few studies have examined the mediating effect of coping flexibility on the relation between challenge appraisal and adjustment outcomes. The current study extends the research by linking coping flexibility, challenge and threat appraisals, and emotions in the same model, and by revealing the mediating role of coping flexibility in the relation between challenge appraisal and positive emotion. Moreover, the proactive role of coping flexibility in enhancing positive emotion is also highlighted in the present study.

Summary

As discussed above, the CBM-I training associated with stressful scenarios, which aims to modify negative interpretation bias relevant to stress, was effective in enhancing college students' challenge appraisal, and maintaining their coping flexibility and positive emotion when confronted with stressful situations. More importantly, the positive path in the conceptual model, concerning the mediating role of coping flexibility in the influence of challenge appraisal on positive emotion, was verified. Finally, the present study implied that, the two protective factors of challenge appraisal and coping flexibility (proved by studies 1, 2, and 3) can be trained by a modified cognitive bias modification program which focused on stress-related interpretation.

Limitations and Future Directions

Several limitations should be addressed when interpreting the effectiveness of the modified CBM-I program in the current study.

Limited Number of Training Sessions

The current study used single-session CBM-I program as manipulation and appraisal induction. In support of the hypotheses, positive CBM-I could increase challenge appraisal, and prevent participants from dropping coping flexibility compared to those in the control condition and negative condition; nonetheless, positive CBM-I did not improve coping flexibility. The limited number of sessions (i.e., one session) may also account for the limited effects of CBM-I on coping flexibility being maintaining, but not improved. Successful CBM-I programs in previous research were usually comprised of multiple sessions, showing effectiveness in lowering down trait anxiety (e.g., Mathews et al., 2007; Salemink et al., 2009). CBM-A programs has also shown the effectiveness in both clinical and nonclinical samples over multiple sessions. For example, in a few studies conducted in 2009 (Amir et al., 2009; Schmidt, Richey, Buckner, & Timpano, 2009), eight 20-minute sessions succeeded in reducing anxiety among individuals with generalized anxiety disorder. In other research, 15 daily training sessions (See et al., 2009) and 5 online training sessions (Hoppitt et al., 2014) were effective in reducing nonclinical college students' threat-related attentional bias and lowering their trait anxiety level while they were responding to the real-life event of moving to a new city. The meta-analysis on CBM-I (Menne-Lothmann et al., 2014) concluded that larger numbers of training sessions were related to larger cognitive mood effects. Hence, in future study, we should enlarge the number of CBM-I sessions for

training purposes and extend the training period to maximize the efficacy of CBM-I program on enhancing challenge appraisal and promoting coping flexibility.

The Relationship between Interpretation Bias and Challenge Appraisal

CBM-I program aims to modify interpretation bias, and the interpretation bias measure paradigm was usually treated as an indicator of CBM-I (e.g., Hoppitt et al., 2014; Telman et al., 2013). In an interpretation style measure, some new ambiguous scenarios, each with a title and the same instructions attached as in the training phase, would be presented to participants again repeatedly (Mathews & Mackintosh, 2000). With positive or negative resolution provided in response to ambiguous situations, interpretation bias is the most direct product of CBM-I. Positively-trained people showed more positive interpretation and fewer negative interpretations of the ambiguous materials, compared to those in the negative condition. In the present study, I used challenge and threat appraisals instead of interpretation bias measure as indicators of manipulation check. We can only suspect that the effectiveness of CBM-I for interpretation might extend to challenge appraisal, which refers to the positive interpretation associated with stressful situations. Thus in future studies, we should directly investigate the process regarding how CBM-I influences challenge appraisal by changing interpretation bias.

Follow-Up

This study provided evidence for the immediate effects of positive CBM-I training on enhancing challenge appraisal, as well as maintaining coping flexibility and positive emotion. However, I did not provide long-term (e.g., 1 day, 1 week, and 1 month) follow-up to track whether the benefits of

CBM-I persisted beyond the moment after training. CBM-I may be successful in training people's positive interpretation "moment to moment", but changing one's general interpretation of stressful life events is more difficult than changing the interpretation biases of a specific situation. Therefore, in future studies, follow-up measurement is required to examine the long-term effectiveness of the CBM-I program.

Implications

This study extends the research on CBM-I paradigm, by modifying the program with stress-related scenarios, and extending its effectiveness to challenge appraisal and coping flexibility in a college student sample. The findings which verified the positive path in the conceptual model, theoretically expands our understanding of the appraisal-coping flexibility-emotion link. Moreover, this study provides additional empirical evidence for the protective roles of both challenge appraisal and coping flexibility in facilitating positive emotions in hypothetical stressful situations.

Apart from theoretical implications, this study also provides essential insights to the design and development of intervention and training programs, in the area of stress. Challenge appraisal and coping flexibility are proven again as protective factors under stress, which should be utilized as components in the intervention. Furthermore, the positive effects of CBM-I on positive interpretation of stress (namely challenge appraisal), coping flexibility, and positive emotion, suggested that challenge appraisal and coping flexibility can be trained by cognitive bias modification programs. Hence, cognitive bias modification training for interpretation can be employed in future training

programs to foster challenge appraisal and coping flexibility, and eventually to promote individuals' positive adjustment outcomes.

Conclusion

The main objective of Study 3 was to test the positive path in the conceptual model, especially concerning the mediating role of coping flexibility in the influence of challenge appraisal and emotions, through an experimental approach. The results in positive CBM-I condition verified the positive path by showing that, challenge appraisal exerts positive influence on positive emotion by promoting coping flexibility. The protective roles of challenge appraisal and coping flexibility were highlighted again in helping individuals achieve adaptive emotional outcomes. Lastly, the modified single-session modified CBM program conducted online was effective in boosting challenge appraisal, maintaining coping flexibility, and enhancing positive emotion; in comparison, participants' coping flexibility and positive emotion dropped in the negative training condition.

CHAPTER 6

GENERAL DISCUSSION

Summary of Findings

The main purpose of the present research was to investigate the working mechanism of how stress influences adjustment outcomes through threat/challenge appraisal and coping flexibility. The current research hypothesized that appraisals mediate the influence of stress on adjustment outcomes, and coping flexibility further mediates the influence of appraisals on adjustment outcomes. Study 1 examined the general conceptual model and revealed two paths, one negative and one positive. In the negative path, experienced stress increased negative emotional outcomes and reduced positive emotion, and this adverse influence was mediated by threat appraisal. In the positive path, challenge appraisal decreased negative emotional outcomes and enhanced positive emotion fully through increasing coping flexibility. Study 2 mainly sought to verify the negative path using an experimental approach. In support of the hypotheses, threat appraisal was found to mediate the negative influence of negative acute stress on emotion as well as positive influence of positive acute stress on emotion. To be specific, negative stress evoked by negative instruction could increase threat appraisal and thus reduce positive emotion, whereas positive stress evoked by positive instruction could decrease threat appraisal and thus enhance positive emotion. The main objective of Study 3 was to verify the positive path using an experimental approach. In line with the hypothesis, coping flexibility was found to mediate the positive influence of challenge appraisal on emotion.

Figure 25. The final model: (A) threat appraisal mediates the association between cumulative stressors and negative emotional outcomes, and coping flexibility mediates the relation between challenge appraisal and negative emotional outcomes, and (B) threat appraisal mediates the influence of both positive and negative acute stress on positive emotion, and coping flexibility mediates the influence of challenge appraisal on positive emotion.

Note. The paths in Model B have not been examined in the same model. +: positive correlation. -: negative correlation.

To conclude, stress determines emotional outcomes through two paths, with appraisal and coping flexibility as two mediators. In particular, threat appraisal serves as the mediator in the relationship between stress and emotions, while coping flexibility serves as the secondary mediator in the relationship between challenge appraisal and emotions. The final model that summarized all three studies' findings was presented in Figure 25.

As extra findings, instruction for an upcoming stressful task plays an essential role in altering threat appraisal and emotion, while cognitive bias modification program targeted at interpretation showed effectiveness in boosting challenge appraisal, promoting coping flexibility, and enhancing positive emotion.

Discussion

Two Paths: A Negative Path and A Positive Path

The three studies revealed that stress could influence emotion via two paths: one negative path and one positive path. In the negative path, stress negatively influences emotion through threat appraisal, and this path was valid under both cumulative stress and acute stress. To be specific, cumulatively experienced stress is associated with aggravated negative emotional outcomes including depression, anxiety and stress/tension through increased threat appraisal (presented in Study 1), while acute stress reduced positive emotions by increasing threat appraisal (presented in Study 2). In the positive path, challenge appraisal positively influences emotion through coping flexibility, and this path was also verified under both cumulative stress and acute stress. In particular, challenge appraisal was associated with reduced negative emotional

outcomes under cumulative stress through increased coping flexibility appraisal (presented in Study 1). Challenge appraisal also enhances positive emotions under acute stress by increasing coping flexibility (presented in Study 3). Moreover, it is interesting to note that, the negative path could be converted to be positive under some conditions, with positive instruction being the key. When positive instruction is provided, the stressful event is perceived as positive, and thus lowers threat appraisal and enhances positive emotion (presented in Study 2).

Negative path. The present thesis revealed that both chronic and acute stress have negative effects on emotions. Study 1 showed that depending on increased threat appraisal, cumulatively experienced stress aggravates negative emotional outcomes, and this result was consistent with the literature which has shown that threat appraisal may lead individuals to negative emotions such as depression symptoms and anxiety (e.g., Lazarus, 1991a; Lazarus & Folkman, 1984; Meiser-Stedman, et al., 2009; Rapee & Heimberg, 1997; Sarason, 1990; Smith, 1991). Study 2 showed that depending on increased threat appraisal, acute stress reduces positive emotion, and this result was consonant with the previous findings that threat appraisal was associated with negative emotions such as anxiety (Bryant et al., 2007; Cerin, 2003; Ellis et al., 2009). Moreover, according to Beck and Clark's (1996) information processing model of anxiety, this negative path may act as a rapid and automatic response to stressful stimuli.

Positive path. Stress could also be a challenge, but not threat, and elicit adaptive reactions and positive emotional outcomes. Study 1 showed that, challenge appraisal could alleviate negative emotional outcomes by increasing coping flexibility under cumulative stress. This result was consistent with the

literature, which has shown that challenge appraisal might reduce negative emotions such as depression and anxiety (Blascovich et al., 2000; Blascovich & Tomaka, 1996; Tomaka et al., 1993). Study 3, through an experimental approach, showed the positive role of challenge appraisal in promoting coping flexibility and thus enhancing positive emotion. The positive influence of stress on emotion via challenge appraisal and coping flexibility aligned with the previous findings which demonstrated that positive appraisal and adaptive coping can lead individuals to positive emotions such as enjoyment and satisfaction (Lazarus & Folkman, 1984; Lazarus et al., 1980), as well as excitement and hope (Cerin, 2003; Dewar & Kavussanu, 2012; Kavussanu et al., 2014).

To summarize, the current research expands our understanding of the effects that stress exerts on emotions, guides us to investigate stress from a positive perspective, and explores the protective factors for enhancing adaptive adjustment under stress. Notably, the positive paths in this thesis highlighted the protective roles of challenge appraisal and coping flexibility in alleviating negative emotional outcomes and enhancing positive emotions under stress.

Two Mediators: Appraisal and Coping Flexibility

Occurring with the positive and the negative paths, appraisals and coping flexibility determine the effects of stress on emotional outcomes. Threat appraisal acts as the mediator in the relation between stress and emotion. In particular, threat appraisal mediates the relationship between cumulative stress and negative emotional outcomes (reported in Study 1); and it also mediates the influence of acute stress on positive emotion (reported in Study 2). Coping flexibility acts as the mediator in the relation between challenge appraisal and

emotion. To be specific, coping flexibility mediates the relationship between challenge appraisal and negative emotional outcomes under cumulative stress (reported in Study 1). It also mediates the influence of challenge appraisal on positive emotion under acute stress (reported in Study 3).

Mediating effect of threat appraisal on the relation between stress and emotion. The current research revealed that threat appraisal serves as a mediator in the relationship between stress and emotional outcomes. Study 1 showed that threat appraisal mediated the relation between cumulative stress and negative emotional outcomes, while Study 2 showed that threat appraisal mediated the influence of acute stress on emotion. Both findings supported the existing theories that negative appraisal mediates the relation between stress and emotions (e.g., Lazarus & Folkman, 1984). In terms of the influence of stress on threat appraisal, the finding that cumulatively experienced stress increases threat appraisal was consistent with the literature that shows appraisal is determined by past experience (Grinker & Spiegel, 1945; Lazarus & Folkman, 1984); specifically, individuals who consistently experience stressful encounters tend to anticipate threat and failure (Rapee & Heimberg, 1997; Sarason, 1990; Tomaka et al., 1993). The finding that acute stress with positive instruction decreases threat appraisal, and that acute stress with negative instruction increases threat appraisal, was consistent with the posit that threat appraisal is influenced by the new information about a particular stressor (Lazarus & Folkman, 1984). With regard to the negative influence of threat appraisal on well-being and emotional outcomes, it has been well discussed in the literature (e.g., Blascovich et al., 2000; Blascovich et al., 2001; Blascovich & Tomaka, 1996; Lazarus & Folkman, 1984); and the negative influence of

threat appraisal on emotions in an actual stressful situation has also been shown in a few studies (e.g., Cerin, 2003), which revealed that threat appraisal is associated with negative emotions such as anxiety under acute stress. Jones and co-workers (2009) explained that threat appraisal might lead to ineffective decision-making. Together, the present research supported literature concerning the mediating effect of threat appraisal on the relation between stress and emotion, and also extended the research by examining the mediation models in both cumulative stress and acute stress context.

Protective role of challenge appraisal. All three studies suggested that challenge appraisal neither mediated the relation between cumulative stress and emotional outcomes nor the relation between acute stress and emotion. Specifically, challenge appraisal may not be affected by cumulatively experienced stress or the instruction for a particular stressful task, but it can alleviate negative emotional outcomes under cumulative stress and enhance positive emotion under acute stress. Our finding suggested that challenge appraisal plays a protective role in regulating emotion under both cumulative stress and acute stress. This finding was consistent with the literature that documents a positive influence of challenge appraisal on well-being (e.g., Blascovich et al., 2000; Blascovich et al., 2001; Blascovich & Tomaka, 1996; Lazarus & Folkman, 1984). It also supported previous findings that challenge appraisal was associated with positive emotions such as excitement and hope under acute stress (Dewar & Kavussanu, 2012; Kavussanu et al., 2014) and reduces negative emotion such as anxiety (Cerin, 2003). To conclude, challenge appraisal could alleviate negative emotional outcomes under cumulative stress,

and enhance positive emotion under acute stress, and this effect was not influenced by experienced stress nor the characteristic of the situations.

Mediating effect of coping flexibility in the relation between challenge appraisal and emotion. Our research indicated that coping flexibility mediated the positive influence of challenge appraisal on emotion. Study 1 showed that challenge appraisal could reduce negative emotional outcomes fully by enhancing coping flexibility under cumulative stress; and Study 3, which was a training study, showed that boosted challenge appraisal could enhance positive emotion fully by promoting coping flexibility. In terms of the positive influence of challenge appraisal on coping flexibility, our finding was consistent with previous work which suggested that appraisals determine individuals' coping behaviors and emotional outcomes (e.g., Lowe et al., 2008). A number of studies (e.g., Blascovich et al., 2000; Jones et al., 2009; Skinner et al., 2003) have indicated that challenge appraisal is associated with adaptive coping, while threat appraisal is associated with maladaptive coping. Coping flexibility defined adaptive coping behaviors in various situations; hence, it should be positively associated with challenge appraisal. In terms of the positive influence of coping flexibility on emotions, our finding was consistent with previous work that revealed coping flexibility to be associated with lower levels of negative emotion such as anxiety and depression symptoms (e.g., Fresco et al., 2006; Williams, 2006; Williams, 2002). Little research has investigated the mediating effect of coping flexibility on the relation between challenge appraisal and emotions. The present thesis extended the research by implying that coping flexibility could be promoted by enhancing challenge appraisal. Additionally, similar to challenge appraisal,

coping flexibility was also not affected by cumulatively experienced stress nor the instruction for a particular stressor. This finding suggests that coping flexibility can also serve as a protective factor to facilitate individuals' positive emotional outcomes.

To summarize, threat appraisal and challenge appraisal play different roles in the response to stress. In particular, threat appraisal, which is influenced by stress, aggravates negative emotions and reduces positive emotions; in contrast, challenge appraisal can alleviate negative emotional outcomes and enhance positive emotion under stress, and this positive effect is mediated by coping flexibility. The mediating effect of threat appraisal in the stress-emotion link, and the protective roles of challenge appraisal and coping flexibility on emotion under stress, expand our understanding of the mechanism of how stress influences adjustment outcomes through challenge and threat appraisal, as well as coping flexibility.

Extra Findings

In addition to the two paths and the two mediators, some extra yet interesting findings were revealed. Threat appraisal and challenge appraisal are not correlated with each other, and they played different roles on individuals' responses to stress and their adjustment outcomes. Moreover, the manipulation methods, which include providing instruction and a CBM-I training program, showed their effects on eliciting appraisals, coping flexibility, and emotion.

Independent relationship between threat appraisal and challenge appraisal. Threat appraisal and challenge appraisal refer to the interpretation of stress situations in a negative or a positive manner. The nonsignificant correlation between threat appraisal and challenge appraisal in the three studies

suggested that they may be independent of each other. This finding was consonant with the posit that threat appraisal and challenge appraisal can be understood as two distinct psychophysiological responses to stressors (Blascovich et al., 2011; Seery, 2011). According to Beck and Clark's information processing model of anxiety (1996), after recognizing stressful stimuli, the first stage of response to stress is rapid and primarily stimulus-driven, due to "the threat-related information processing for the survival of the organism" (Beck & Clark, 1996, p. 57). Some automatic negative thoughts about possible threat and danger, biased cognitive processing, primary threat appraisal or an initial threat impression usually occur in this automatic process. Hence, threat appraisal may function as an immediate and automatic response to stress, driven by the stimuli. At the second stage of response to stress—secondary elaboration—individuals engage in a more reflective evaluation of their coping resources and the situational characteristics. Hence, threat appraisal (again) and challenge appraisal may occur at this stage in response to stress. Moreover, the independent relationship between threat appraisal and challenge appraisal also implied that they may be determined by different factors, and it led our attention to the antecedents of threat and challenge appraisals. Lazarus and Folkman (1984) stated that appraisal is determined by both past experience and new information. Our findings supported this posit by showing the association between threat appraisal and cumulatively experienced stress (past experience), and characteristics such as consequences and goals of a specific stressful situation (new information). In particular, cumulatively experienced stress may lead individuals to higher levels of threat appraisal; negative information about a particular stressor which focuses on negative

consequences, an avoidance goal, and inadequate self-competence may aggravate individuals' threat appraisal; whereas positive information about a particular stressor which encourages positive consequences, an approaching goal, and adequate self-competence may reduce individuals' threat appraisal. In terms of challenge appraisal, the present research showed that challenge appraisal may not be easily affected by cumulatively experienced stress or instruction about a particular stressful situation, but it can be trained by the interpretation bias modification program. This finding suggested that challenge appraisal may be more largely influenced by some other stable factors. The present research suggests that personal interpretation styles might determine individuals' challenge appraisal in stressful situations. Additionally, according to the Cognitive-Motivational-Relational (CMR) Theory (Lazarus, 1991b), besides personal resources and environmental demands, personality also serves as an antecedent leading to appraisals, action tendencies, and coping. Hence, we can infer that threat appraisal may largely depend on cumulative stressful experience, and rely on the information about (which influences the individual's understanding of) a particular stressor in terms of environmental demands and personal resources. In other words, threat appraisal may function as an automatic response when an individual is confronted with stress. In comparison, challenge appraisal may be more likely to depend on personal factors such as interpretation styles and personality, and it is relatively more consistent across various stressful situations regardless of the types of instruction. Based on the current findings, we can infer that challenge appraisal can be promoted by positive interpretation bias training, rather than by simply exposing individuals to stressful situations or providing positive instruction for

an upcoming stressful task. More empirical evidence is required to explore the antecedence of threat and challenge appraisal. Furthermore, two paths in the present thesis indicated that threat and challenge appraisals play different roles in the response to stress and outcomes, in support of past research which demonstrated that threat and challenge appraisals have different implications for psychological, physiological, and behavioral responses. To summarize, threat appraisal and challenge appraisal are independent of each other, and play different roles in the stress process.

The manipulation methods. In addition to showing a mediation model linking stress, threat appraisal, challenge appraisal, coping flexibility, and emotions, the current research has also shown some interesting findings concerning how to mitigate threat appraisal and reduce the negative influence of stress on emotions, and how to promote challenge appraisal and coping flexibility, both of which are viewed as protective factors for individuals under stress to achieve adaptive adjustment outcomes.

Instruction for a stressful task can alter threat appraisal and emotion. Our findings suggested that instruction for an upcoming stressful task may alter one's threat appraisal and emotions. Negative instructions increased participants' threat appraisal and reduced their positive emotion, while positive instructions reduced participants' threat appraisal and enhanced their positive emotion. Threat and challenge appraisals occur when the situation is goal-relevant (Blascovich & Tomaka, 1996; Lazarus & Folkman, 1984), thus negative and positive instruction involving an approaching or avoidance goal could elicit threat and challenge appraisals (Schneider, 2008). Previous studies documenting positive instruction with achievement goals having positive

effects on emotions and well-being in the sporting context (e.g., Adie et al., 2008, 2010; Jones et al., 2009), support our findings. The present research extended the literature by revealing similar results in the educational context, and highlighting the mediating role of threat appraisal in the influence of instruction on emotions. Our findings also emphasized the important roles of instructions in the educational context. Specifically, in an actual stressful situation such as a test, positive instruction that encourages college students to focus on an approaching goal, positive consequences, and adequate self-competence could alleviate students' threat appraisal and further enhance their positive emotion; in contrast, negative instruction that encourages college students to focus on an avoidance goal, negative consequences, and inadequate self-competence could aggravate students' threat appraisal and further reduce their positive emotion.

An interpretation bias modification program is effective in enhancing challenge appraisal, coping flexibility, and positive emotion. An interesting finding in the current research is the effectiveness of a cognitive bias modification program in boosting challenge appraisal, maintaining coping flexibility and positive emotion when facing hypothetical stressful situations. In terms of the positive effects of CBM-I on challenge appraisal, our finding are in line with previous work which revealed that participants in the CBM-I program endorsed more positive interpretation of ambiguous material compared to those in the negative condition (Telman et al., 2013). According to Telman, Holmes, and Lau (Telman et al., 2013), the induction of positive interpretation in each scenario can add up to a greater endorsement of positive “foils”. We can infer that inducing positive interpretation in each hypothetical stressful scenario may

add up and further transfer to a general positive interpretation of all the stressful situation which can be regarded as challenge appraisal. In terms of the positive effects of CBM-I programs on emotions, previous studies have shown that CBM-I could reduce anxiety associated with real-life stressors (See et al., 2009), prevent negative emotions (e.g., anxiety and social evaluative fear) associated with a forthcoming real-life stress event among college students (Hoppitt et al., 2014), and can even reduce global symptoms of anxiety in high anxious populations over multiple sessions (Beard & Amir, 2008; Mathews et al., 2007; Salemink et al., 2009). Our training study not only supported the previous findings that CBM-I can be delivered effectively online to exert positive effects on interpretation and emotions (Hoppitt et al., 2014; See et al., 2009), but also extended the literature by revealing the positive effects of CBM-I on coping flexibility in hypothetical stressful real-life scenarios. In the present thesis, CBM-I showed its effectiveness in maintaining coping flexibility in hypothetical stressful scenarios. Hence, this program could be adopted to assist individuals in maximizing their coping potentials to deal with various stressful events. To summarize, the cognitive bias modification program on interpretation may be able to increase the extent to which college students appraise stress as a challenge, to improve their ability to deploy adaptive coping strategies across diverse stressful situations, and to further enhance their positive emotion and facilitate their psychological well-being.

Limitations and Future Directions

There are some limitations to be addressed in order to understand the mediation model.

Self-Reported Measures

In the present research, most of the data such as experienced stress, threat and challenge appraisals, coping flexibility, and emotional outcomes were collected from self-reported measures, so we should exercise caution in interpreting the conceptual model.

Measure of experienced stress. ICSRLE (Kohn et al., 1990) was adopted to measure experienced stress, but its items might have reflected the interpretative/perceived stressful experience instead of the stressful events the participants really experienced. In order to investigate the influence of experienced stress, a measurement which could objectively record the stressful events that an individual had ever experienced is necessary.

Measure of threat and challenge appraisals. A number of researchers (e.g., Blascovich et al., 2000; Chalabaev, Major, Cury, & Sarrazin, 2009) suggest that it may be difficult to assess challenge and threat states and to reflect the conscious and unconscious evaluations of a stressor through self-reported measures. Self-reported psychological states are often inconsistent with implicit measures and cardiovascular (CV) reactivity. Thus in future studies, the implicit measures and biological measures should be utilized to assess threat and challenge appraisals.

Measure of coping flexibility. The current self-reported questionnaires of coping flexibility may measure flexible coping from a dispositional perspective. The dispositional focus might account for the finding that coping flexibility was independent of situational characteristics and resistant to situational changes. In future studies, it would be necessary to operationalize

and measure coping flexibility behaviorally, so as to explore the nature of coping flexibility, dispositional or situational.

Therefore, the conceptual model might only be valid through a self-reported approach with the current measures. In order to further verify the proposed model linking the above variables, we should adopt more precise measurements like behavioral measures, implicit measures and biological indicators, instead of self-reported measures for future studies.

Instruction

Instruction for an upcoming task was used in Study 2 as a manipulation tool. In line with the hypotheses, the manipulation in Study 2 was found to be successful in changing task performance scores, altering threat appraisal, and influencing emotions, nonetheless, we should be cautious while interpreting the effectiveness of the manipulation in terms of the components of instruction. Three components including the goal of task (avoiding vs. approaching), the consequence of task (negative vs. positive), and self-competence (inadequate vs. adequate) were involved in the instruction, but no direct questions were used to check if the positive and negative stress induction were successful in terms of each individual component. In this case, we cannot confirm if all three components play roles in stress manipulation, or which factor(s) determined participants' threat and challenge appraisals, coping flexibility, and emotional outcomes. Thus, we should manipulate one single component while controlling for the other two in future research, in order to confirm the effectiveness of each components in the instruction.

Training Program

Study 3 used a single-session training program modified from the Cognitive Bias Modification - Interpretation program to manipulate/train challenge appraisal. As discussed in Chapter 5, the limited number of training sessions might set limits on the effectiveness of CBM-I program. Hence, future research should enlarge the duration of training and increase the number of training sessions to maximize the positive effects of training programs on challenge appraisal, coping flexibility, and emotion. In addition, follow-up is necessary to evaluate the long-term benefit of the CBM-I program. To summarize, a multiple-session training program should be designed in future research, by engaging a cognitive bias modification program to promote the positive path, in order to boost challenge appraisal and improve coping flexibility.

Generalization of the conceptual model

Given the limitations of the current measures (i.e., self-reported) and study design (i.e., cross-sectional), as well as the limited representativeness of the current sample (i.e., college students), the conceptual model revealed in this thesis may only be valid under certain conditions. The conceptual model could not be easily generalized to other populations. Under different cultures like western culture, in different populations like who are really in chronic conditions, the model might change. Therefore, we can only conclude that, the two-path mediation model regarding the relationships between self-reported experienced stress, perceived appraisals, coping flexibility, and emotion, is valid for college students in the Singaporean Society. To further verify the

model, a longitudinal study design should be employed, in populations under chronic stress.

Implications

Despite the limitations, the present thesis provided both theoretical and practical insights to understanding how to foster adaptive adjustment outcomes under stress. This thesis adopted a multi-method approach to examine the conceptual model with regard to the influence of appraisals and coping flexibility on psychological adjustment under stress. Overall, this research was conducted from a positive perspective of stress, by proposing protective factors and effective methods through which individuals under stress could achieve adaptive emotional outcomes. The protective factors included challenge appraisal and coping flexibility, and the effective methods included positive instruction and cognitive bias modification, all of which could reduce negative emotional outcomes and enhance positive emotion. The positive perspective of stress would motivate researchers to explore the protective factors and positive paths to promote individuals' adaptive adjustment enhancement under stress.

Theoretical Implications

First of all, three studies provided empirical evidence to support the existing theories and previous findings concerning the effects of threat and challenge appraisals as well as coping flexibility on emotions and psychological well-being. In addition, this thesis extended the research on motivated performance situations from the sporting context to the educational context; also, it extended the research on Cognitive Bias Modification program to a context of daily stress by designing stress-related scenarios and investigating

the effectiveness of CBM-I program in stress appraisals, coping flexibility and emotional outcomes.

More importantly, the present thesis extended the literature by suggesting a more comprehensive mechanism that explains how stress influences emotions via two paths and two mediators. Especially, the two paths (one positive and one negative) and one converted path (from negative to positive) shed light on the stress coping research by indicating that stress could result in different outcomes with the influence of other environmental or personal factors. The mediating roles of appraisals and coping flexibility revealed in this study expand our understanding of the process regarding how appraisals and coping flexibility interact with each other to determine individuals' emotional outcomes.

The present research serves as the initial test of the proposed model in a sample of college students. Each component of the conceptual model (i.e., experienced stress, threat appraisal, challenge appraisal, coping flexibility, and emotion) and each path in this model deserves further investigation.

Lastly, the findings regarding the independent relationship between threat and challenge appraisals suggested that these two types of appraisals might be determined by different factors, or occur at different stages of information processing. Threat appraisal might rely more on environmental variables such as past stressful experience and instruction for a particular event, whereas challenge appraisal is more likely to be determined by personal variables like personal interpretation style. It could also be explained by Beck and Clark's information processing model which states that the image of

potential threat occurs rapidly in response to stress, whereas the elaborative stage occurs later. These arguments might motivate further investigation.

Practical Implications

In addition to the theoretical implications, the present research also provides practical implications for the concerns on promoting psychological well-being under stress. This thesis emphasizes the essential roles of two protective factors (i.e., challenge appraisal and coping flexibility) and two effective methods (i.e., positive instructions and cognitive bias modification) to enhance individuals' adaptive adjustment outcomes under stress, especially in the educational context. Specifically, our findings encourage educators to provide positive instructions to students, by encouraging students to establish approaching goals, to focus on the potential positive consequences and to positively evaluate their self-competence, as so to reduce students' threat appraisal and enhance their positive emotion while facing a stressful task such as examinations, presentations and job interviews. Moreover, CBM-I program could be integrated into intervention programs to boost challenge appraisal, fulfil coping flexibility potentials and facilitate adaptive psychological outcomes, by modifying one's interpretation bias in the hypothetical stressful scenarios from a negative manner to a positive manner. Lastly, the negative impacts of risky factors (i.e., negative instruction and interpretation bias) on behavioral and emotional outcomes should be scrutinized. Negative instruction might lead students to negative emotional outcomes such as depression, anxiety and stress, by emphasizing avoiding goals, potential negative consequences, and negative self-evaluation. Interpretation bias in every single stressful situation might add up to general negative appraisal by repeating interpreting

situations or imaging resolutions in a negative manner, thus further lowering coping flexibility and positive emotions.

In summary, the positive perspective of stress research, the conceptual models, as well as the protective factors and effective methods revealed in the current research, provide new insights into both theoretical exploration and application in the practical settings.

Conclusion

The present thesis has advanced our understanding of the mechanism by which stress influences emotional outcomes among college students. Two paths and two mediators were discovered. In the negative path, stress increases negative emotional outcomes and reduces positive emotion by increasing threat appraisal; in an acute stressful situation where a positive instruction is provided, the negative path could be converted to be positive by reducing threat appraisal. In the positive path, challenge and coping flexibility serve as protective factors, exerting positive effects on emotional outcomes: challenge appraisal reduces negative emotional outcomes and enhances positive emotion. The findings concerning the different roles of threat appraisal and challenge appraisal in determining adjustment outcomes under stress, together with the mediating effects of appraisals and coping flexibility on the relationship between stress and emotions, not only support the literature, but also expands our understanding of it. Moreover, the conceptual model proposed in this thesis might motivate future research to investigate each component in this model, and further explore the determinants of two types of appraisals. Finally, the current thesis suggests two potential methods to facilitate adjustment outcomes

under stress: (a) positive instructions which could reduce threat appraisal and enhance positive emotion, and (b) an online interpretation bias modification program which could boost students' challenge appraisal, promote their coping flexibility, and enhance their positive emotions. The present research has made theoretical and methodological contributions to the research on stress coping, and provided practical implications for future intervention programs on improving individuals' psychological well-being in the long run.

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APPENDICES

Appendix A

Inventory of College Students' Recent Life Experiences (ICSRLE; Kohn, Lafreniere, & Gurevich, 1990)

Following is a list of experiences which many students have some time or other.

Please indicate for each experience how much it has been a part of your life **over the three past months**. "1" means it was **not at all** part of your life over the past month; "2" means **only slightly part** of your life over that time; "3" means **distinctly part** of your life; and "4" means **very much part** of your life over the past three months.

	not at all	only slightly	distinctly	very much
1. Conflicts with boyfriend's/girlfriend's/spouse's family	1	2	3	4
2. Being let down or disappointed by friends	1	2	3	4
3. Conflict with professor(s)	1	2	3	4
4. Social rejection	1	2	3	4
5. Too many things to do at once	1	2	3	4
6. Being taken for granted	1	2	3	4
7. Financial conflicts with family members	1	2	3	4
8. Having your trust betrayed by a friend	1	2	3	4
9. Separation from people you care about	1	2	3	4
10. Having your contributions overlooked	1	2	3	4
11. Struggling to meet your own academic standards	1	2	3	4
12. Being taken advantage of	1	2	3	4
13. Not enough leisure time	1	2	3	4

14. Struggling to meet the academic standards of others	1	2	3	4
15. A lot of responsibilities	1	2	3	4
16. Dissatisfaction with school	1	2	3	4
17. Decisions about intimate relationship(s)	1	2	3	4
18. Not enough time to meet your obligations	1	2	3	4
19. Dissatisfaction with your mathematical ability	1	2	3	4
20. Important decisions about your future career	1	2	3	4
21. Financial burdens	1	2	3	4
22. Dissatisfaction with your reading ability	1	2	3	4
23. Important decisions about your education	1	2	3	4
24. Loneliness	1	2	3	4
25. Lower grades than you hoped for	1	2	3	4
26. Conflict with teaching assistant(s)	1	2	3	4
27. Not enough time for sleep	1	2	3	4
28. Conflicts with your family	1	2	3	4
29. Heavy demands from extracurricular activities	1	2	3	4
30. Finding courses too demanding	1	2	3	4
31. Conflicts with friends	1	2	3	4
32. Hard effort to get ahead	1	2	3	4
33. Poor health of a friend	1	2	3	4
34. Disliking your studies	1	2	3	4
35. Getting "ripped off" or cheated in the purchase of services	1	2	3	4
36. Social conflicts over smoking	1	2	3	4
37. Difficulties with transportation	1	2	3	4
38. Disliking fellow student(s)	1	2	3	4
39. Conflicts with boyfriend/girlfriend/spouse	1	2	3	4
40. Dissatisfaction with your ability at written expression	1	2	3	4
41. Interruptions of your school work	1	2	3	4

42. Social isolation	1	2	3	4
43. Long waits to get service (e.g., at banks, stores, etc.)	1	2	3	4
44. Being ignored	1	2	3	4
45. Dissatisfaction with your physical appearance	1	2	3	4
46. Finding course(s) uninteresting	1	2	3	4
47. Gossip concerning someone you care about	1	2	3	4
48. Failing to get expected job	1	2	3	4
49. Dissatisfaction with your athletic skills	1	2	3	4

Appendix B

Chinese Making Sense of Adversity Scale (CMSAS; Pan, Wong, Chan, & Chan, 2008)

When we feel stress, we try to cope using various actions and thoughts. The following items describe the stress situations.

Please indicate how these situations apply to you by choosing one of the following for each situation: “1” means **not applicable**, “2” means **slightly applicable**, “3” means **often applicable**, and “4” means **very applicable**.

	not applicable	slightly applicable	often applicable	very applicable
1. Stress is normal and natural, and everyone will have to face it in life.	1	2	3	4
2. Stress is a fact of life and one cannot grow up without it.	1	2	3	4
3. Stress provides a good opportunity for learning.	1	2	3	4
4. Stress not only causes pressure, but is also a motivation.	1	2	3	4
5. Stress means the end of the world and I am not able to resolve it.	1	2	3	4
6. To me, coping with stress is a process of accumulating life experiences.	1	2	3	4
7. Stress makes me feel that life is meaningless.	1	2	3	4
8. Stress is indispensable in life.	1	2	3	4
9. I have lost a lot because of the stress.	1	2	3	4
10. To me, stress is a kind of discipline.	1	2	3	4
11. Stress constitutes a platform for future development.	1	2	3	4
12. I have wasted precious time in my life because of the stress I have experienced.	1	2	3	4

Appendix C

Coping Flexibility Scale (CFS; Kato, 2012)

When we feel stress, we try to cope using various actions and thoughts. The following items describe stress- coping situations. Please indicate how these situations apply to you by choosing one of the following for each situation: “1” means **not applicable**, “2” means **slightly applicable**, “3” means **often applicable**, and “4” means **very applicable**

	not applicable	slightly applicable	often applicable	very applicable
1. When a stressful situation has not improved, I try to think of other ways to cope with it.	1	2	3	4
2. I only use certain ways to cope with stress.	1	2	3	4
3. When stressed, I use several ways to cope and make the situation better.	1	2	3	4
4. When I haven’t coped with a stressful situation well, I use other ways to cope with that situation.	1	2	3	4
5. If a stressful situation has not improved, I use other ways to cope with that situation.	1	2	3	4
6. I am aware of how successful or unsuccessful my attempts to cope with stress have been.	1	2	3	4
7. I fail to notice when I have been unable to cope with stress.	1	2	3	4
8. If I feel that I have failed to cope with stress, I change the way in which I deal with stress.	1	2	3	4
9. After coping with stress, I think about how well my ways of coping with stress worked or did not work.	1	2	3	4
10. If I have failed to cope with stress, I think of other ways to cope.	1	2	3	4

Appendix D

Depression Anxiety Stress Scale (DASS; Lovibond & Lovibond, 1996)

Please read each statement, and indicate how much the statement applied to you **over the past three months**. “1” means **did not apply to me at all**; “2” means **applied to me to some degree, or some of the time**; “3” means **applied to me to a considerable degree, or a good part of time**; and “4” means **applied to me very much, or most of the time**.

	not applicable	slightly applicable	often applicable	very applicable
1. I found myself getting upset by quite trivial things	1	2	3	4
2. I was aware of dryness of my mouth	1	2	3	4
3. I couldn't seem to experience any positive feeling at all	1	2	3	4
4. I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion)	1	2	3	4
5. I just couldn't seem to get going	1	2	3	4
6. I tended to over-react to situations	1	2	3	4
7. I had a feeling of shakiness (e.g., legs going to give way)	1	2	3	4
8. I found it difficult to relax	1	2	3	4
9. I found myself in situations that made me so anxious I was most relieved when they ended	1	2	3	4
10. I felt that I had nothing to look forward to	1	2	3	4
11. I found myself getting upset rather easily	1	2	3	4
12. I felt that I was using a lot of nervous energy	1	2	3	4
13. I felt sad and depressed	1	2	3	4

14. I found myself getting impatient when I was delayed in any way (e.g., elevators, traffic lights, being kept waiting)	1	2	3	4
15. I had a feeling of faintness	1	2	3	4
16. I felt that I had lost interest in just about everything	1	2	3	4
17. I felt I wasn't worth much as a person	1	2	3	4
18. I felt that I was rather touchy	1	2	3	4
19. I perspired noticeably (e.g., hands sweaty) in the absence of high temperatures or physical exertion	1	2	3	4
20. I felt scared without any good reason	1	2	3	4
21. I felt that life wasn't worthwhile	1	2	3	4
22. I found it hard to wind down	1	2	3	4
23. I had difficulty in swallowing	1	2	3	4
24. I couldn't seem to get any enjoyment out of the things I did	1	2	3	4
25. I was aware of the action of my heart in the absence of physical exertion (e.g., sense of heart rate increase, heart missing a beat)	1	2	3	4
26. I felt down-hearted and blue	1	2	3	4
27. I found that I was very irritable	1	2	3	4
28. I felt I was close to panic	1	2	3	4
29. I found it hard to calm down after something upset me	1	2	3	4
30. I feared that I would be "thrown" by some trivial but unfamiliar task	1	2	3	4
31. I was unable to become enthusiastic about anything	1	2	3	4
32. I found it difficult to tolerate interruptions to what I was doing	1	2	3	4
33. I was in a state of nervous tension	1	2	3	4

34. I felt I was pretty worthless	1	2	3	4
35. I was intolerant of anything that kept me from getting on with what I was doing	1	2	3	4
36. I felt terrified	1	2	3	4
37. I could see nothing in the future to be hopeful about	1	2	3	4
38. I felt that life was meaningless	1	2	3	4
39. I found myself getting agitated	1	2	3	4
40. I was worried about situations in which I might panic and make a fool of myself	1	2	3	4
41. I experienced trembling (e.g., in the hands)	1	2	3	4
42. I found it difficult to work up the initiative to do things	1	2	3	4

Appendix E

Coping Flexibility Questionnaire (in Hypothetical Scenarios)

Please **vividly imagine** you are encountering the following situations, and decide what strategies you would employ to handle the situations.

Please indicate each of the stressful situations is a (A) controllable situation which can be mastered by you, or a (B) uncontrollable situation which totally exceeds your ability. Write down the **strategies (as many as possible)** you will adopt to deal with each stressful situation. And indicate that your primary goal for using each strategy is (a) to directly solve the problems, or (b) to change your thoughts and feelings.

Situation 1: Layoff Vividly imagine that, due to a large drop in sales, it is rumored that several people in your department at work will be laid off. Your supervisor has turned in an evaluation of your work for the past year. The decision about lay-offs has been made and will be announced in several days.
It is a (A) controllable situation; (B) uncontrollable situation
Your strategies: 1. 2. ...
Primary goal of using each strategy: (a) to directly solve the problems (b) to change your thoughts and feelings
Situation 2: Business Dinner Vividly imagine that your supervisor and you attend a business dinner. You have not attended this kind of formal dinner before. You realize that you do not know any guests who attend the dinner.
It is a (A) controllable situation; (B) uncontrollable situation
Your strategies:

1. 2. ...
Primary goal of using each strategy: (a) to directly solve the problems (b) to change your thoughts and feelings
Situation 3: Ballgame Vividly imagine that you have to participate in a very important ballgame. The outcome of the ballgame will have a huge impact on your team's reputation. Your team has been widely expected to be the champion. The audience cheers your team loudly in the stadium.
It is a (A) controllable situation; (B) uncontrollable situation
Your strategies: 1. 2. ...
Primary goal of using each strategy: (a) to directly solve the problems (b) to change your thoughts and feelings
Situation 4: Early Cancer Vividly imagine that you go to the clinic to get a body-check report. The doctor tells you that the report shows that you have got early stomach cancer, which can be controlled by medication.
It is a (A) controllable situation; (B) uncontrollable situation
Your strategies: 1. 2. ...
Primary goal of using each strategy: (a) to directly solve the problems (b) to change your thoughts and feelings