



FACULTY OF EDUCATION
DEPARTMENT OF EDUCATION AND SPECIAL EDUCATION

THE RELATIONSHIP OF ACADEMIC STRESSORS AND SUBJECTIVE WELL-BEING AMONG CHINESE ADOLESCENTS: THE BUFFERING EFFECTS OF SOCIAL AND EMOTIONAL SKILLS

—AN EMPIRICAL ANALYSIS BASED ON SSES 2019

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Abstract

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This is a cross-sectional study based on data of 15-year-group from Suzhou China in Survey on Social and Emotional Skills (SSES) 2019 of OECD. It aims to fill in the research gap whether and how social and emotional skills protect adolescents' mental health and well-being from academic stressors. By examining the mediating effects of social and emotional skills on the relationship between academic stressors and subjective well-being, this study desires to add empirical evidence to Wheaton's (1985) additive stress-buffering model, which is the theoretical framework for the mediation models presenting how the five domains of social and emotional skills act to *buffer* the impact of academic stressors. The Big Five Model was employed as the assessment framework of social and emotional skills. Structural Equation Modelling (SEM) technique was implemented to perform the mediation analysis using Mplus version 8.3. The results demonstrated that four domains of Chinese adolescents' social and emotional skills- Collaboration (COL), Engaging with others (EWO), Open-mindedness (OPN) and Task performance (TAP) significantly mediated the impact of academic stressors (external expectations) on subjective well-being. The expectation stressors positively predicted the four social and emotional skills, and these skills in turn, positively impacted on subjective well-being. The direct effect of academic stressors of external expectations on well-being is negative but non-significant. As such, the stress-buffering function of the mediating effects of the four social and emotional skills was not confirmed. Nevertheless, the results provide evidence for the coping resources mobilization theory, alternatively, academic stressors mobilize social and emotional skills (COL, EWO, OPN and TAP). This is the most crucial premise to prove additive stress-buffering effect. Compared with COL, EWO, OPN and TAP, the Chinese adolescents were much less confident in their emotional regulation (EMR) skill, thus Chinese policymakers and educators should pay more attention to that. Among the three control variables, gender was the only variable that had significant confounding effects on subjective well-being in all the five models, as a negative predictor, which means Chinese girls had lower level of subjective well-being.

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Acronyms and Abbreviations

OECD	The Organization for Economic Co-operation and Development
WHO	World Health Organisation
CASEL	Collaborative for Academic, Social, and Emotional Learning
GHE	Global Health Estimates
ESD	Education of Sustainable Development
SSES	Survey on Social and Emotional Skills
PISA	Programme for International Student Assessment
PIAAC	Programme for the International Assessment of Adult Competencies
IELS	International Early Learning Study
IQ	Intelligence Quotient
SES	Socio-economic Status
HISEI	The highest occupational status of parents index
PAREDYRS	The highest level of parental education index
HOMEPOS	The household possessions index
SEL	Social and Emotional Learning
SPSS	Statistical Package for the Social Sciences
CFA	Confirmatory Factor Analysis
SEM	Structural Equation Modelling
TCS	Target Cluster Size
MGCFA	Multiple Group Confirmatory Factor Analysis
IRT	Item Response Theory
GPCM	Generalised Partial Credit Model
PCM	Rasch Partial Credit Model
ML	Maximum likelihood
MLR	Robust maximum likelihood
MI	Modification indices
CFI	Comparative Fit Index
TLI	Tucker-Lewis index
RMSEA	Root-mean-square error of approximation
RMSR	Root Mean Square Residual
χ^2	chi-square/
df	degrees of freedom
β / Est.	estimate coefficient
S.E.	standard error
Z	the ratio of the estimated coefficient (Est.) to its standard error (S.E.)

Scale Labels

COL	Collaboration
EMP	Empathy
TRU	Trust
COO	Cooperation
EWO	Engaging with Others
ENE	Energy
SOC	Sociability
ASS	Assertiveness
EMR	Emotional Regulation
EMO	Emotional control
OPT	Achievement motivation
STR	Stress resistance/resilience
OPN	Open-mindedness
CRE	Creativity
CUR	Curiosity
TOL	Tolerance
TAP	Task Performance
PER	Persistence
RES	Responsibility
SEL	Self-control
EFF	Self-efficacy
MOT	Achievement motivation

Introduction

In recent years, students' mental health has become a topic of increasing global concern. There is a growing body of research on this realm, highlighting the rise in students facing mental health challenges and the subsequent rise in demand for support (Barkham et al., 2019; R. Brown, 2018; Sibley et al., 2020). According to data from World Health Organization (WHO) (2021), around 14% of teenagers between the ages of 10 and 19 were affected by mental health challenges on a global scale. Mental health issues can negatively impact students' academic performance, increase the risk of dropping out, and have long-term effects on their adult lives and roles in society (Cawood, 2010; Newton-Howes & Boden, 2016). Therefore, well-being, defined as students' emotional and mental capital (Skoglund et al., 2023), has been increasingly addressed as part of a whole-child perspective to education (Eva, 2021).

Adolescence, which refers to the phase of life stretching between childhood and adulthood (Kuruville et al., 2016), is a critical transitional period characterized by significant physiological and psychological changes (Arnett, 2000; Barbayannis et al., 2017; Lally & Valentine-French, 2018; Matud et al., 2020), and this puts adolescents in a kind of hazardous situation to develop psychological crisis and unstable well-being (Deighton et al., 2019; Patalay & Fitzsimons, 2018). Those crises could potentially predict mental health issues in later life, and research confirmed that roughly half of mental disorders first occur before the age of 14 (Patel et al., 2018). The main reasons of mental health problems are daily stress and annoyance (Rodríguez-Naranjo & Caño, 2016). Since adolescents spend considerable time in the school environment, academic stress, which is mainly related to academic performance expectations and achievement, is regarded as the most relevant stress they perceive and undergo (Pascoe et al., 2020; Sang et al., 2018). Therefore, to develop mental health and well-being of adolescents, coping with academic stress should be taken seriously.

But in China, this issue is earning much more concerns (Yao et al., 2021). An international study demonstrated that Chinese adolescents reported higher level of academic stress and depression than their counterparts overseas (Greenberger et al., 2000; Stewart et al., 1999; Sun et al., 2013). A survey comparing the lives of high school students in China, Japan, South Korea, and the United States, showed that Chinese students experienced the most academic stress among the participating countries (X. Zhao et al., 2009). For Chinese adolescents, the negative emotions derived from the relatively high academic requirements and pressure become the most common cause (58.9%) of the prevalence of mental health problems (Luo et al., 2020). A nationwide study of mental health conducted in 2020 revealed that 26.6% of Chinese youths were found to be at risk for depression, and it is estimated that at least 30 million children and adolescents under 17 years of age in China struggled with emotional or behavioural problems (Fu et al., 2021). Earlier, Azhu et al. (2017) found that the estimated prevalence of non-suicidal self-harm because of mental disorders in Chinese middle school students (aged 13 – 18 years) was 27.4%. The reasons for their high academic stress are complicated, including the influence of traditional Confucian culture, the fierce career competitions in society, the exam-oriented education system, and so forth (Hwang, 1999; Kim, 2009; J. B. Tan & Yates, 2011). Therefore, to relieve Chinese adolescents' academic stress is a systemic issue that cannot be addressed with piecemeal solutions within short time. That is why despite the Chinese government has continuously launched some educational reforms, e.g., 'The Double Reduction Policy', to reduce students' study load, the results have never been satisfactory. As such, to improve Chinese students' capability to cope with academic stress obviously becomes vitally important and realistic. Wang et al. (2020) highlighted in their article that "more research and guidance for professionals are needed to establish an

interconnected mental health system, which could provide the professional services for schools, communities, and families, and improve the mental health and well-being of adolescents in China” (p.e637).

Social and emotional skills are a subset of an individual’s abilities, attributes and characteristics, which include behavioural dispositions, internal states, approaches to tasks, the management of behaviours and emotions, as well as beliefs about oneself and relationships with others (OECD, 2022a). These skills play a critical role in how people adapt to their environment and have a greater impact on mental health and well-being than intelligence and other cognitive abilities (Chernyshenko et al., 2018). And abundant studies have highlighted social and emotional learning (SEL) interventions can alleviate students’ emotional distress, promote academic performance, and improve peer relations in an academic context (Durlak et al., 2011). In addition, some competences or characters that are closely linked to social and emotional skills, like emotional intelligence, mindfulness, resilience, self-regulation (self-management) and interpersonal relationships (social skills) are proved to be significantly related to stress coping (Austin et al., 2010; W. Chen, n.d.-a; Ciesla et al., 2012; Nyarko et al., 2020; Shirmohammadi et al., 2023; Versteeg & Kappe, 2021; X. Wang et al., 2014; Weinstein et al., 2009)¹. Therefore, it is rational to assume that students’ social and emotional skills may contribute to the process of dealing with stress and challenges in academic environment, and consequently defend students’ mental health and well-being. As what is stated in the Survey on Social and Emotional Skills (2019) report, “When competitive learning environments and external high expectations are not accompanied by adequate social and emotional support, and training in strategies to cope with test anxiety, students may feel overwhelmed and unable to face challenges” (OECD, 2021, p.102). However, to the best of the researcher’s knowledge, how social and emotional skills could protect adolescents’ mental health and well-being from academic stress, has not been investigated directly and systematically yet. There is very little empirical knowledge about the mechanism through which social and emotional skills mitigate academic stress effects among adolescents, especially how the different domains of the skills contribute to the impacts is really underexplored.

Therefore, this study aims to fill in this gap, to conduct theory-driven research based on solid data, and empirically examine whether social and emotional skills could help Chinese adolescents effectively alleviate effects of academic stressors on well-being. With this purpose, data of 15-year-group from Suzhou China in Survey on Social and Emotional Skills (SSES) 2019 conducted by Organisation for Economic Co-operation and Developments (OECD) were analysed. And five mediations models were constructed based on Wheaton’s (1985) additive version of Stress-buffering model, which highlights the mediating effects of coping resources on the impact of stress. Given that there is very little literature that focuses on the stress-buffering effects of social and emotional skills, the Stress Appraisal and Coping theory (Lazarus & Folkman, 1984) was also introduced to explain the underlying theoretical logic for stress-buffering to depict the protective role of coping resources and clarify why social and emotional skills can be assumed to function as coping resources in the hypothesized mediation models. Structural Equation Modelling (SEM) was chosen as the statistical technique to perform the mediation analysis, because it is flexible and powerful enough to represent the properties of studied variables and structural relationships, compared with other statistical techniques (Bollen, 1989; Byrne, 2012).

The relevance of this study extends beyond theoretical and empirical perspectives on adolescents’ coping with stress to practical implementations of social and emotional skills. It is not only related to adolescents’ well-being and education initiatives in China or even other backgrounds, but also has potential enlightenment for global quality education, as well as the overall health and well-being of citizens. Firstly, this research contributes to the literature on social and emotional skills by demonstrating the important role of the five domains of skills in possibly reducing the effect of

¹ Why these competences or characters are linked to social and emotional skills are explained in Appendix 1.

academic stressors on adolescents' well-being. This is perhaps the first study that empirically focuses on the stress-buffering role of social and emotional skills among Chinese adolescents. In addition, this could also contribute to the empirical evidence supporting the *additive stress-buffering*, which represents a more complete stress-buffering model, yet is not regarded enough by researchers. Secondly, it will provide China the empirical evidence on how social and emotional skills can protect their students' well-being by suppressing effects of academic stressors, and how different aspects of social and emotional skills may aid in the suppression. Hopefully, this will alert policymakers, educators, and even parents to the significance of facilitating adolescents' social and emotional skills, leading to more interventions to help them handle stress and challenges in life. Finally, knowing the benefits of social and emotional skills in suppressing or buffering stress may lead to an increase in social and emotional learning (SEL) interventions that improve the quality of education and mental health among adolescents, as well as other students' groups, promising the students' future life quality and flourish, hence the whole society well-being.

Statement of Sustainability

Firstly, this topic is closely connected to adolescents' mental health and well-being, which will contribute to the third goal of Education of Sustainable Development (ESD)—*Good health and well-being* (UNESCO, 2017). Social and emotional skills have been demonstrated not only to protect students' mental health, but also to improve their well-being. This research will deepen our understanding of social and emotional skills' stress-buffering effects, hence provide empirical evidence and practical directions for educators and policymakers to develop interventions to facilitate adolescents' social and emotional skills to manage academic stress and promote well-being. Secondly, this study also can be related to the fourth goal of ESD—*Quality Education*. Because in the process of handling academic stressors with their social and emotional skills, adolescents will “recognize the importance of their own skills for improving their life”, and social and emotional skills can enable them to understand themselves more deeply, and consequently “identify their own learning needs in their personal development” (UNESCO, 2017, p.18). These are the important requirement in *Quality Education*. Finally, this research may potentially nurture the foundation of the seventeenth goal of ESD—*Partnerships for The Goals*. Social and emotional skills will improve adolescents' collaboration skills, including abilities of empathy, trust, and co-operation. These will help them more easily “experience the sense of ... sharing values and responsibilities based on human rights” and “become a change agent to realize SDGs and to take on their role as an active, critical and global sustainability citizen” (UNESCO, 2017, p.44).

Key Concepts

Social and Emotional Skills

Social and emotional skills generally refer to assets of personal traits that are expressed as consistent patterns of thoughts, feelings, and actions. These characteristics can evolve over time, and they are increasingly critical for individuals to successfully adapt to diverse and changing societies and environments (Chernyshenko et al., 2018; Kankaraš, 2017).

Social and emotional skills have been the focus of interdisciplinary research involving researchers, educators, and practitioners from various backgrounds. As a result, there are numerous terms used to depict these interrelated skills and their conceptual frameworks (Kankaraš, 2017), such as ‘21st century skills’, ‘non-cognitive skills’ (Lippman et al., 2015), ‘social and emotional intelligence’ (Mayer et al., 1990), ‘emotional literacy’ (Seron, 2020), ‘social and emotional competence’ (Elias et al., 1997), and so forth. In the education field, social and emotional learning (SEL) is a commonly used phrase that refers to those social and emotional competences and non-academic skills (Lippman et al., 2015).

There is no consensus as regards a clear operational definition. In the Survey of Social and Emotional skills (SSES), OECD defines social and emotional skills as: “...individual capacities that can be (a) manifested in consistent patterns of thoughts, feelings and behaviours, (b) developed through formal and informal learning experiences, and (c) important drivers of socio-economic outcomes throughout the individual’s life” (OECD, 2015, p.35). The term *skills* was used instead of *traits*, as it suggests potential for change and development.

Social and emotional skills have been suggested to play a key role in enhancing cognitive abilities (Chernyshenko et al., 2018). And substantial amount of accumulated evidence demonstrates that social and emotional skills profoundly impact key life outcomes, including education, employment, health, and personal well-being (Chernyshenko et al., 2018; Kankaraš, 2017; Kautz et al., 2014; OECD, 2015). Especially for mental health and subjective well-being, social and emotional skills have even been found to have a stronger correlation with them than with intelligence quotient (IQ) and other cognitive skills (Chernyshenko et al., 2018). These skills are also of importance for societies and nations, since they have been suggested to be associated with higher levels of civic participation, volunteering, and social cohesion with greater interpersonal trust and acceptance, and additionally, and they also contribute to reducing anti-social and criminal behaviours while enhancing overall safety (Heckman et al., 2013; Heckman & Kautz, 2012; Kankaraš, 2017; OECD, 2015; B. W. Roberts et al., 2007).

Academic Stress and Academic Stressors

Stress is characterized as a dynamic interplay between an individual’s internal condition and the external environment (Cohen et al., 1997). When using the concept of stress, it is important to avoid the mistake of assuming the outcome. We cannot just assess stress by looking at events or conditions that have been seen to cause distress and then use that assessment to predict or explain distress. A better approach is to measure stress based on potential sources of stress, which are commonly known as *stressors* (Wheaton, 1983). According to Lazarus and Folkman (1984), stressors typically motivate individuals to manage behavioural challenges and the associated emotional responses they elicit. As stressors build up, individuals may exceed their capacity to cope or adapt, depleting their physical and

psychological resource, which can then increase the possibility of developing illness, disease, as well as experiencing psychological distress or disorders (G. W. Brown & Harris, 1978; Lazarus & Folkman, 1984; Pearlin, 1989).

Academic stress refers to the pressure related to expected disappointment in academics or awareness of the potential for failure (Gupta & Khan, 1987). The way students deal with academic pressure can be contextualized through their interaction with external stressors, their cognitive appraisal of the situation, as well as the strategies they use to cope with academic stress and their psychological or physical reactions to it (Misra & Mckean, 2000). Academic stress among students have long been researched, and it is demonstrated there are some differences across different cultural backgrounds. The study from Seiffge-Krenke et al. (2009) suggested, in the Western countries, early and middle adolescents often face higher levels of family and romantic stress, while late adolescents tend to encounter more academic stress. And the factors for western students' academic stress mainly come from sources such as academic frustration, the burden of homework, and test anxiety (Lal, 2014). Generally, in the Western context, parental expectations are typically not a main source of academic pressure (AKGUN & CIARROCHI, 2003). In contrast to their Western counterparts, Chinese teenagers experience high levels of academic pressure throughout their whole adolescent period (Liu & Lu, 2011). For instance, a survey for 538 Chinese secondary school students found that 56% of the studied students reported academic pressure as their main source of stress (Li et al. 2007). Lou and Chi (2000) surveyed 2,986 high school students in Shanghai, and stated the primary source of stress for these students was related to academics. And Greenberger et al. (2000) found that the correlation between academic performance and mental well-being may be stronger in Chinese students than their peers in America. Empirical studies emphasized that two of the largest contributors to Chinese students' academic stress are parents' and teachers' expectations and competitions with their peers (Gu, 1999; Zhen, & Chen, 1999; Lou & Chi, 2000; Zhang, & Du, 2005; Ang & Huan, 2006; Burnett & Fanshawe, 1997; Lay et al., 1998; Sun et al., 2012; Zhou et al., 2023). This has been caused by the complexity of social and cultural backgrounds. In China, education has been quite important, as people see academic success as a way to gain admission into reputable universities, build a remarkable career and achieve financial success (L. J. Lau et al., 2000). In combination with the Confucian Heritage Culture, education is highly regarded by Chinese families, and Chinese students demonstrate a stronger feeling of responsibility towards their parents and family in comparison to students from Western countries (C. J. Yeh & Huang, 1996). Failing to meet personal and societal expectations can have significant consequences, leading to a loss of face, confidence, and the support of family and community (C. Yeh & Huang, 1996). As such, Chinese students are taught to be extremely sensitive to the opinions of others, particularly significant others like parents or teachers. Therefore, this study chose two scales from SSES 2019—*parents' and teacher's expectations* and *school competitiveness*, to measure *academic stressors* of the studied Chinese students.

Subjective Well-being

Well-being is an important measure of the quality of life alongside other social and economic dimensions (R et al., 2013). It involves considering various aspects of people's lives and understanding their relative significance, therefore, it is difficult to be defined (OECD, 2011). However, they have been given brief definitions and explanations. For example, the World Health Organisation (WHO) stated that "well-being exists in two dimensions, subjective and objective. It comprises an individual's experience of their life as well as a comparison of life circumstances with social norms and values" (Europe, 2013, p.1). And well-being is considered as a crucial element in the concept of health: "Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (Europe, 2013, p.4). The two definitions implies that well-being and health are interactive concepts with shared factors. Health impacts overall well-being, while well-being also plays a role on future health (Europe, 2013).

Similarly, OECD defined well-being as “people’s living conditions and quality of life” and as “people’s evaluations and feelings about their own live” (OECD, 2011, p.19). With this definition, OECD has stressed the importance of considering both objective and subjective aspects when assessing people’s well-being. While objective components provide essential information about living conditions, it is also crucial to understand individuals' evaluations and feelings toward their own lives in order to grasp the psychological aspects of well-being and the connection between objective and subjective elements (OECD, 2020).

Subjective well-being generally encompasses reflective cognitive evaluations, such as life satisfaction, as well as the emotional reactions to daily experiences in terms of positive and enjoyable emotions compared to negative and distressing emotion (Diener, 1984). Thus, subjective well-being provides the psychological devices that depict both physical and emotional stability of people’s life (Rivera-Vargas & Oyanedel, 2023), not just temporarily but for the long term (Veenhoven, 1994). When individuals look back on their lives and make assessments about their overall life or specific areas like work and health, they measure these against their own idea of what makes a good life. Thus, what factors lead to well-being in life are decided by the respondents themselves rather than by researchers. Likewise, when individuals feel active emotions, it is because they are reacting to situations in their lives that they view as positive (Diener et al., 2018).

Subjective well-being is highly related to mental health, which was defined by WHO as a state of well-being, in which an individual realizes his or her own skills, deals with everyday pressures, is productive at work and contributes to the community (Europe, 2013). This aligns with Antonovsky’s (1979) salutogenic perspective of health. Derived from stress appraisal and coping theory (Lazarus & Folkman, 1984), the salutogenic model (SM) of health tries to explain how individuals maintain well-being despite the constant presence of stressors (Mittelmark et al., 2017). In this model, Antonovsky empathized that the hypothesis that health is a function of the absence of stressors should be dismissed. Because stressors are a common part of human beings, and they are involved under any environmental conditions and at all stages of development (Sullivan, 1989). Antonovsky (1987) stated, encountering a stressor creates a state of internal tension in an individual that can have both positive and negative effects on health. Successfully managing this tension through effective strategies can improve one’s ability to handle stressors, leading towards better health outcomes. However, if the tension is not managed successfully and exceeds an individual’s resources, it can result in distress and ultimately contribute to health problems, alternatively, impaired well-being. Consequently, individuals’ specific reactions based on the adequacy of available resources to stressors should be considered as a determinant of health.

Theoretical Frameworks

Three theoretical frameworks were implemented in this study underpinning the process of data collection, analysis, and interpretation: Big Five Model, Stress Appraisal and Coping Theory, and Stress-Buffering Model. They laid the foundation of constructing important variables and structuring the relationships between the variables.

Big Five Model

The Big Five Model was used to construct the assessment framework of social and emotional skills in Survey of Social and Emotional Skills (SSES) 2019. It does not align with a specific theoretical perspective, but it has built up substantial empirical evidence (John et al., 2008). It aims to identify the basic framework of key aspects of human personality. This system provides a concise and thorough method for capturing unique variations in all personality traits expressed through natural language (John & De Fruyt, 2015). The Big Five framework evolved from numerous distinct research endeavours carried out by diverse researchers. Based on the research conducted by Allport and Odbert (1936), who discovered a wide range of words describing personalities, several psychologists working separately and using different datasets reached the conclusion that personality traits can be categorized into a comparable five-factor model. In other words, the Big Five model developed from multiple research streams carried out by various researchers (Costa & McCrae, 1992; Digman, 1990; Norman, 1963; Tupes & Christal, 1992). This is not just applied to Western societies. Similar personality structures have been found in many countries across the world (McCrae & Costa Jr., 2006). And this consistency in results has helped make this model widely accepted (John et al., 2008).

The Big Five model comprises five broad personality dimensions: Conscientiousness, Extraversion, Agreeableness, Emotional Stability (also called Neuroticism), and Openness to Experience (Borkenau & Ostendorf, 1990; Christal, 1992; Digman, 1990; Goldberg, 1990; McCrae & Costa, 1987; Tupes & Christal, 1992). Each dimension of personality captures a group of interrelated emotions, thoughts, and actions. Research has demonstrated that these personality factors based on Big Five can be measured and are indicative of various results in life, like well-being, physical health, academic achievement, and work performance, etc. (B. Roberts et al., 2007). Furthermore, these personal traits are not fixed at birth but can be shaped by a person's environment and improve throughout lifetime (Helson et al., 2002; Srivastava et al., 2003).

After evaluating numerous models for social and emotional skills, John and De Fruyt (2015) found that the Big Five structure of personality traits was most suitable for the needs of the OECD's Survey on Social and Emotional Skills (SSES). Most of the practical research on how social and emotional traits develop and their long-term effects has used measurements based on Big Five model. For example, a group of economists from three different countries pointed out that non-cognitive skills have been largely neglected in current policy debates and economic models, despite being extensively researched by personality psychologists for the last century, who have developed a widely accepted classification of these skills known as the Big Five (Kautz et al., 2014). Similarly, the National Academy of Sciences in the United States stated in their report *Education for Life and Work* (2012): "the 'Big five' model of personality has been widely accepted to characterize competencies in the interpersonal and intrapersonal domains" (p. 28).

Since the Big Five model was first developed based on studies of adults, the SSES team of OECD looked at a lot of research done on children and found that youths' social and emotional skills, like

those of adults, can be organized into broader domains that can then be broken down into more specific sub-domains (Chernyshenko et al., 2018). They also found that the Big Five model is a reliable way to measure these skills in both childhood and adolescence (Caspi & Shiner, 2006; De Fruyt et al., 2015; Measelle et al., 2005; R. Shiner & Caspi, 2003; R. L. Shiner, 1998; Soto et al., 2008; Tackett et al., 2008, 2012). Recent studies have found that measures of sub-domains are better predictors than broad domains, because sub-domain measurements are more detailed and accurate, providing clearer guidance for potential interventions (Ashton, 1998; Paunonen, 1998; B. W. Roberts et al., 2005). That is why SSES 2019 follows John and De Fruyt’s (2015) suggestion to include measures of the Big Five sub-domains. As such, the Big Five model serves as an integrative tool that presents a shared, experience-driven framework for the social and emotional measurement in SSES 2019 to define social and emotional skills in five domains: **Collaboration (COL)**, **Engaging with others (EWO)**, **Emotion regulation (EMR)**, **Open-mindedness (OPN)** and **Task performance (TAP)**. And this is how social and emotional skills is presented in this study.

Stress Appraisal and Coping Theory

Stress-buffering model is the basic theoretical framework for this study to present how social and emotional skills act to *buffer* the impact of academic stressors on subjective well-being. However, before elaborating Stress-buffering, we need to refer to Stress Appraisal and Coping Theory firstly, because it explains the underlying theoretical mechanisms for stress-buffering to depict the protective role of coping resources, and why social and emotional skills can be assumed to function as coping resources in the hypothesized mediation model in the resent study.

Stress Appraisal and Coping Theory is one of the theories that focus on the specific relationship between external demands (stressors) and bodily processes (stress). It provides a comprehensive framework for understanding how people interact with their stressors in real life (Krohne, 2001). In this theory, Lazarus and Folkman (1984) emphasized *appraisal* and *coping* as the two critical processes in an individual’s response to stressors. *Appraisal* involves the way individuals perceive and understand stressors and challenges, which are assessed based on their perceived level of threat, change, or controllability (Lazarus & Folkman, 1984). There are two basic forms of appraisal: primary appraisal is about whether something of relevance to the individual’s well-being happens, while secondary appraisal concerns an individual’s available resources and coping strategies (Folkman et al., 1986). *Coping* is initiated when an individual’s appraisal indicates that important objectives have been threatened (Lazarus & Folkman, 1984). Lazarus and Folkman (1984) defined coping as the “cognitive and behavioural efforts to manage external and/or internal demands that are appraised as taxing or exceeding the resources of the person” (p. 141). Basically, behaviour efforts are defined as problem-focused coping, which attempts to address the stressor directly by changing the person’s environment, while cognitive efforts refer to emotion-focused coping, which focuses on managing emotions or altering one’s perception of the challenging situations (Folkman & Moskowitz, 2004; Grech et al., 2018).

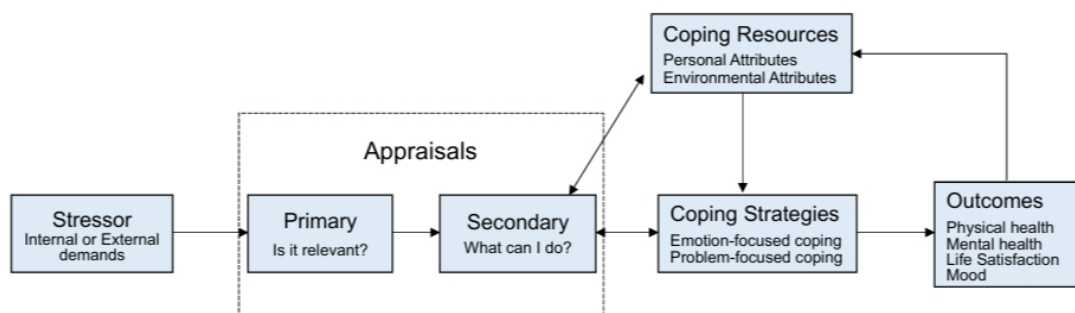


Figure 1 The Model of Stress Appraisal and Coping (Lazarus & Folkman, 1984; Margaret et al., 2018)

According to Stress Appraisal and Coping Theory (Lazarus & Folkman, 1984), life events are not equally stressful to all people, and there are variations in how individuals react to stress. This means that the same level of stress or stressors can affect people's well-being in different ways. The issue of differential impact has been a major concern, especially regarding the coping resources and/or the behavioural coping strategies of individuals exposed to events. Coping resources and specific strategies both play a crucial role: resources come before behaviours, while strategies are the actual focus and decisions in behaviour. The two are not mutually exclusive. Personal resources could potentially influence the inclination to use specific coping strategies (Wheaton, 1983). Pearlin and Schooler (1978) highlighted that the influence of coping resources, in contrast to coping strategies, on feelings of distress is as strong or even stronger in three out of four life roles. Coping resources can be distinguished as environmental or personal. Environmental resources are generally described in relation to the availability of social support, especially from family, friends, or colleagues (Liem & Liem, 1978). Personal resources are *facets of personality*, which influences how individuals respond to stress and can help them cope more effectively in challenging situations (Wheaton, 1983, p.210). And in the empirical literature, focus has been primarily on the significance of environmental resources, especially social support (Aneshensel & Stone, 1982; G. W. Brown & Harris, 1978; Dean & Lin, 1977; Gore, 1978; LaRocco et al., 1980; Lin et al., 1979; Pearlin & Schooler, 1978; Thoits, 1982b, 1985; B. A. Turner, 1983; R. J. Turner, 1981), but Kohn (1972) argued that variations in the availability of environmental resources are not enough to account for the differential effects of stress among, for example, social classes. In this context, it is important to take into account individuals' personal resources. People with adaptive coping resources and a positive personality can manage stressors more effectively compared to those who are biologically susceptible and do not have adequate coping resources (Schneiderman et al., 2005).

Based on the above illustrations, the whole process of stress appraisal and coping is demonstrated in Figure 1.

As what have been elaborated in the 'Key concepts' section and 'Big Five model' part, social and emotional skills are assets of personal traits that are expressed as consistent patterns of thoughts, feelings, and actions (Chernyshenko et al., 2018; Kankaraš, 2017). And for SSES 2019, OECD as well adopted the Big Five model as a base of measurement of adolescents' social and emotional skills. Additionally, empirical research has demonstrated that good interpersonal skills (engaging with others, collaboration) have a positive impact on the utilization of social support as a coping strategy (Rowse et al., 2016), better problem-solving strategies (task performance) and a growth-oriented mindset (open-mindedness) may help in developing more effective coping methods (Molden & Dweck, 2006; Wong & Power, 2019), and emotional regulation and optimistic mindset have been found to be closely linked to emotion-focused coping (Compas et al., 2017). Those evidence provides the confidence to state that social and emotional skills can effectively assist people with developing effective strategies to deal with stressors. The whole reasoning process indicates social and emotional skills can be regarded as an appropriate set of personal resources for stress coping.

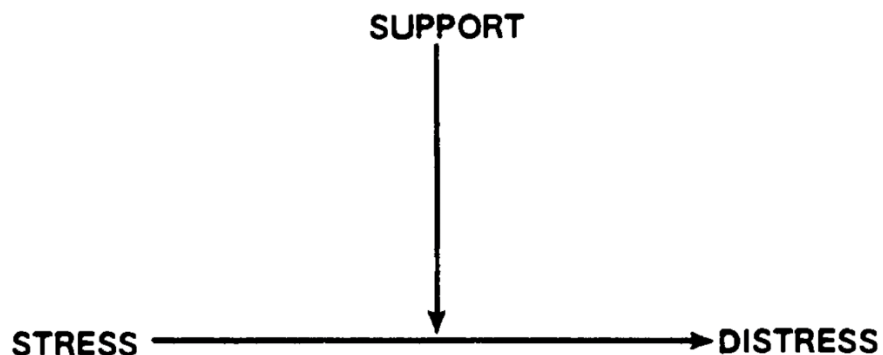
Stress-Buffering Model: The Additive (Mediation) Model

The development of stress-buffering theory is initially related to researchers' great interests in the coping effects of social support. As we stated in last part, "focus has been on the significance of environmental resources, especially social support". Studies in the 1970s and 1980s first looked into how social support relates to stress, noting that it is a key factor in determining health and well-being, particularly when dealing with stress (Minkler, 1981). Cohen and Syme (1985) introduced the stress-buffering theory, which implies that social support can mitigate the adverse effects of stress on health. Building on this model, Cohen and Wills (1985) expanded it further by presenting a conceptual framework. Their model suggests that social support works in two primary ways: by directly reducing the impact of stress and indirectly shaping an individual's perception of stressful situations. At the same time, some research pointed out that personal coping resources may also be important for

minimizing the impact of stress (e.g. Antonovsky, 1979; Kobasa et al., 1981; Kohn, 1972; Lefcourt et al., 1981; Wheaton, 1983). Some researchers have looked into other variables such as ‘internal locus of control’ (e.g. Johnson & Sarason, 1978; Kobasa, 1979; Kobasa et al., 1982; Lefcourt et al., 1981) and personal competence (e.g. Husaini et al., 1982) as possible moderators of life stress. Husaini et al. (1982) found that people who lack both internal (personal) resources or external (environmental) resources are more likely to show depressive symptoms when experiencing life stress compared to individuals who have these resources. The findings of this study generally supported the idea that personal and environmental resources can mitigate the impact of stress on health.

There was some ambiguity about what types of results actually indicate *stress-buffering* processes. However, it is clear that stress-buffering primarily involves reducing the impact of exposure (stressors) to stress. This implies that the effects of stress should be somewhat reduced by the operation of the coping resource in the model (Wheaton, 1985). A relatively common argument is that *stress-buffering* works through the interaction between potential stressors and coping resources, leading to a decrease in the impact of stress when access to important resources increases (Billings & Moos, 1981; Dean & Lin, 1977; Pearlin & Schooler, 1978). This is a well-known concept of ‘stress-buffering’ and the majority of researchers have been interested in this *interactive* framework. Within this framework, a coping resource is defined as a condition or set of conditions under which the effects of stress are notably reduced (see Figure 2A) (Wheaton, 1985). However, this prediction is only about the direct effect of stress which is part of the total effect (Alwin & Hauser, 1975). As the total effect is the sum of direct and indirect effects of stress through coping resource variables, indirect effects become critical to determine the involvement of stress-buffering (Alwin & Hauser, 1975). Therefore, there were a small number of researchers who also referred to an additive model of stress-buffering (Billings & Moos, 1981; Dean & Lin, 1977; Lin et al., 1979; Pearlin et al., 1981). In the additive model, stress-buffering occurs when an indirect effect of stress (via a coping resource) imposes against the direct effect of stress, resulting in a negative factor that suppresses, or buffers an otherwise positive effect of stress on distress. In this model, a resource that suppresses or mediates the effects of stress is described as an intervention, typically mobilized by increased stress levels, that leads to the inhibition of its overall causal effect (Wheaton, 1985) (see Figure 2B). Put simply, this means that in the additive model, stress *activates* a positive coping response which in turn negatively impacts on the distress (in the case of this study, the response positively impacts on subjective well-being).

**A. INTERACTIVE EFFECT BUFFERING:
THE RESOURCE AS A MODERATOR VARIABLE**



**B. ADDITIVE EFFECT BUFFERING:
THE RESOURCE AS AN INTERVENING, SUPPRESSOR VARIABLE**

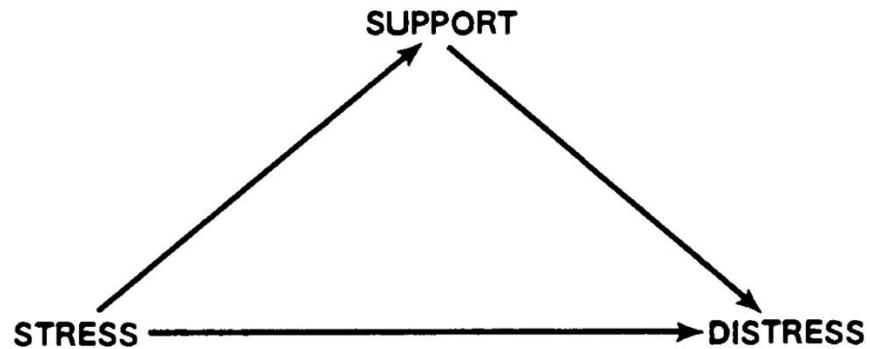


Figure 2 *Two Models Representing Stress-Buffering Functions of Coping Resources (with social support in the coping resource role) (Wheaton, 1985, p.354)*

Figure 2A represents the interactive model. This model requires an interaction between stress and social support such that the impact of stress can be reduced at higher levels of social support. Figure 2A depicts how support directly influences the effect of stress. In this model, a coping resource acts as a moderator (Wheaton, 1985).

Figure 2B represents the additive model. It shows the total correlation between stress and distress is the sum of two parts: (a) the effect of stress on distress controlling for support and (b) the effect of support on distress determined by how much stress impacts the level of support. These two parts refer to a direct effect of stress on distress and an indirect effect through consequent changes in the level of support. In this model, a coping resource acts as a suppressor or mediator (Wheaton, 1985).

Wheaton (1985) highlighted, to truly grasp stress-buffering, we need to refer to the overall model (additive model), rather than just a single equation (interactive model). For every equation that predicts distress based on stress and a coping resource, one should be estimated to examine how stress is related to the resource (additive model). Therefore, this study focusses on **the additive (mediating) version of stress-buffering model** to provide more empirical evidence. Specifically, the present study examined whether the five domains of social and emotional skills buffer the academic stressors effects on adolescents' subjective well-being via mediation.

Figure 3 below shows the hypothesized model of stress-buffering effect of five domains of social and emotional skills developed from Wheaton's (1985) additive Stress-buffering Model. In this model, stressors act as the independent variable, well-being acts as the dependent variable, and the five domains of social and emotional skills—Collaboration (COL), Engaging with others (EWO), Emotion regulation (EMR), Open-mindedness (OPN) and Task performance (TAP), act as mediators respectively. Specifically, *a* represents the stressor effect on skills, *b* represents the skills effect on well-being, and the product of *a* and *b* ($a \times b$) generates the indirect effect of stressor on well-being, while *c'* indicates the direct effect of stressor on well-being. Based on this model, the mediation models within Structural Equation Modelling (SEM) will be formulated for data analysis.

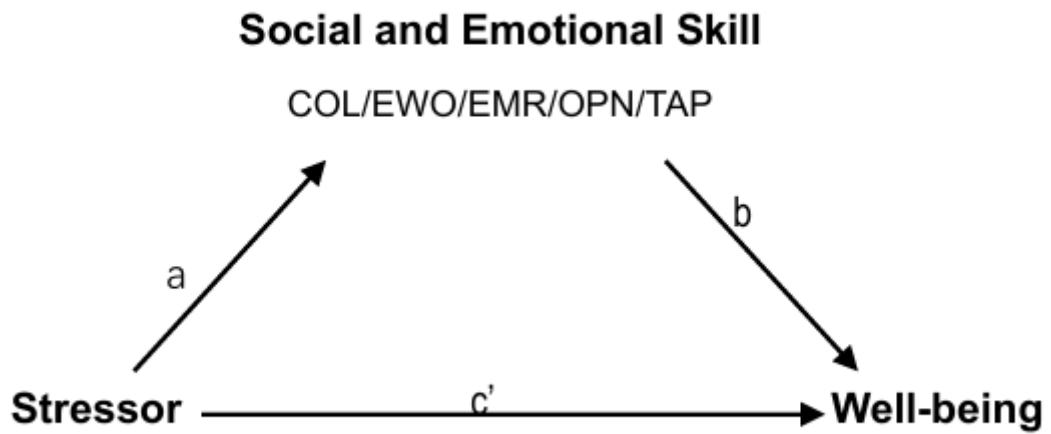


Figure 3 *The hypothesized model of stress-buffering effect of social and emotional skills based on Wheaton's (1985) additive version of Stress-buffering Model*

Empirical Literature Review

According to the researcher's review on the literature so far, no empirical study has directly focused on the relationship of social and emotional skills with academic stress and well-being among adolescents, but those social and emotional skills related competences or traits, including emotional intelligence, resilience, mindfulness, social skills, self-regulation, and ability to solve problems (see Appendix 1), have been demonstrated to be associated with stress and well-being. Therefore, the researcher conducted a systematic review on those studies, to get a full picture of the empirical evidence investigating the relationships among social and emotional skills related competences, (academic) stress, and well-being among adolescents, and to investigate what kinds of relationships have been explored, providing reference to the present study. The systematic review was undertaken through bibliographic databases online search based on GU Library, Education Database, ERIC, EBSCO host, Scopus, Web of Science and Google scholar. The search was not limited to specific time span and publication types. 147 studies were yielded to the screening process, during which they were screened and filtered sequentially by title, abstract, and full text, following some specific inclusion and exclusion criteria (see Appendix 2.1). Overall, 21 articles that satisfied all the inclusion criteria were selected for the review. The results are briefly presented below.

Among the 21 reviewed articles, 19 studies demonstrated there are significant correlations among social and emotional skills related competences, (academic) stress and adolescents' well-being. For example, Khorani et al. (2021) demonstrated a clear and substantial link between aspects of mental health and academic stress with the ability to solve social problems; Wen et al. (2021) backed the impact of mindfulness, both as a temporary state and a long-term trait, in alleviating stress and anxiety among elementary school students. 8 of the 19 studies suggested social and emotional skills related competences moderated the effects of (academic) stress on adolescents' well-being. For instance, 4 studies (Green et al., 2022; Jaureguizar et al., 2018; Wang et al., 2014; Zhong, 2009) demonstrated that perceived social or emotional support moderated the effect of students' academic stress on their well-being or mental health. Ciesla et al. (2012) highlighted mindful nonreactivity and nonjudgmental helped reduce the impact of life stress on negative emotions, while also reducing the effects of stress on recurring negative thoughts. Meanwhile, 6 of the 19 studies proved the mediating role of social and emotional skills related competences on (academic) stress and well-being relationship. According to Ho et al. (2023), resilience partially mediated the relationship between academic stress and depression, at the same time, life satisfaction moderated the indirect relationship between academic stress and depression through resilience. Versteeg and Kappe (2021) revealed a significant serial mediation model showing that educational support could mitigate the impact of academic stress on depression. On the other hand, 2 studies could not support that perceived social support or emotional intelligence would protect adolescents' mental health from (academic) stress. Data of Chen (2018) concluded none of the perceived social supports were found to moderate the relationship between academic stress and depression; Nyarko et al. (2020) highlighted high levels of EI could not protect adolescents' mental health from stressful life events.

At the same time, there were 3 of the 19 studies suggesting that (academic) stress acted as a mediating role on the relationship of social and emotional skills related competences with adolescents' well-being. For example, the results of Shirmohammadi et al. (2023) showed that, perceived academic stress played a mediating role in the connections between self-compassion and self-regulation with academic well-being among students; Schoeps et al. (2019) revealed perceived stress can mediate the association between the emotional competencies and life satisfaction; additionally, Weinstein et al. (2009) tested the mindfulness – anxiety mediation by stress processes, and the results indicated a

significant mediation effect for both stress and avoidant coping in this model. However, this does not mean the results of the 17 articles were contradictory to each other. Their different results more possibly remind us that the relationships among social and emotional skills related competences, academic stress and well-being may go beyond one single moderation or mediation structural model. For example, their relationships may be as complicated as a bidirectional mediation model, which means there is a bidirectional relationship between social and emotional skills related competences and academic stress, and they mediate each other's relationship with well-being. Or social and emotional skills related competences may act as both mediator and moderator roles (dual roles) on the relationship between academic stress and well-being.

Only 5 of the 21 studies were conducted based on theories or theoretical frameworks. The stress appraisal and coping theory was introduced by 3 articles in the same way as a foundation of constructing important variables. For instance, Chen (2016) and Austin et al. (2010) utilized it to build the latent variable '(stress) coping styles' by adopting the measurement tool—The short form of coping inventory for stressful situation Endler and Parker (2018) and based on this, three observed variables—task-oriented coping style, emotion-oriented coping style and avoidance coping style—were developed to indicate '(stress) coping styles'. 2 articles—Aloia and McTigue (2019), and Green et al. (2022), employed stress-buffering theory in their research as theoretical frameworks, to structure the relationships among social support, academic stress, and well-being. Aloia and McTigue (2019) “contend that academic stress is alleviated by supportive informational and emotional communication to improve psychological well-being” (p.128), and Green et al. (2022) hypothesized that “emotional support received moderates the relation between academic stress and mental well-being” (p.1750).

To conclude, among those reviewed studies, the mediator role of social and emotional skills related competences or traits on stress and well-being relationship has been proved or supported by Versteeg and Kappe (2021), Berdida and Grande (2023), and Ho et al. (2023), but none of them referred to stress-buffering. Simultaneously, although 2 articles—Aloia and McTigue (2019), and Green et al. (2022), employed stress-buffering theory as theoretical frameworks, they did not test the additive stress-buffering. Therefore, it is meaningful for this study to examine whether the five domains of social and emotional skills *buffer* the academic stressors effects on adolescents' subjective well-being via *mediation*, to try to add more evidence to the additive version of stress-buffering model.

Aims and Research Questions

The aim of the study is to empirically examine whether social and emotional skills could help Chinese adolescents effectively deal with academic stressors to promote their well-being. Additionally, this study desires to test Wheaton's (1985) additive version of stress-buffering model.

According to these research aims, the study asks two research questions:

1) Whether Chinese adolescents' academic stressors affect their subjective well-being through the indirect effect of the five domains of social and emotional skills—Collaboration (COL), Engaging with others (EWO), Emotional regulation (EMR), Open-mindedness (OPN) and Task performance (TAP), respectively?

2) If present, does the indirect (mediating) effect of each domain exert a stress-buffering function?

Methodology

This is a cross-sectional study based on secondary data from Survey on Social and Emotional Skills (SSES) 2019, which was initiated by OECD. To answer the research questions, the Structural Equation Modelling (SEM) technique was implemented. In this section, the data source, variables and statistical analysis methods and process are presented in detail. The validity and reliability of data and measurements are also elaborated. Data management and descriptive data analysis were conducted using the Statistical Package for the Social Sciences (SPSS) software version 29.0. Structural Equation Modelling (SEM), including Confirmatory Factor Analysis (CFA), was performed to test mediation models using Mplus version 8.3.

Data Source and Sampling

SSES 2019 is one of the earliest global initiatives to collect a wide range of data about students' social and emotional skills in family, school, and community learning settings. This aims to assist education leaders and practitioners in providing better support for their students (OECD, 2021). The survey is based on the idea that a comprehensive approach, which supports both cognitive and non-cognitive development, is most effective in empowering children to reach their full potential. While schools typically prioritize traditional academic knowledge and abilities, SSES 2019 seeks to broaden education policies to incorporate social and emotional skills alongside the conventional academic domains and cognitive abilities (Kankaraš & Suarez-Alvarez, 2019).

Ten different cities from nine OECD countries took part in SSES 2019. The study looked at social and emotional skills as well as contextual information about students in two age groups: those who are at least 10 years old and in grade 2 or higher, known as the younger cohort, and those who are at least 15 years old and in grade 7 or higher, known as the older cohort (Eva, 2021).

The sampling process involved a two-stage stratified cluster sample. In the first stage, cities for each group were divided into specific categories based on similar traits. Schools were then selected separately by group and category, with the likelihood of selection being greater for schools with larger student enrolments. In the second stage, a certain number of students specified by the Target Cluster Size (TCS) were chosen from each participating school. If a school had fewer eligible students than the TCS, then all students in the school were selected to participate. Chosen students then took part in the SSES survey, and their teachers and parents were also involved by filling out questionnaires (Eva, 2021) (Eva, 2021).

Assessment Instruments

SSES 2019 project developed two main types of questionnaires: scales for assessment of students' social and emotional skills and contextual questionnaires.

Assessment of students' social and emotional skills in SSES 2019 was based on the Big Five Model—that distinguishes five dimensions of social and emotional skills: task performance (TAP), emotional regulation (EMR), open-mindedness (OPN), collaboration (COL), and engaging with others (EWO). Each of these five broad domains consists of a group of linked behaviours or thoughts and can be broken down into more specific sub-domains, which are more detailed, precise, and therefore simpler to measure (Abrahams et al., 2019; John et al., 2008; Lipnevich et al., 2017). Given that students may act differently in various settings, data regarding social and emotional skills were taken from students,

teachers, and parents, which is called triangulation of measures. This helped make measurements of students' social and emotional skills more objective and accurate (Kankaraš & Suarez-Alvarez, 2019).

Triangulation of measures were also applied to Contextual questionnaires. The survey gathered contextual details from students, their parents, teachers, and school principals to gain insights into various aspects, including students' socio-demographic background, family environment, school environment, peer environment and wider community environment (Kankaraš & Suarez-Alvarez, 2019). Apart from background information, Contextual questionnaires also measured students' various life outcomes: academic achievement, active citizenship and civic participation, social connectedness, health, well-being (current psychological well-being, life satisfaction and test anxiety) and behaviours (Kankaraš & Suarez-Alvarez, 2019).

Given the time and technique limitations, the current research only adopted data from the direct assessment of social and emotional skills and contextual questionnaires via students' self-reports, such that more efforts were put on the analysis to answering research questions. This approach might be not as rigorous as the triangulation of measure (collecting information from students, parents and teachers at the same time), but students' self-reports are in general able to describe students' typical behaviours, thoughts and feelings in the intended way (Heine et al., 2008; Krosnick, 1999). And most social and emotional skills measurements are based on self-report questionnaires by far, which have consistently shown to yield reliable results, often closely providing objective measures (Connelly & Ones, 2010; Duckworth et al., 2010).

Validity and Reliability of SSES 2019

Validity and reliability of measurement instruments are the two most important and essential elements that enable research to generate high-value and quality results (Heale & Twycross, 2015; Kimberlin & Winterstein, 2009). This current study was based on secondary dataset from OECD, which means the survey tools were developed by a team of professionals in statistical measurement area with scientific and rigorous process.

Validity refers to whether the measuring instrument accurately assesses the behaviours or characteristic it is intended to evaluate (Anastasi & Urbina, 1997). Content validity, criterion validity and construct validity are three distinct and important aspects to convincingly demonstrate our measurement validity (Muijs, 2004). Content validity assesses whether the contents used in the manifest variables are suitable for measuring the latent concept (Muijs, 2004). An important factor in determining if an instrument has content validity is how well it aligns with a theory of how the concept works and what it is. Additionally, content validity can be also achieved by thoroughly reviewing the literature on the concept a study aims to measure (Muijs, 2004). Similarity, what is needed to establish criterion validity are two things related to theory: a solid understanding of the theory behind the concept, and an evaluation of how our measure relates to those factors (Muijs, 2004). As stated in the previous sections, SSES framework is structurally and conceptually aligned with a well-researched framework—the Big Five Model. With this solid theoretical foundation, the instrument was comprehensive and elaborate (Eva, 2021). Meanwhile, in the current study, all the constructs or scales derived from the student contextual questionnaire were all developed based on some existed measures from other OECD studies like PISA (subjective well-being and socio-economic backgrounds) or some empirical literature (academic stressors) or based on a well-researched and tested process by the SSES team (details see 'Measurements and Descriptive Statistics' section). Therefore, the measurement of all the variables in the present study, were developed based on a solid theoretical and/or empirical foundation, which are strong evidence for the content and criterion validity of the measurements.

Construct validity is concerned with how well an instrument actually measures the theoretical construct it is supposed to measure (Sürücü & Maslakçi, 2020). As these social and emotional skills assessed in SSES are latent constructs, they have to be estimated based on the responses to sets of items that are observable. Therefore, it is crucial to evaluate the construct validity for the assessment

of these psychometric properties of items and scales. A series of repeated modelling and analysis steps were conducted for SSES 2019 to validate these measurements, including confirmatory factor analysis (CFA), multiple group confirmatory factor analysis (MGCFA) and IRT (Item Response Theory) Generalised Partial Credit Model (GPCM). More details and the results can be seen in Chapter 12 of Eva (2021). However, in this study, to obtain measurement models that were more precisely fitted into the Suzhou older cohort data, validation of the measurements of social and emotional skills were conducted specifically by applying CFA. Therefore, all the initial items and measurement pattern of scales of assessment students' social and emotional skills were adopted firstly, then some modifications were made according to the results of CFA after fitting into the sample data to achieve satisfactory model fits (see 'Model modification' on p.29 and 'Confirmatory factor analysis' of 'Results' section).

For any international large-scale assessment like SSES, it is critical to ensure that the developed scales are comparable across various national settings and sub-groups within the populations being assessed (Eva, 2021). This can enhance the construct validity of the measurement instrument. To review measurement invariance of SSES data, MGCFA modelling was carried out considering three grouping variables: age cohorts, gender groups, and cities. More statistical details and results refer to Chapter 12 of Eva (2021). In summary, to improve the overall invariance levels across cohorts, cities, and gender groups, modifications were made according to the combined results of CFA models and IRT GPCM (Eva, 2021). For this study, the target sample were the 15-year-old group Chinese students from Suzhou, which means there was no comparison across cohorts or cities. And according to the invariance test results for gender groups, boys and girls generally had similar response patterns for most of the items (Eva, 2021). Consequently, there was no influence to implement the initial measurement models of scales of social and emotional skills for the Suzhou order cohort sample in this study, without any tests of measurement invariance.

On the other hand, reliability refers to the consistency of measurements across different conditions, where similar results are expected to be consistently obtained (Nunnally, 1978). SSES 2019 utilized Cronbach's alpha and omega coefficient to calculate internal consistency reliability both for scales of social and emotional skills assessment and contextual questionnaire. For both measures, reliabilities above 0.7 are generally regarded as satisfactory and values above 0.8 indicate high degree of reliability (Nunnally & Bernstein, 1994). Results showed that all 15 scales had satisfactory reliabilities. The omega coefficients were similar to the alpha coefficients across scales. The scale reliabilities for student direct assessment data in the older cohort were above 0.70, showing satisfactory internal consistency of reliability. More details see Chapter 12 of Eva (2021). Related to the Suzhou older cohort student direct skills assessment scales and contextual questionnaire data (variables used in the current study), results of reliabilities (Cronbach's alpha) are shown in the 'Measurement and Descriptive Statistics' section.

Suzhou Dataset and Data Management

This study focuses on the Suzhou population in SSES (2019). Suzhou of China is one of the largest cities that participated in SSES 2019, with 10.7 million inhabitants. It is located in one of the most developed regions in eastern China and is renowned for its high-quality education (OECD, 2022b). Participants of this city were 3,647 10-year-old students and 3,621 15-year-old students from 151 primary and secondary schools in six districts and four county-level cities representing 150,964 elementary and middle school students in Suzhou (Eva, 2021). For this current research, studied sample were the older cohort (15-year-old group) Chinese students, because 15 years of age is a typically representative stage for adolescents, when students are experiencing life changes both physically and psychologically. Additionally, Chinese students aged 15 are transforming from middle school to high school, which means they are experiencing the greatest stress in their student academic career because of the high school entrance examination and the upcoming university entrance

examination. Among the 3,621 15-year-old students, 2,811 (77.6%) were enrolled in regular high schools, and 810 (22.4%) were in vocational high schools (OECD, 2022b).

All the implemented data files of the students' social and emotional skills assessment scales and contextual questionnaires of SSES 2019 were obtained from the public resources of OECD iLibrary², except that the social and emotional skills assessment scales were acquired by an application to the SSES project team of OECD. A series of data processing and cleaning procedures were carried out with SPSS to prepare data for the SEM analysis in Mplus: irrelevant variables or items were deleted; some items were renamed for the convenience of analysis under the same construct; all the used negatively worded items were reverse-coded, so that the highest value represented a higher attribute; all missing values were recoded into 9999; etc.

Missing data is frequently attributed to factors beyond the researcher's control and needs to be handled if it follows a non-random pattern and makes up more than 10% of the entire dataset (J. F. Hair et al., 2019). The portion of missing values for Suzhou order cohort data of SSES2019 ranged from 0 to 0.2%, which were well below 10%. However, some missing data happened because of a systematic loss of data, which means they were not missing at random. This was taken into consideration during the final SEM analysis process, by applying a maximum likelihood estimator with robust standard errors (MLR) under the ANALYSIS command, which uses all available data regardless of completeness.

Measurements and Descriptive Statistics

In the mediation models of this study, the mediator variables are *five scales of social and emotional skills- Collaboration (COL), Engaging with others (EWO), Emotional regulation (EMR), Open-mindedness (OPN) and Task performance (TAP)*. The independent variable is *academic stressors*, and the dependent variable is *subjective well-being*. They are all complex scales which were presented by multiple sub-scales based on the measurement of a series of observed indicators (items). There are also three control variables: gender, socio-economic status (SES) and immigration background. Student weights was also inputted to address the sampling bias. For those variables, scales of social and emotional skills and student weights were obtained from Suzhou 15-year-old students' direct assessment of social and emotional skills, and academic stressors, subjective well-being and control variables were derived from the Suzhou 15-year-old students' contextual questionnaires. In this section, the measurements of these variables, as well as their reliabilities (Cronbach's alpha) based on Suzhou order cohort data are elaborated. The descriptive statistics of the Suzhou data collected for these variables are also shown in detail.

Variables about Students' Socio-demographic Backgrounds

Three socio-demographic background variables were implemented as control variables in the current study: gender, SES and immigration background. SSES 2019 report shows that age, gender, immigration backgrounds, and SES, obviously influence students' social and emotional skills and their relationships with subjective well-being (OECD, 2021). Additionally, plenty of studies have shown that socio-demographic factors play a crucial role in shaping how adolescents perceive stress and well-being (Ronald et al., 2002; B. Y. Q. Tan et al., 2020). Thus, it is necessary to control for them to reduce their confounding effects in the mediation analysis. Because the main idea behind using control variables in research is to deal with predictor-criterion contamination by including confounding variables in statistical analyses (Spector & Brannick, 2011). Since the current study only focused on the 15-year-old group, the issue of age was excluded.

² Public resources of SSES 2019 dataset see <https://www.oecd.org/education/ceeri/social-emotional-skills-study/>.

Gender (Gender2) was represented as a dichotomous variable and coded using dummy values, with 0 indicating ‘Males’ and 1 indicating ‘Females’. Among the 3613 studied 15-year-old Chinese students, 1848 (51.1%) were girls and 1756 (48.6%) were boys, with 2% missing value (see Table 1).

Immigration backgrounds (IMMBACK) was also a dichotomous variable, which was dummy coded with 0 for ‘Native’ and 1 for ‘Immigrant Background’. In the studied sample, 2449 (67.8%) were native students, and 1162 (32.2%) students had immigrant background, with 0.01% missing value (see Table 1).

Table 1 Descriptive statistics of Gender and Immigrant Background

Scale		N	%	Missing Value	
				N	%
Gender	Female	1848	51.1	9	0.2
	Male	1756	48.6		
IMMBACK	Native	2449	67.8	2	0.1
	Immigrant	1162	32.2		

As a composite index, Socio-economic Status (SES) was measured by three indices: highest level of parental occupation (HISEI), highest level of parental education (PAREDYRS) and household possessions (HOMEPOS). For more information on this composite variable, see Chapter 14 of Eva (2021). The overall SES scores of this study were obtained directly from the dataset and were derived as component scores for the first principal component with zero being the score of an average respondent within each site and one being the standard deviation. In the Suzhou older cohort, according to the SSES 2019 principal component analysis (PCA) results, the standardised factor loadings of HISEI for the SES scale was 0.76, PAREDYRS was 0.80 and HOMEPOS was 0.74 (Eva, 2021). For more information on SES, see Tables 2.

Table 2 Descriptive statistics of Index of Socio-economic Status (SES)

Scale	Label	N	Minimum	Maximum	Mean	SD
SES	Index of Socio-economic Status	3604	-2.19	3.34	0.2606	0.8195

Independent Variable: Academic Stressors

The variable *Academic Stressors* was used as a predictor in the mediation models. This latent variable was derived from the SSES 2019 dataset based on the empirical evidence from literature on academic stress(or), which has been stated in ‘Key Concepts’ section. The measurement of *Academic Stressors* comprised 2 scales (6 items): parents’ and teachers’ expectations, and school competitiveness. The 4 items of *parents’ and teachers’ expectations* were responded on a 5-point Likert scale, with 1 indicating ‘strongly disagree’, 2 indicating ‘disagree’, 3 indicating ‘neither agree nor disagree’, 4 indicating ‘agree’ and 5 indicating ‘strongly agree’. And the 2 items of *school competitiveness* were answered on 4-point Likert scale, scoring from 1— ‘almost never or never true’, 2— ‘sometimes true’, 3— ‘often true’ to 4— ‘almost always or always true’. The two scales were measured by the related initial items that were offered in the student background questionnaire.

Descriptive statistics and reliability of *Academic Stressors* have been presented in Table 3. Based on the Suzhou dataset of the older cohort, the internal consistency reliability of the two scales were both over 0.7, resulting in an overall reliability for *Academic Stressors* of 0.718, which suggests that the items in the scale were reasonably correlated with each other. More careful tests and modifications for this construct model was carried out by CFA, the results will be presented in ‘Confirmatory Factor Analysis’ part of ‘Results’ section.

According to the mean values of Suzhou data, the 15-year-old Chinese students got more expectations from their parents than their teachers, and competitiveness with their peers in schools acted as a

weaker academic stressor compared with expectations from parents and teachers. This is consistent with the literature, which revealed that Chinese students got much more pressure from the high expectations of their parents and family (Gu, 1999; Zhen, & Chen, 1999; Lou & Chi, 2000; Zhang, & Du, 2005; Ang & Huan, 2006; Burnett & Fanshawe, 1997; Lay et al., 1998; Sun et al., 2012; Zhou et al., 2023). However, when referring to standard deviations, we can see the variability of students' perception of parent expectations was obviously higher than teacher expectations and school competitiveness, indicating that parents' expectations were more diverse from case to case. But generally, the Chinese students suggested they got moderate level of expectations from their parents and teachers and they perceived moderate level of peer competitions in their schools.

Table 3 Descriptive statistics and reliability of Academic Stressors

	Scale	Item	Item Label	Mean	SD	Cronbach's alpha
Academic Stressors	Parent And Teacher Expectation	STQM0340 1	Parents expect me to be perfect	3.45	0.893	0.775
		STQM0340 2	Parents expect me to do better than others	3.70	0.854	
		STQM0340 3	Teachers expect my work to be perfect	3.56	0.796	
		STQM0340 4	Teachers ask too much of me	2.86	0.759	
	School Competitiveness	STQM0380 3	Students value competition	2.59	0.743	0.870
		STQM0380 4	Students competing with each other	2.50	0.788	

Note. Reliabilities above 0.7 are typically regarded as satisfactory and values above 0.8 indicate high reliability (Nunnally & Bernstein, 1994). This standard applies to all the reliability values in this study.

Mediator Variables: Five Scales of Social and Emotional Skills

Scales of social and emotional skills are a set of complex scale factors, which were composed by three latent variables respectively. As stated in the previous sections, they were developed in reference to the Big Five Model with the aim of measuring social and emotional skills among young people (John et al., 2008). Based on this conceptual framework, SSES 2019 measured students' social and emotional skills with 15 latent constructs (120 items) that were grouped into five broad domains—Task performance (TAP), Emotional regulation (EMR), Collaboration (COL), Open-mindedness (OPN) and Engaging with others (EWO) (see Table 4).

The 15 scales under the five complex scales were measured by 120 items, 8 items for each scale. For each item, respondents were asked to describe to which degree they agreed with the statements according to their feelings, thoughts, and behaviours (e.g. 'I know how to control my anger'). Statements were positively or negatively worded. Responses were given on a 5-point Likert scale with scoring from 1 to 5. Accordingly, 1 represented 'strongly disagree', 2 represented 'disagree', 3 represented 'neither agree nor disagree', 4 represented 'agree' and 5 represented 'strongly agree'.

Collaboration (COL) (in Big Five Model—Agreeableness) involves the ability to be open to working with others, showing empathy, and demonstrating altruism (Kankaraš & Suarez-Alvarez, 2019). This ability was measured by Empathy (EMP), Trust (TRU) and Cooperation (COO). The descriptive statistics and reliability of this scale have been shown in Table 4. It is revealed that, for Suzhou older cohort dataset, the reliability of these three scales ranged from 0.783 to 0.862, and the overall reliability of the complex scale COL was 0.913. This indicates the items under this complex scale have quite good internal consistency. When referring to the descriptive statistics, we can see that the Chinese students perceived they had quite good capability of COL in this domain, and their variations for this ability were much smaller than other skills. Meanwhile, their performance for EMP and TRU were also impressive. This means Chinese students tend to cooperate and interact with other people.

Engaging with others (EWO) (in Big Five Model—Extraversion) tends to assess individuals for their level of energy, optimism, and confidence, as well as their ability to establish social support networks (Kankaraš & Suarez-Alvarez, 2019). It was measured by Sociability (SOC), Assertiveness (ASS) and

Energy (ENE). According to data of Suzhou older cohort (see Table 4), the reliability of these three scales varied from 0.790 to 0.875, and the reliability of the overall complex scale EWO was 0.896, revealing a good internal consistency reliability. The descriptive statistics suggested that the studied Chinese students had more common tendency to perceive higher ability of SOC compared with other two skills, with much higher mean value and slightly lower standard deviation. Among the EWO domain, those Chinese students considered they were less good at ASS, which means they thought their ability of voicing themselves and influencing the society was weaker. Meanwhile, the highest standard deviation suggests, students were more diverse in this regard.

Table 4 Descriptive statistics and reliability of Scales of Social and Emotional Skills

Complex Scale	Scale	Items	Examples of Item Labels	Mean	SD	Cronbach's alpha			
Collaboration (COL)	Empathy (EMP)	COLEM P01-08	I understand what others want It is important that my friends are ok	29.490	88.671	4.058	11.533	0.783	0.913
	Trust (TRU)	COLTR U01-08	I believe that most people are honest I trust others	28.073		5.331		0.862	
	Cooperation (COO)	COLCO O01-08	I get along well with others I am always willing to help classmates	31.109		3.987		0.826	
Engaging With Others (EWO)	Sociability (SOC)	EWOSO C01-08	I like to be with friends I like talking to a lot of different people	29.600	80.446	5.047	12.893	0.813	0.896
	Assertiveness (ASS)	EWOAS S01-08	I like being a leader in my class I know how to convince others to do what I want	24.945		5.756		0.875	
	Energy (ENE)	EWOE NE01-08	I maintain high energy throughout the day I show a lot of enthusiasm	25.998		5.189		0.790	
Emotional Regulation (EMR)	Stress resistance (STR)	EMRST R01-08	I am relaxed and handle stress well I do not panic easily	24.001	56.682	6.279	14.380	0.855	0.934
	Optimism (OPT)	EMROP T01-08	I believe good things will happen to me I enjoy life	14.758		4.827		0.840	
	Emotional control (EMO)	EMRE MO01-08	I stay calm even in tense situations I am not easily upset	17.939		5.228		0.895	
Open-mindedness (OPN)	Curiosity (CUR)	OPNCU R01-08	I love learning new things in school I like to know how things work	29.962	90.664	4.549	11.841	0.823	0.908
	Tolerance (TOL)	OPNTO L01-08	I like hearing about other cultures and religions I learn a lot from people with differing beliefs	31.579		4.591		0.819	
	Creativity (CRE)	OPNCR E01-08	I sometimes find a solution that other people don't see I have a good imagination	29.123		4.932		0.843	
Task Performance (TAP)	Responsibility (RES)	TAPRE S01-08	I keep promises I avoid responsibilities	29.314	85.915	4.699	11.741	0.823	0.903
	Self-control (SEL)	TAPSE L01-08	I avoid mistakes by working carefully I stop to think before acting	27.729		4.279		0.731	
	Persistence (PER)	TAPPE R01-08	I keep working on a task until it is finished I finish things despite difficulties in the way	28.855		4.744		0.848	

Emotional regulation (EMR) (in Big Five Model—Emotional stability) is about the abilities that allow people to manage adverse emotional experiences and stressors (Kankaraš & Suarez-Alvarez, 2019). It was measured by Stress resistance (STR), Optimism (OPT) and Emotional control (EMO). For Suzhou older cohort dataset (see Table 4), the reliability of these three scales were all over 0.8, and the overall reliability of the complex scale EMR was 0.934, showing a very satisfactory reliability. When referring to the descriptive statistics, the low mean values indicate that Chinese students overall had relatively low perceived EMR abilities. And among the three skills, their mean values also showed considerable disparities. The students thought they performed worst for OPT, which means they need more encouragement to foster more active attitudes towards themselves and their life. Their perceived EMO skill was also much lower than most other skills, implying they may experience more emotional frustrations when facing challenges. Their perceived ability of STR was obviously higher than the above two skills, which may be due to their long-term adaptability to the stressful environments.

Open-mindedness (OPN) (in Big Five Model—Openness to experience) intends to test individuals' ability to deal with life changes, including the curiosity of learning, understanding and intellectual exploration, the openness to different points of view, values and cultures, and abilities to generate novel ways to do or think about things through exploring, learning, insight, and vision (Kankaraš & Suarez-Alvarez, 2019). It was measured by three scales—Curiosity (CUR), Tolerance (TOL) and Creativity (CRE). According to Table 4, the reliability of these three scales rooted in Suzhou older cohort dataset were all over 0.80, composing a high reliability of 0.908 for the overall scale OPN, which shows satisfactory or high reliability. The means of the Suzhou data suggests that the Chinese students considered they had good performance in this domain. All the mean values of their CUR, TOL and CRE were relatively high comparing with other skills, meanwhile, the three scales had similarly moderate standard deviations. This means those Chinese students had group tendency to flexibly adapt to changes in life.

Task performance (TAP) (in Big Five Model—Conscientiousness) refers to people's ability to be self-disciplined and stay on task, which can lead to high achievements (Kankaraš & Suarez-Alvarez, 2019). It was indicated by Responsibility (RES), Self-control (SEL) and Persistence (PER). Grounded in Suzhou older cohort dataset (see Table 4), the reliability of these three scales varied from 0.731 to 0.848, and Cronbach's alpha for the overall reliability of TAP was 0.903, showing satisfactory or high reliability. Speaking of the descriptive statistics, the Chinese students also showed good quality in this domain, where they perceived the highest mean value for RES, together with slightly weaker performance for PER and SEL.

Dependent Variable: Subjective Well-being

This study adopted three scales from the contextual questionnaire of Suzhou order cohort to indicate the independent variable *subjective well-being*: a simple scale-life satisfaction (STQM01901), and two Item Response Theory (IRT) scale indices—current subjective well-being index (st_wellbeing), and test anxiety index (st_anxtest), which were composite measures by combining a group of items that intended to measure an underlying latent construct (Eva, 2021).

The assessment of students' life satisfaction (STQM01901) was conducted with the same measure that was used in PISA 2015 and PISA 2018. It was an evaluation that students assessed their quality of life based on their own standards, influenced by factors like mood, memory, and immediate surroundings (OECD, 2022b). Respondents were asked: 'Overall, how satisfied are you with your life as a whole these days?' The answer was on a scale from 0 to 10 where 0 meant 'not at all satisfied' and 10 meant 'completely satisfied'. Therefore, higher scale scores corresponded to higher levels of satisfaction, hence presenting higher levels of subjective well-being. The mean value for the responses of Suzhou order cohort students was over 7, indicating a moderate level of satisfaction to their life.

Index of current psychological well-being (st_wellbeing) was derived from the WHO-Five Well-Being Index (WHO-5) (STQM02001-05) to ask students about their feelings and experiences related to how

often they had a kind of positive feelings during the two weeks prior to the survey (e.g. felt cheerful and in good spirits) (OECD, 2022b), and these questions were answered on a 5-point scale, with ‘at no time’ scored 1, ‘some of the time’ scored 2, ‘more than half of the time’ scored 3, ‘most of the time’ scored 4 and ‘all of the time’ scored 5. Therefore, higher scores of this scale corresponded to higher perceived levels of student well-being. Among the five indicators (items), the response of STQM02004— ‘Last two weeks—woken up feeling fresh and rested’ obtained a slightly lower mean value compared with the ones of other four indicators.

Index of test anxiety(st_anxtest) was created using 3 items (STQM04201-03), which were a subset of the five items originally used in PISA 2015 where it was referred to as an index on schoolwork-related anxiety (OECD, 2021). Students were asked to indicate how anxious they felt about testing (e.g. Worry it will be difficult taking a test), by selecting their level of agreement. The responses were given on a 5-point Likert scale, with 1 indicating ‘strongly disagree’, 2 indicating ‘disagree’, 3 indicating ‘neither agree nor disagree’, 4 indicating ‘agree’ and 5 indicating ‘strongly agree’. Thus, students received higher scores on this scale if they indicated higher levels of anxiety. And higher levels of anxiety indicated lower levels of subjective well-being. Thus, this scale measured the construct in a reverse manner as a negative aspect.

The reliability (Cronbach’s alpha) of *psychological well-being* was 0.901, and test anxiety was 0.878, and the overall reliability of the composite scale *subjective well-being* was 0.834, showing quite satisfactory level of reliabilities (see table 5).

Table 5 Descriptive statistics and reliability of Subjective Well-being

Scale	Scale Label	Item	Item Label	Mean	SD	Cronbach’s alpha
Life satisfaction		STQM01901	Overall satisfaction of your life	7.02	2.024	
St_wellbeing	WHO-5 Wellbeing Index	STQM02001	Last two weeks - felt cheerful and in good spirits	3.07	41.388	0.930
		STQM02002	Last two weeks - felt calm and relaxed	3.05		0.934
		STQM02003	Last two weeks - felt active and vigorous	3.01		0.966
		STQM02004	Last two weeks - woken up feeling fresh and rested	2.69		1.097
		STQM02005	Last two weeks - daily life filled with things that interest me	3.09		1.024
St_anxtest	Index of Test Anxiety	STQM04201	Worry it will be difficult taking a test	2.59	52.767	1.002
		STQM04202	Well prepared for test but very anxious	2.68		1.042
		STQM04203	Very tense when studying for test	2.78		1.035

Data Analysis

Structural Equation Modelling (SEM) is a statistical approach to testing hypotheses about the relationships among observed and latent variables (Hoyle, 1995). This research employed SEM as the analysis instrument because it has unique features that make it flexible and powerful enough to represent the properties of studied variables and structural relationships, compared with other statistical techniques (Bollen, 1989; Byrne, 2012). First, SEM can include both unobserved (latent) and observed (manifest) variables, while other multivariate techniques are solely based on observed measurements (Bollen, 1989). This is important for this study, since all the dependent, independent and mediator variables were latent constructs. Second, one important purpose of this study was to test the specified mediating relationships that were assumed based on the additive stress-buffering theory. SEM enables the modelling of indirect (mediating) effects which occur when one variable is related to

another through the involvement of a mediating factor (Byrne, 2012). This is the structural model (how academic stressors influence subjective well-being through social and emotional skills) that needs to be tested in this study. Additionally, complex multivariate analysis enables the estimation of connections between a specific set of variables (Byrne, 2012). Finally, SEM allows for the explicit representation of measurement error, which leads to obtaining unbiased estimates of variable relationships (Byrne, 2012). This effectively eliminated any potential influence of measurement error on the regression estimates among the construction of the latent variables, especially the complex scale variables in this study.

According to James et al. (1982), there is a two-step approach to SEM, which refers to two distinct models in SEM: the measurement model and the structural model. The measurement model specifies how the different indicators (observed variables or items) are connected to the factors (latent variables or constructs), and the quantity of indicator errors (James et al., 1982). In a measurement model, how well a factor is defined depends on the strength and magnitude of the connections from the indicators to the factor (factor loadings) (James et al., 1982). Meanwhile, the measurement error (residual) for each indicator is presented to indicate how adequately the indicators reflect the corresponding factor. Confirmatory Factor Analysis (CFA) has been widely implemented to deal specifically with measurement models. It allows for the assessment of a conceptualized model that specifies the hypothesized causal relations between latent factors and their observed indicator (Mueller & Hancock, 2015). In this study, CFA was applied to examine the measurement models of all latent variables. On the other hand, the structural model defines how the various factors relate to each other (Coulacoglou & Saklofske, 2017). There are typically two kinds of relationships between variables in SEM: direct and indirect effects. Direct effects represent the relationship between one latent variable to another. Indirect effects reflect the relationship between an independent variable and a dependent variable that is mediated by one or more latent variables (Coulacoglou & Saklofske, 2017). The analysis of this study mainly focused on indirect effects (mediation models).

This two-step approach emphasizes that only when the measurement model is confirmed, it is meaningful to test the structural model. Because it helps researchers resolve procedural issues, thus laying a solid foundation for the following structural model analysis (Jöreskog et al., 1979). Therefore, this study tested measurement model fit and evaluated the construct validity and reliability for the latent variables through CFA, prior to performing path analysis for the structural models.

The data analysis was proceeded by following the five steps involved in testing SEM models: model specification, identification, estimation, evaluation, and modification (J. Hair et al., 2006; Kline, 2005; Schermelleh-Engel et al., 2003). Although the CFA process also followed these five steps, the following interpretations will primarily focus on the structural models since the examination of the hypothesised relationships among the latent variables was of main interest to the researcher.

Model Specification

In this step, the hypothesized relationships among the latent variables—academic stressors, the five domains of social and emotional skills and subjective well-being—were specified based on the fundamental model formulated in ‘Stress-buffering Model’ of ‘Theoretical Framework’ section. Five mediation models within SEM were hypothesized, with each presenting the mediating effect of a domain of social and emotional skills. As the five hypothesized models are quite similar to each other, only one of them (COL as an example) is shown in Figure 4 below, other models see Appendix 3.1.

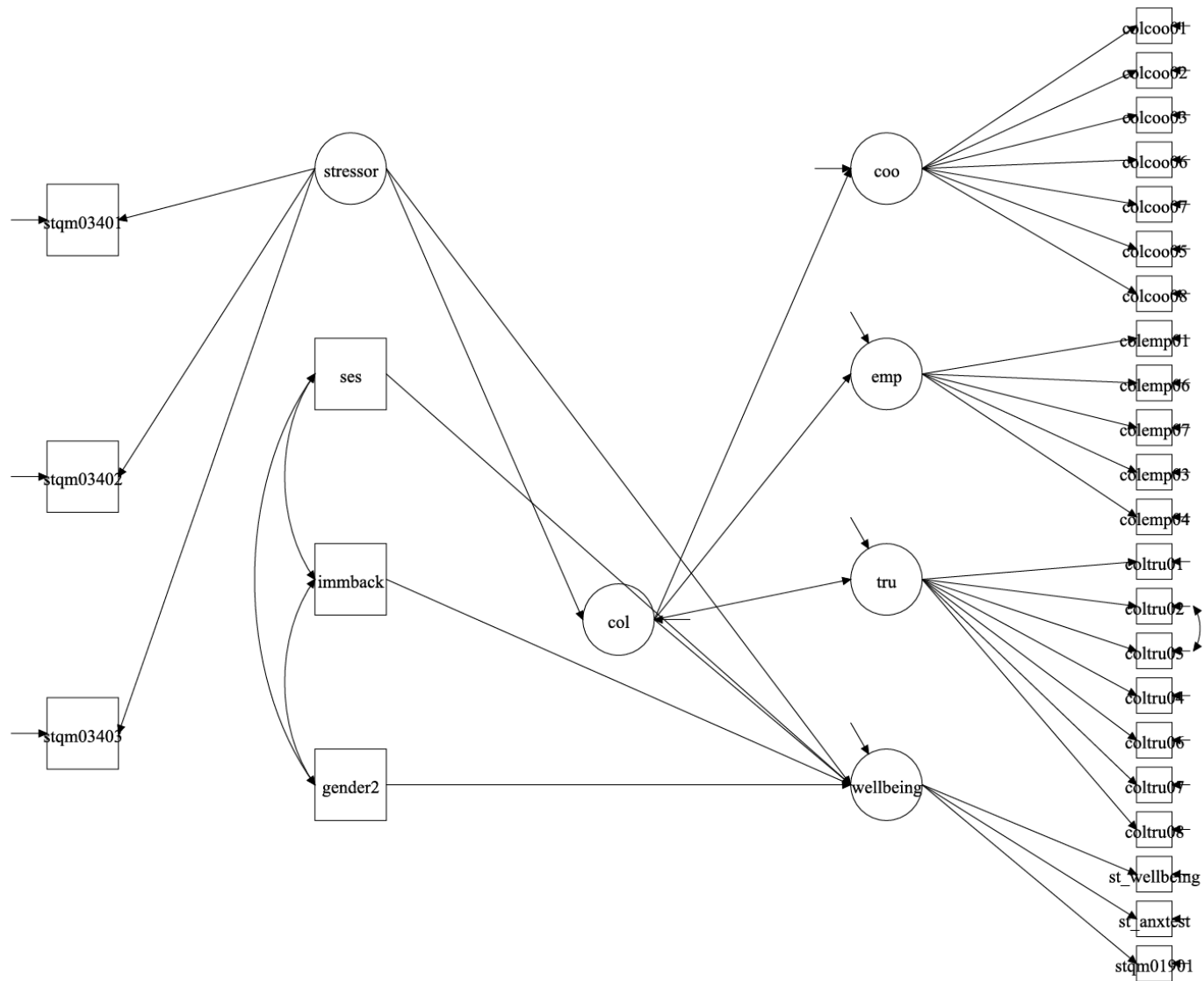


Figure 4 The hypothesized mediation model in SEM, presenting the indirect effect of academic stressors (external expectations) on subjective well-being through social and emotional skills (Collaboration (COL) as an example), accounting for gender, SES and immigrant background

In a SEM diagram like Figure 4, circles (O) represent latent variables that are indicated by latent or observable variables (e.g., stressor, wellbeing, col, coo, emp and tru in Figure 4); squares (□) represent observable variables that can be observed or measured directly (indicators or items); single-headed arrows (→) represent the impact of one variable on another; double-headed arrows (↔) represent covariances or correlations between pairs of variables; a single-headed arrow with a circle (→O) represents the residual error in the prediction of an unobserved variable; and a single-headed arrow with a square (→□) represents measurement error associated with an observed variable (Byrne, 2012).

Therefore, in Figure 4, both measurement models of academic stressors (stressor), subjective well-being (wellbeing) and Collaboration (COL), and the structural mode of their relationships are demonstrated. For the structural model, academic stressors (stressor) function as the independent variable on the dependent variable—subjective well-being (wellbeing) through the mediator variable— Collaboration (COL) (one of the social and emotional skills). In other words, academic stressors predict COL (one of the social and emotional skills), and COL (one of the social and emotional skills) in turn, impacts on subjective well-being. Additionally, control variables—gender (gender2), Socio-economic status (ses) and immigrant background (immback) were included in the model to account for their effects on subjective well-being (wellbeing).

According to Khine (2013), all parameters which refer to the relationships between variables (e.g. effect coefficients, factor loadings, variances and covariances) need to be specified in SEM. In the mediation models, the specified parameters were the effect coefficients of relations between the latent variables (the stressor—COL/EWO/EMR/OPN/TAP relationship, COL/EWO/EMR/OPN/TAP—well-being relationship and stressor—well-being relationship), the factor loadings of all indicators regressed on each latent variable, variances (residuals or measurement errors) of the latent and observed variables, and covariances (correlations) between some pairs of variables. Among these parameters, it was crucial to determine which parameters were fixed or freely estimated. Because, if a parameter is set free, it will be estimated from the observed data, and then all the estimated parameters “will be used to compare the hypothesized diagram with the sample population variance and covariance matrix in testing the fit of the model” (Khine, 2013, p 9). For the parameters setting, this study adopted the built-in defaults of Mplus. Basically, the factor loading of the first indicator for each latent variable was fixed at 1 (Byrne, 2012). According to this, the estimated parameters were determined, and they were: 66 parameters in COL model, 60 in EWO model, 69 in EMR model, 61 in OPN model, and 66 in TAP model (more details see Appendix 3.2).

Model Identification

At this stage, the main task was to see whether there is a unique set of parameters consistent with the observed data (Khine, 2013). Models need to be overidentified to allow estimation and testing of hypotheses about the relationships among variables. This implies that there are more elements (e.g. the off-diagonal values) in the correlation matrix from the observed variables than parameters to be estimated, and the difference between them is the degree of freedom. The goal of the researcher was to see whether the degree of freedom of each model was positive. The number of elements in a correlation matrix is calculated by the formula: $[p(p+1)]/2$, in which ‘p’ represents the number of observed variables (Khine, 2013). Applying this formula to all the models, we got the degree of freedom for them:

In the COL mediation model, with 25 observed variables and 66 parameters specified for estimation, the degree of freedom was $325-66= 259$; in the EWO mediation model, with 22 observed variables and 60 parameters specified for estimation, the degree of freedom was $253-60= 193$; in the EMR mediation model, with 26 observed variables and 69 parameters specified for estimation, the degree of freedom was $351-69= 282$; in the OPN mediation model, with 23 observed variables and 61 parameters specified for estimation, the degree of freedom was $276-61= 215$; in the TAP mediation

model, with 24 observed variables and 66 parameters specified for estimation, the degree of freedom was $300-66=234$. Therefore, all the five models were over-identified and were able to be estimated and test the hypothesized relationships among the variables by implementing the observed data.

Model Estimation

Model estimation involves determining the value of the unknown parameters and the error associated with the estimated value based on sample data. The goal of this step is to estimate the sample parameters by minimizing the difference between the observed data variance or covariance matrix and the model-predicted variance or covariance matrix (Khine, 2013). There are various types of estimation methods to deal with model estimations in SEM, among which the maximum likelihood (ML) is most widely used. This method involves repeatedly updating an initially assumed value through calculation. The process continues until the most favourable values are reached, indicating that the model has converged. It is reliable in various conditions and tends to generate unbiased, consistent, and efficient parameter estimates (Bollen, 1989).

In the Mplus syntax for the mediation models of this study, MLR was specified as the ESTIMATOR under the ANALYSIS command, to use a maximum likelihood estimator with robust standard errors. This estimation method is based on maximum likelihood estimator (ML). It is more suitable for dealing with large dataset like SSES 2019, where normality assumptions might be more likely to be violated. Because, with this estimator, estimates of the model parameters were less influenced by non-normality in the data. Meanwhile, missing values were also taken into consideration, since it uses all available data regardless of completeness (Enders, 2001). Additionally, given the dataset properties and to achieve specific estimation purposes, some particular options were also specified for the models: the usage of WEIGHT = WT2019 and CLUSTER = SchID options under VARIABLE command in conjunction with TYPE=COMPLEX option of the ANALYSIS command, achieved the correlations to the standard errors and chi square test of model fit that take into account of the unequal probability of selection and non-independence of observations. This was determined because of the two-stage stratified cluster sample method of SSES 2019. Firstly, it resulted in variations of the selection probabilities across different students. Survey weights can ensure that each sampled student accurately represents the correct number of eligible students at his or her specific site, because they account for the chances of schools and students being chosen, as well as adjustments for non-responses among them. Consequently, the inclusion of students' survey weights (WT2019) enables the researcher to generate approximate unbiased estimates of standard errors, conduct significance tests, and generate confidence intervals that properly account for the complex sample design of SSES at each participating site (Eva, 2021). In addition, because the participated students were nested within schools, it is expected that students from the same school were more similar to each other than students from different schools. By specifying the CLUSTER option with School ID (SchID), the analysis allowed for appropriate adjustment for school clustering effects, ensuring that the results were valid and reliable. Besides, as a complement, bias-corrected bootstrap method with confidence intervals (CI) was also applied to the mediation models separate from MLR, to improve the accuracy of the estimations of effects (Hoyle, 2023). This was carried out by implementing BOOTSTRAP = 500 together with ESTIMATOR =ML instead of ESTIMATOR =MLR under the ANALYSIS command. The final input of the mediation models sees Appendix 7 (with COL as an example).

Model Evaluation

Once parameters are estimated, it is time to use fit indices to examine how well the models fit the data. There are various types of fit indices. Chi square (χ^2) test is one of the most reasonable measure of model fit. Since the non-significance of chi-square (χ^2) indicates that the difference between the observed and the model-implied variance/covariance matrices is statistically nonsignificant, which implies the proposed model can be considered fit into the sample data (Khine, 2013). And this is the primary goal of SEM analysis for assessing the adequacy of a model. However, if the sample size obtained for the study is greater than 200, the absolute fit index of minimum discrepancy chi-square can be ignored (J. Hair et al., 2012; Jöreskog et al., 1979). Because, with large samples, they tend to

identify meaningless differences as statistically significant (Kline, 2005; Ullman et al., 2007). And this happened in this study: the SEM analysis revealed that the chi-square (χ^2) values for all measurement models were statistically significant. As such, the assessment of a hypothesized model is usually not only based on chi-square (χ^2), but some other fit indices are also necessary and beneficial references. Nevertheless, there is no consensus regarding which fit indices should be reported for model evaluation. According to Innami and Koizumi (2011), who has reviewed literatures about reporting fit indices, the most common recommended indices are the chi-square (with degrees of freedom and p-values), Comparative Fit Index (CFI), Tucker-Lewis index (TLI) Root-mean-square error of approximation (RMSEA) (especially for sample size that is over 200) and Root Mean Square Residual (RMSR). The results of these indices for each structural model will be shown and interpreted in the 'Results' section.

Model Modification

This stage is applied when the model cannot fit data well (Schumacker & Lomax, 2004). The improvement of fitness of a model, is normally achieved by adding or removing parameters. Meanwhile, parameters could be changed from fixed to free or from free to fixed (Khine, 2013). In Mplus, the diagnostic tool—modification indices (MI) can be applied to provide helpful references in the process of model modification, because the value of a given modification index is the amount that chi-square (χ^2) value is expected to decrease if the corresponding parameter is freed (Whittaker, 2011).

In this study, model modifications based on parameter change and modification indices (MI) were performed mostly in the CFA process, because the original measurement models of most of the latent variables were not adequate. These cautious modifications in CFA helped resolve the measurement issues, which laid a solid foundation for the following structural model analysis. Consequently, all the structural models indicated acceptable model fit and there was no modifications for final structural models. The procedures for the modifications in CFA will be reported in the following section.

Results

In this section, the results of how the two components of Structural Equation Modelling (SEM) — measurement model and structural model fit into the Suzhou older cohort data will be reported.

Confirmatory Factor Analysis (CFA)

In this study, independent variable, mediator variables and dependent variable were all latent constructs and complex scales that were derived from latent scales measured by manifest indicators (items), which means they were all tested as second-order models in CFA (T. A. Brown, 2006; Byrne, 2012). Those hypothesized measurement models were both derived from SSES 2019 and empirical literature. With CFA, these measurement models were firstly examined how well they fitted Suzhou older cohort data. The initial indices of model fit and standardized model results for each scale are displayed in Appendix 4. Consequently, some problems in these measurements were detected and handled specifically for the sample data.

According to the initial analysis for the measurement models (Appendix 4), besides *Subjective well-being* presenting a perfect model fit, all the other latent variables' measurement models did not show satisfying results. This is consistent with the test results of measurement invariance in SSES 2019, “across sites, most of the scales showed metric invariance, only a few of the 15 scales reached scalar invariance”, which means that groups across cities responded to the items differently (Eva, 2021, p.131). This is probably because indicators for scales in SSES 2019 are mostly related to attitudes, feelings, or experiences, they can be interpreted differently by students from different cultural backgrounds. And these differences may cause more unexplained residuals or covariances among items. However, the assessments of SSES scales are meant to be applicable to a wide range of countries, and the OECD team also omitted some items depending on the specific country (Eva, 2021). Therefore, it is not accidental that there were some misfits when the models were applied to the Suzhou older cohort data. In addition, in each measurement model, there were 3 scales which were measured by 8 items respectively (24 items all together). All those items assessed students' personal traits under a broad domain based on their feelings or beliefs, which may lead to homogeneities of indicators. However, the initial models with so many indicators (items) are too complex, and too restrictive to represent the homogeneous properties of indicators or any other unexplained effects or paths. Therefore, it would be beneficial to remove some constraints or allow more paths in these models.

Based on the above analysis, to achieve better model fit (at least acceptable) for the studied data, some model modification steps were carefully performed. All those modification decisions were made in consideration of whether removed items improved the model fit without reducing scale reliability significantly; and removing a minimum number of items within each scale. Firstly, items with factor loadings that were under 0.40 were deleted from the measurement model; then items with residual variances that were over 0.70 were abandoned. Because both low factor loadings and high residual variance indicate the actual values for the items tend to deviate significantly from what the model predicts, thus they are not measuring what the model intended to measure (Khine, 2013). To delete those biased items can be beneficial for the improvement of the measurement model. After the two steps, if the model fit was still not satisfying, the modification indices were introduced (Khine, 2013). This was achieved by specifying MODINDICES option in the OUTPUT command in Mplus. First, the magnitude of the modification indices regarding the ‘with’ statements were examined. Then the correlations between the items stated by the highest modification index were checked, if they had

relatively higher correlations (typically over 0.60) than other pairs of items, the covariance between the two items would be allowed in the model. Then the refined model was evaluated, and the same procedures for items with the highest modification index in the refined model was repeated to get better model, until the model reached a satisfactory fit. The specific modification procedures for each problematic scale (measurement model) are shown in Appendix 5. In the end, all the measurement models achieved acceptable model fits. Results see Table 6.

The point that deserves more attention is the scale of *Academic stressors*. Because there were only three items measuring *parents' and teachers' expectations* left in the final measurement model, and this should be an insufficient coverage of the latent construct *academic stressors*. Nevertheless, the three items were enough to present *parents' and teachers' expectations*, the measurement model showed quite satisfactory model fit, validity, and reliability (Cronbach' α =0.808), their correlations were moderate (correlations were all over 0.5 but below 0.7), and as stated in the 'Key concepts' section, parents' and teachers' expectations are the biggest contributor to Chinese students' academic stressors (Gu, 1999; Zhen, & Chen, 1999; Lou & Chi, 2000; Zhang, & Du, 2005; Ang & Huan, 2006; Burnett & Fanshawe, 1997; Lay et al., 1998; Sun et al., 2012; Zhou et al., 2023), it is still meaningful and reasonable to use this measurement model to indicate one of the most important *academic stressors* for Chinese students, namely *external expectations*. However, attention should be paid to this point when interpreting the results.

Table 6 The final measurement model fit indices and reliability for modified constructs

Complex Scale	CFI Acceptable: ≥0.90 Excellent: ≥0.95	TLI Acceptable: ≥0.90 Excellent: ≥0.95	RMSEA Acceptable: ≤0.08 Excellent: ≤0.05	SRMR Acceptable: ≤0.08 Excellent: ≤0.05	χ^2/df (P-Value)	Cronbach' α
Academic Stressors	1	1	0.000	0.000	0.000/0 (0.0000)	0.808
Collaboration (COL)	0.921	0.908	0.051	0.041	1540.221/148 (0.0000)	0.912
Engaging With Others (EWO)	0.921	0.905	0.062	0.058	1504.435/100 (0.0000)	0.886
Emotional Regulation (EMR)	0.913	0.900	0.059	0.063	2511.549/184 (0.0000)	0.925
Open-mindedness (OPN)	0.924	0.910	0.052	0.048	1239.753/116 (0.0000)	0.897
Task Performance (TAP)	0.916	0.901	0.054	0.051	1505.915/129 (0.0000)	0.912

Note: *CFI=Comparative Fit Index, TLI=Tucker-Lewis index, RMSEA=Root-mean-square error of approximation, RMSR=Root Mean Square Residual, χ^2/df =chi-square/degrees of freedom, for more details see 'Model Modification' of 'Data analysis' section.

* CFI and TLI are goodness -of -fit indices in a proportion fit metric. When $0.90 \leq CFI$ or $TLI < 0.95$ the model indicates a reasonable fit, when CFI or $TLI \geq 0.95$, the model has an excellent fit (Schumacker & Lomax, 2004). RMSEA and SRMR are badness-of-fit indices that are not in a proportion metric. When $RMSEA$ or $SRMR \leq 0.05$, the model will be considered excellent, and when $0.05 < RMSEA$ or $SRMR \leq 0.08$ the model will be considered acceptable (J. Hair et al., 2012; Hu & Bentler, 1998).

Structural Equation Modelling (SEM)

Structural Equation Modelling (SEM) was performed for the structural model analysis in this study, to examine the impact of academic Stressors on Subjective Well-being as mediated or even buffered by the five domains of social and emotional skills—Collaboration (COL), Engaging with others (EWO), Emotional regulation (EMR), Open-mindedness (OPN) and Task performance (TAP), respectively.

All the results of 95% Confidence Interval (CI) of Bootstrap confirmed the corresponding p-values³, which means when an effect had a p-value<0.05, the corresponding 95% CI⁴ did not include 0, and when an effect had a p-value>0.05, the corresponding 95% CI included 0⁵. All the results are presented in the tables below, and the diagrams are shown in appendix 6.

Model 1 Mediating Effect of Collaboration (COL)

The model fit indices of Model 1 (see Table 7) indicated that this model fit the Suzhou order cohort data properly (CFI=0.911, TLI=0.901, RMSEA=0.043, SRMR=0.048). When referring to the effect paths (Table 8), the results of indirect effect revealed that Collaboration (COL) skill significantly and positively mediated the effect of academic stressors on subjective well-being ($\beta = 0.097$, $z = 6.675$, $p < 0.001$). Academic stressors positively affected COL skill ($\beta = 0.171$, $z = 6.897$, $p < 0.001$), and COL in turn, positively affected subjective well-being ($\beta = 0.568$, $z = 25.016$, $p < 0.001$). Meanwhile, the direct effect presented academic stressors negatively predicted subjective well-being ($\beta = -0.026$, $z = -1.078$), however it was not significant ($p > 0.05$). According to Meule (2019), the statistical significance of direct effect is not relevant for the existence of indirect effect, and if the direct effect is not significant but the indirect effect is, the indirect effect plays a full mediator role. Therefore, in this case, COL fully mediated the relationship between academic stressors and well-being. However, Wheaton (1985) stated when considering the additive effects of stress and resources, the notion of *stress-buffering* applies when the indirect effect through coping resource operates in a direction opposite to the causal effect of stress (direct effect). Although the indirect and direct stressor effect operated in the opposite directions, the direct effect was non-significant, which means the direct effect did not constantly impose in the negative direction, therefore, we cannot confirm the stress-buffering function in this model. In addition, considering the confounding effects of control variables, only gender and socio-economic status (SES) revealed significant effects on well-being. And gender impacted subjective well-being in a negative way ($\beta = -0.121$, $z = -7.119$, $p < 0.001$), while the influence of SES was positive ($\beta = 0.054$, $z = 2.488$, $p < 0.05$). This suggests, both gender and SES contributes to the mediating effect of stressors on well-being.

Table 7 The model fit indices of Model 1

	CFI Acceptable: ≥ 0.90 Excellent: ≥ 0.95	TLI Acceptable: ≥ 0.90 Excellent: ≥ 0.95	RMSEA Acceptable: ≤ 0.08 Excellent: ≤ 0.05	SRMR Acceptable: ≤ 0.08 Excellent: ≤ 0.05	χ^2/df (P-Value)
Model 1	0.911	0.901	0.043	0.048	2595.127/340 (0.0000)

Note: *CFI=Comparative Fit Index, TLI=Tucker-Lewis index, RMSEA=Root-mean-square error of approximation, RMSR=Root Mean Square Residual, χ^2/df =chi-square/degrees of freedom, for more details see 'Model Modification' of 'Data analysis' section.

* CFI and TLI are goodness -of -fit indices in a proportion fit metric. When $0.90 \leq CFI$ or $TLI < 0.95$ the model indicates a reasonable fit, when CFI or $TLI \geq 0.95$, the model has an excellent fit (Schumacker & Lomax, 2004). RMSEA and SRMR are badness-of-fit indices that are not in a proportion metric. When $RMSEA$ or $SRMR \leq 0.05$, the model will be considered excellent, and when $0.05 < RMSEA$ or $SRMR \leq 0.08$ the model will be considered acceptable (J. Hair et al., 2012; Hu & Bentler, 1998).

³ P-value represents the probability of an observed difference occurring by random chance, assuming that the null hypothesis (which posits no relationship between the two sets of data or variables under analysis) is true. 'Statistical significance' is conventionally set at a P-value of <0.05 (Flechner & Tseng, 2011).

⁴ Confidence Interval (CI) can be computed around the point estimate of the result to provide a range of values within which the true value is believed to lie with a certain level of confidence (Flechner & Tseng, 2011).

⁵ In accordance with the conventional acceptance of statistical significance at a P-value of 0.05, Confidence Interval (CI) are frequently calculated at a confidence level of 95%. In general, if an observed result is statistically significant at a P-value of 0.05, then the null hypothesis (0) should not fall within the 95% CI (Flechner & Tseng, 2011). For more information about P-value and Confidence Interval, please refer to Davies and Crombie (2009).

Table 8 Standardized mediation analysis results of Model 1

Effects Paths	Model 1			95% CI	
	Estimate	Z-value (Est./S.E.)	P-value	Lower	Upper
Total Effect (c)	0.071	2.272	0.023	0.001	0.127
Direct effect (c')	-0.026	-1.078	0.281	-0.076	0.021
Stressor->Well-being					
Indirect Effect (a×b)	0.097	6.675	0.000	0.067	0.126
Stressor->COL ->Well-being					
Stressor->COL (a)	0.171	6.897	0.000	0.126	0.218
COL->Well-being (b)	0.568	25.016	0.000	0.522	0.607
Gender ->Well-being	-0.121	-7.119	0.000	-0.155	-0.088
SES ->well-being	0.054	2.488	0.013	0.008	0.094
Immigrant background->well-being	-0.017	-0.976	0.329	-0.054	0.016

Note: *COL= Collaboration (one of the social and emotional skills).

*95% CI= 95% Confidence Interval. It provides a range of values within which the true mean of the population is likely to lie with 95% confidence. If an effect is statistically significant at a P-value of 0.05 ($P < 0.05$), its lower and up range should not include 0, otherwise, the effect is probably not significant ($P > 0.05$).

*For the ease of description, 'estimate coefficient' is described as β in the following texts, which generally refers to the standardized path coefficient.

*Z-value is the ratio of the estimated coefficient (Est.) to its standard error (S.E.), representing the statistical significance of estimate coefficient. A higher Z-value (farther from zero) indicates a stronger signal compared to the noise (standard error), suggesting a more statistically significant effect.

*Total effect (c) =direct effect (c') + indirect effect (a×b)

Model 2 Mediating Effect of Engaging with Others (EWO)

The indices (see Table 9) indicated that Model 2 had a marginally satisfactory fit with the sample data (CFI=0.901, TLI=0.889, RMSEA=0.051, SRMR=0.064). Although TLI was slightly lower than the acceptable threshold (0.9), it did not influence the overall model fitness. The analysis results (see Table 10) revealed that there was a significant indirect effect from academic stressors to subjective well-being through Engaging with others (EWO) skill, and it is positive ($\beta = 0.118$, $z = 5.001$, $p < 0.001$). Academic stressors firstly positively predicted EWO ($\beta = 0.153$, $z = 5.204$, $p < 0.001$), and then EWO positively affects subjective well-being ($\beta = 0.770$, $z = 36.217$, $p < 0.001$). The direct effect from academic stressors to subjective well-being was negative ($\beta = -0.041$, $z = -1.747$), which was opposite with the indirect effect, but the effect was also non-significant ($p > 0.05$). This means EWO played a full mediating role in the relationship between academic stressors and well-being, and the stress-buffering function of the indirect effect of EWO cannot be supported. Among the three control variables, only gender showed a significant effect on well-being ($\beta = -0.060$, $z = -3.816$, $p < 0.001$), which was negative.

Table 9 The model fit indices of Model 2

	CFI Acceptable: ≥ 0.90 Excellent: ≥ 0.95	TLI Acceptable: ≥ 0.90 Excellent: ≥ 0.95	RMSEA Acceptable: ≤ 0.08 Excellent: ≤ 0.05	SRMR Acceptable: ≤ 0.08 Excellent: ≤ 0.05	χ^2/df (P-Value)
Model 2	0.901	0.889	0.051	0.064	2729.912/265 (0.0000)

Note: *CFI=Comparative Fit Index, TLI=Tucker-Lewis index, RMSEA=Root-mean-square error of approximation, RMSR=Root Mean Square Residual, χ^2/df =chi-square/degrees of freedom, for more details see 'Model Modification' of 'Data analysis' section.

* CFI and TLI are goodness -of -fit indices in a proportion fit metric. When $0.90 \leq \text{CFI}$ or $\text{TLI} < 0.95$ the model indicates a reasonable fit, when CFI or $\text{TLI} \geq 0.95$, the model has an excellent fit (Schumacker & Lomax, 2004). RMSEA and SRMR are badness-of-fit indices that are not in a proportion metric. When RMSEA or $\text{SRMR} \leq 0.05$, the model will be considered excellent, and when $0.05 < \text{RMSEA}$ or $\text{SRMR} \leq 0.08$ the model will be considered acceptable (J. Hair et al., 2012; Hu & Bentler, 1998).

Table 10 Standardized mediation analysis results of Model 2

Effects Paths	Model 2			95% CI	
	Estimate	Z-value (Est./S.E.)	P-value	Lower	Upper
Total Effect (c)	0.077	2.471	0.013	0.008	0.134
Direct effect (c')	-0.041	-1.747	0.081	-0.086	0.009
Stressor->Well-being					
Indirect Effect (a×b)	0.118	5.001	0.000	0.073	0.170
Stressor->EWO					
->Well-being					
Stressor->EWO (a)	0.153	5.204	0.000	0.093	0.214
EWO->Well-being (b)	0.770	36.217	0.000	0.723	0.808
Gender ->Well-being	-0.060	-3.816	0.000	-0.092	-0.031
SES ->well-being	0.030	1.486	0.137	-0.012	0.069
Immigrant background->well-being	-0.028	-1.599	0.110	-0.063	0.006

Note: *EWO= Engaging with others (one of the social and emotional skills).

*95%CI= 95% Confidence Interval. It provides a range of values within which the true mean of the population is likely to lie with 95% confidence. If an effect is statistically significant at a P-value of 0.05 ($P < 0.05$), its lower and up range should not include 0, otherwise, the effect is probably not significant ($P > 0.05$).

*For the ease of description, 'estimate coefficient' is described as β in the following texts, which generally refers to the standardized path coefficient.

*Z-value is the ratio of the estimated coefficient (Est.) to its standard error (S.E.), representing the statistical significance of estimate coefficient. A higher Z-value (farther from zero) indicates a stronger signal compared to the noise (standard error), suggesting a more statistically significant effect.

*Total effect (c) =direct effect (c') + indirect effect (a×b)

Model 3 Mediating Effect of Emotional Regulation (EMR)

Model 3 had a marginally acceptable model fit (CFI=0.904, TLI=0.894, RMSEA=0.049, SRMR=0.062) (see Table 11). The value of TLI was also slightly under the threshold, but all the other indices showed satisfactory values, thus there is no problem to ignore it. The results of model 3 (see Table 12) showed that only effect path of Emotional Regulation (EMR) on well-being was significant, and it indicated a negative impact ($\beta = -0.833$, $z = -34.223$, $p < 0.001$). Both the direct and indirect effects from academic stressors to subjective well-being were non-significant. Therefore, EMR did not mediate the relationship between academic stressors and well-being, consequently, it cannot be accepted EMR played a stress-buffering role on the academic stressors effect. Both gender and Socio-economic status (SES) had significant confounding effects on well-being. Specifically, gender negatively predicted well-being ($\beta = -0.046$, $z = -3.199$, $p = 0.001$), while SES positively affected well-being ($\beta = 0.050$, $z = 2.609$, $p < 0.05$).

Table 11 The model fit indices of Model 3

	CFI Acceptable: ≥ 0.90 Excellent: ≥ 0.95	TLI Acceptable: ≥ 0.90 Excellent: ≥ 0.95	RMSEA Acceptable: ≤ 0.08 Excellent: ≤ 0.05	SRMR Acceptable: ≤ 0.08 Excellent: ≤ 0.05	χ^2/df (P-Value)
Model 3	0.904	0.894	0.049	0.062	3577.500/366 (0.0000)

Note: *CFI=Comparative Fit Index, TLI=Tucker-Lewis index, RMSEA=Root-mean-square error of approximation, RMSR=Root Mean Square Residual, χ^2/df =chi-square/degrees of freedom, for more details see 'Model Modification' of 'Data analysis' section.

* CFI and TLI are goodness -of -fit indices in a proportion fit metric. When $0.90 \leq \text{CFI}$ or $\text{TLI} < 0.95$ the model indicates a reasonable fit, when CFI or $\text{TLI} \geq 0.95$, the model has an excellent fit (Schumacker & Lomax, 2004). RMSEA and SRMR are badness-of-fit indices that are not in a proportion metric. When RMSEA or $\text{SRMR} \leq 0.05$, the model will be considered excellent, and when $0.05 < \text{RMSEA}$ or $\text{SRMR} \leq 0.08$ the model will be considered acceptable (J. Hair et al., 2012; Hu & Bentler, 1998).

Table 12 Standardized mediation analysis results of Model 3

Effects Paths	Model 3			95%CI	
	Estimate	Z-value (Est./S.E.)	P-value	Lower	Upper
Total Effect (c)	0.050	1.589	0.112	-0.018	0.108
Direct effect (c')					
Stressor->Well-being	0.039	1.695	0.090	-0.011	0.082
Indirect Effect (a×b)					
Stressor->EMR ->Well-being	0.012	0.517	0.605	-0.037	0.052
Stressor->EMR (a)	-0.014	-0.516	0.606	-0.064	0.042
EMR->Well-being (b)	-0.833	-34.223	0.000	-0.880	-0.787
Gender ->Well-being	-0.046	-3.199	0.001	-0.074	-0.014
SES ->well-being	0.050	2.609	0.009	0.007	0.085
Immigrant background->well-being	-0.027	-1.511	0.131	-0.063	0.006

Note: *EMR= Emotional Regulation (one of the social and emotional skills).

*95%CI= 95% Confidence Interval. It provides a range of values within which the true mean of the population is likely to lie with 95% confidence. If an effect is statistically significant at a P-value of 0.05 ($P < 0.05$), its lower and up range should not include 0, otherwise, the effect is probably not significant ($P > 0.05$).

*For the ease of description, 'estimate coefficient' is described as β in the following texts, which generally refers to the standardized path coefficient.

*Z-value is the ratio of the estimated coefficient (Est.) to its standard error (S.E.), representing the statistical significance of estimate coefficient. A higher Z-value (farther from zero) indicates a stronger signal compared to the noise (standard error), suggesting a more statistically significant effect.

*Total effect (c) =direct effect (c') + indirect effect (a×b)

Model 4 Mediating Effect of Open-mindedness (OPN)

After fitting into the sample data, indices of Model 4 (see Table 13) suggested a marginally satisfactory model fit. CFI and TLI values were slightly under the acceptable threshold (0.898 and 0.887 respectively), but RMSEA and SRMR values still suggested acceptable or even excellent fit (0.046 and 0.059 respectively). The results of model 7 (see Table 14) showed Open-mindedness (OPN) skill played a positive and significant mediating role on the relationship between academic stressors and subjective well-being ($\beta = 0.106$, $z = 7.171$, $p < 0.001$). Academic stressors imposed a positive effect on OPN ($\beta = 0.198$, $z = 7.994$, $p < 0.001$), and simultaneously, OPN positively predicted subjective well-being ($\beta = 0.534$, $z = 23.371$, $p < 0.001$). On the other hand, the negative direct effect of academic stressors on subjective well-being was non-significant ($\beta = -0.027$, $z = -0.970$, $p > 0.05$), which again means although the direct and indirect effect imposed on opposite directions, the stress-buffering function still cannot be affirmatively detected. Therefore, OPN fully mediated the negative relationship between academic stressors and well-being, with no confirmed stress-buffering. When considering the confounding effect of control variables, both gender and immigrant background showed significant effects negatively impacting on well-being, and their parameters were ($\beta = -0.080$, $z = -4.627$, $p < 0.001$) and ($\beta = -0.036$, $z = -1.970$, $p < 0.05$).

Table 13 The model fit indices of Model 4

	CFI Acceptable: ≥ 0.90 Excellent: ≥ 0.95	TLI Acceptable: ≥ 0.90 Excellent: ≥ 0.95	RMSEA Acceptable: ≤ 0.08 Excellent: ≤ 0.05	SRMR Acceptable: ≤ 0.08 Excellent: ≤ 0.05	χ^2/df (P-Value)
Model 4	0.898	0.887	0.046	0.059	2488.517/290 (0.0000)

Note: *CFI=Comparative Fit Index, TLI=Tucker-Lewis index, RMSEA=Root-mean-square error of approximation, RMSR=Root Mean Square Residual, χ^2/df =chi-square/degrees of freedom, for more details see 'Model Modification' of 'Data analysis' section.

* CFI and TLI are goodness -of -fit indices in a proportion fit metric. When $0.90 \leq \text{CFI}$ or $\text{TLI} < 0.95$ the model indicates a reasonable fit, when CFI or $\text{TLI} \geq 0.95$, the model has an excellent fit (Schumacker & Lomax, 2004). RMSEA and SRMR are badness-of-fit indices that are not in a proportion metric. When RMSEA or $\text{SRMR} \leq 0.05$, the model will be considered excellent, and when $0.05 < \text{RMSEA}$ or $\text{SRMR} \leq 0.08$ the model will be considered acceptable (J. Hair et al., 2012; Hu & Bentler, 1998).

Table 14 Standardized mediation analysis results of Model 4

Effects Paths	Model 4			95%CI	
	Estimate	Z-value (Est./S.E.)	P-value	Lower	Upper
Total Effect (c)	0.079	2.582	0.010	0.014	0.134
Direct effect (c')	-0.027	- 0.970	0.332	-0.082	0.032
Stressor->Well-being					
Indirect Effect (a×b)	0.106	7.171	0.000	0.078	0.135
Stressor->OPN ->Well-being					
Stressor->OPN (a)	0.198	7.994	0.000	0.148	0.2245
OPN->Well-being (b)	0.534	23.371	0.000	0.478	0.572
Gender ->Well-being	-0.080	-4.627	0.000	-0.116	-0.048
SES ->well-being	0.024	1.124	0.261	-0.019	0.066
Immigrant background->well-being	-0.036	-1.970	0.049	-0.078	-0.003

Note: *OPN= Open-mindedness (one of the social and emotional skills).

*95%CI= 95% Confidence Interval. It provides a range of values within which the true mean of the population is likely to lie with 95% confidence. If an effect is statistically significant at a P-value of 0.05 ($P < 0.05$), its lower and up range should not include 0, otherwise, the effect is probably not significant ($P > 0.05$).

*For the ease of description, 'estimate coefficient' is described as β in the following texts, which generally refers to the standardized path coefficient.

*Z-value is the ratio of the estimated coefficient (Est.) to its standard error (S.E.), representing the statistical significance of estimate coefficient. A higher Z-value (farther from zero) indicates a stronger signal compared to the noise (standard error), suggesting a more statistically significant effect.

*Total effect (c) =direct effect (c') + indirect effect (a×b)

Model 5 Mediating Effect of Task Performance (TAP)

According to the model fit indices (see Table 15), Model 5 also showed a marginally acceptable model fit with the sample data, with CFI=0.907, TLI= 0.896, RMSEA=0.044 and SRMR=0.053. In model 5 (see Table 16), the results of the indirect effect revealed Task performance (TAP) positively mediated the relationship between academic stressors and subjective well-being ($\beta = 0.085$, $z=6.295$, $p < 0.001$). More specifically, academic stressors positively predicted TAP ($\beta = 0.154$, $z= 6.524$, $p < 0.001$), and then TAP had a positive effect on subjective well-being ($\beta = 0.553$, $z=26.107$, $p < 0.001$). All these effect paths were statistically significant. Meanwhile, analysing the direct effect, academic stressors exerted a negative impact on subjective well-being ($\beta = -0.016$, $z=-0.570$), which means it imposed in an opposite direction with the indirect effect, but it was again non-significant ($p > 0.05$). Therefore, in this model, TAP played a full and significant mediating role on stressors and well-being relationship, but this indirect effect cannot be confirmed to be a stress-buffering effect. After accounting for the effects of the control variables, the results suggested, gender significantly impacted well-being as a negative predictor ($\beta = -0.083$, $z=-4.765$, $p < 0.001$), and SES significantly and positively predicted well-being ($\beta = 0.061$, $z=2.690$, $p < 0.01$).

Table 15 The model fit indices of Model 5

	CFI Acceptable: ≥ 0.90 Excellent: ≥ 0.95	TLI Acceptable: ≥ 0.90 Excellent: ≥ 0.95	RMSEA Acceptable: ≤ 0.08 Excellent: ≤ 0.05	SRMR Acceptable: ≤ 0.08 Excellent: ≤ 0.05	χ^2/df (P-Value)
Model 5	0.907	0.896	0.044	0.053	2494.066/312 (0.0000)

Note: *CFI=Comparative Fit Index, TLI=Tucker-Lewis index, RMSEA=Root-mean-square error of approximation, RMSR=Root Mean Square Residual, χ^2/df =chi-square/degrees of freedom, for more details see 'Model Modification' of 'Data analysis' section.

* CFI and TLI are goodness -of -fit indices in a proportion fit metric. When $0.90 \leq$ CFI or $TLI < 0.95$ the model indicates a reasonable fit, when CFI or $TLI \geq 0.95$, the model has an excellent fit (Schumacker & Lomax, 2004). RMSEA and SRMR are badness-of-fit indices that are not in a proportion metric. When $RMSEA$ or $SRMR \leq 0.05$, the model will be considered excellent, and when $0.05 < RMSEA$ or $SRMR \leq 0.08$ the model will be considered acceptable (J. Hair et al., 2012; Hu & Bentler, 1998).

Table 16 Standardized mediation analysis results of Model 5

Effects Paths	Model 5 Estimate	Z-value (Est./S.E.)	P-value	95% CI	
				Lower	Upper
Total Effect (c)	0.069	2.174	0.030	0.002	0.127
Direct effect (c') Stressor->Well-being	-0.016	-0.570	0.569	-0.076	0.041
Indirect Effect (a×b) Stressor->TAP ->Well-being	0.085	6.295	0.000	0.060	0.111
Stressor->TAP (a)	0.154	6.524	0.000	0.111	0.200
TAP->Well-being (b)	0.553	26.107	0.000	0.510	0.592
Gender ->Well-being	-0.083	-4.765	0.000	-0.120	-0.047
SES ->well-being	0.061	2.690	0.007	0.011	0.103
Immigrant background->well-being	-0.007	-0.375	0.708	-0.043	0.028

Note: * TAP = Task Performance (one of the social and emotional skills).

*95%CI= 95% Confidence Interval. It provides a range of values within which the true mean of the population is likely to lie with 95% confidence. If an effect is statistically significant at a P-value of 0.05 ($P < 0.05$), its lower and up range should not include 0, otherwise, the effect is probably not significant ($P > 0.05$).

*For the ease of description, 'estimate coefficient' is described as β in the texts, which generally refers to the standardized path coefficient.

*Z-value is the ratio of the estimated coefficient (Est.) to its standard error (S.E.), representing the statistical significance of estimate coefficient. A higher Z-value (farther from zero) indicates a stronger signal compared to the noise (standard error), suggesting a more statistically significant effect.

*Total effect (c) =direct effect (c') + indirect effect (a×b)

Discussion

Answering Research Questions

Drawing from Stress-buffering model, this study examined whether the Chinese adolescents' five domains of social and emotional skills respectively buffer the impact of academic stressors (external expectations) on subjective well-being via mediation, specifically, where social and emotional skills are *activated* by the presence of stressors. Gender, SES, and immigrant background were included in the mediation models to minimize their potential confounding effects. The study aimed to answer the following research questions:

1) Whether Chinese adolescents' academic stressors affect their subjective well-being through the indirect effect of the five domains of social and emotional skills—Collaboration (COL), Engaging with others (EWO), Emotional regulation (EMR), Open-mindedness (OPN) and Task performance (TAP), respectively?

2) If present, does the indirect (mediating) effect of each domain exert a stress-buffering function?

Related to research question 1, the results showed that all the five domains of social and emotional skills (COL, EWO, EMR, OPN and TAP) except EMR, played mediator roles on the academic stressors and subjective well-being relationship.

However, related to research question 2, the stress-buffering function of the indirect effects of the four domains of social and emotional skills (COL, EWO, OPN and TAP) was not explicitly proved.

The following sections elaborate on the findings within a theoretical and practical context.

Theoretical Perspective

The theoretical framework of this study was the additive version (a coping resource act as the mediator) of stress-buffering model derived from Wheaton (1985), which is much less popular than the interactive version (a coping resource acts as the moderator). However, it is a more *complete model* to depict stress-buffering mechanism, because compared with the interactive version which simply represents a causal model in which coping resources directly impact on the direct effects of stress, the additive version does not only represents the direct effects of stress, but also accounts for the nature of the indirect effects through intervening coping resource variables, and the total causal effect of direct and indirect effects of stress (Wheaton, 1985). According to the researcher's review work, although there are some studies that proved the mediating role of coping resources that are closely related to social and emotional skills (Versteeg & Kappe, 2021; Berdida & Grande 2023; Ho et al., 2023), they did not refer to stress-buffering effect. Most researchers who tested stress-buffering automatically assumed to do moderation analysis directly (Cranford, 2004; J. Green et al., 2021; Rector & Roger, 1997; Szkody & Mckinney, 2019). This confirms what Wheaton (1985) has stated almost 40 years ago, the reason why so little studies provide evidence for coping resources as mediator role is that "no one is looking for such evidence" (p.361). Therefore, one ambition of this study is to test the additive stress-buffering models with social and emotional skills, hence providing potential empirical evidence.

In the additive version, the significant indirect (mediating) effect is the first step in deciding the involvement of stress-buffering, figuring out how the variables are connected to each other. Furthermore, for the full stress-buffering hypothesis to be confirmed, the resource mobilization or the additive component (the positive relationship between stressor and skills) needed to be confirmed, as well as the opposite direction of the direct effect and indirect effect (Wheaton, 1985).

In the present study, the mediating effects of four domains of social and emotional skills (COL, EWO, OPN and TAP) were proved. The results suggested, the academic stressors (external expectations) significantly predicted social and emotional skills (COL, EWO, OPN and TAP), and simultaneously, these skills significantly affected subjective well-being, presenting significant indirect stress effect through the four skills. This confirms the premise of the additive model of stress-buffering.

The essential feature that concerns in additive stress-buffering is that the coping resource must be activated or mobilized by increases in stress to be consistent with the notion of *stress-buffering*, which is called resource mobilization theory (Wheaton, 1985). Although there have been very little studies in literature (e.g. Aneshensel & Frerichs, 1982; Cronkite & Moos, 1984) to provide evidence for this theory, it is consistent with Antonovsky's (1972) salutogenic model, which indicates, in tension states (stress), a strong sense of coherence can help mobilize generalized resistance resources and promote effective coping to resolve tension in a healthy way. The results of this study demonstrated that the four domains of social and emotional skills (COL, EWO, OPN and TAP) were positively affected by academic stressors (external expectations), and this empirically supported the resource mobilization theory, supporting the salutogenic model, as well as the crucial component of additive model of stress-buffering.

Wheaton (1985) stated that the notion of *stress-buffering* applies when the indirect effect through social support operates in a direction opposite to the causal effect of stress on distress. In the present study, the direct and indirect effects did in fact operate in opposite directions, however, the direct effect is not statistically significant. This is not in line with the literature, because academic stressors (stress) and well-being (mental health) has been proved to show strong negative association by abundant research (e.g. Eisenberg et al., 2009; J. Green et al., 2021; Li & Lin, 2003). This is probably related to the measurement of *academic stressors* which was only presented by the scale *external expectations*. Although this is one of the most important *academic stressors* for Chinese students (Gu, 1999; Zhen, & Chen, 1999; Lou & Chi, 2000; Zhang, & Du, 2005; Ang & Huan, 2006; Burnett & Fanshawe, 1997; Lay et al., 1998; Sun et al., 2012; Zhou et al., 2023), it is still not sufficient to indicate the whole coverage of *academic stressors* construct. Therefore, there is possibility to prove the formulation of stress-buffering effect in these mediation (additive) models if there is more comprehensive and in-depth presentation for the independent variable *academic stressors* which may impose a strong and consistent negative direct effect on subjective well-being.

To conclude, following the preconditions of additive stress-buffering, this study proved the mediating effects of four domains of social and emotional skills (COL, EWO, OPN and TAP) on academic stressors (external expectations) and subjective well-being relationship, as well as the positive relationship between stressors and the four skills (resource mobilization), but did not detect consistent opposite directions between direct effect and indirect effect of stressors on well-being, because the direct effect was not significant. Therefore, Wheaton's (1985) additive stress-buffering model was only partially confirmed by this study.

Practical Perspective

This study firstly provided evidence about the mediating role of four aspects of the social and emotional skills (COL, EWO, OPN and TAP) on academic stressors and subjective well-being relationship among Chinese adolescents. It empirically confirmed the possibility for students to develop social and emotional skills to deal with academic stressors. Thus, this provides a distinct and

more general perspective for policymakers and educators to take social and emotional skills into consideration when facing problems of reducing impact of academic stress on students.

Following the descriptive statistics based on their self-reports, Suzhou students perceived moderate level of expectations from their parents and teachers and moderate level of well-being. With respect to social and emotional skills, these Chinese students perceived they had the best performance for open-mindedness (OPN) among the five social and emotional skills. They also considered themselves to be good at collaboration (COL), task performance (TAP), and engaging with others (EWO). Only their perceived emotional regulation (EMR) skill was relatively poor compared with other skills, and this scale also had the largest standard deviation, suggesting more variations across the individuals. These results demonstrate that Chinese students were more skilled at taking actions and cooperating with others to manage challenges and fulfil missions. But when it came to dealing with their own emotions, they felt much less efficient. These results are generally consistent with the literature research. On the one hand, pro-social and cooperative behaviours are highly encouraged in the Chinese Confucian culture because it is considered essential to collective well-being, meanwhile, Chinese students tend to have high levels of committed and internalized control to achieve goals (X. Chen, 2000). On the other hand, Chinese students were more emotionally restrained since early childhood compared with their American counterparts, which is related to their emotion communication and regulation skills in the later years (Camras et al., 1998; Q. Wang, 2003).

The study showed how the social and emotional skills—COL, EWO, OPN and TAP assist the Chinese adolescents to alleviate the potential negative impact of academic stress derived from parents and teachers' expectations and finally promote their subjective well-being. To some extent, these social and emotional skills act as power converters to transform the pressure of the external expectations into motivations to promote students' actions, competences, and achievements, hence boosting well-being. In this sense, the Chinese adolescents' academic stressors derived from external expectations produced eustress, which typically refers to "a positive response to a cognitively appraised stressor" (Nelson & Simmons, 2004, p.279). According to Lazarus and Folkman (1984), individuals distinguish between stressors as either threatening or challenging, and whether they lead to distress or eustress is determined by the appraisal of stressors, and this appraisal was mainly dependent on two factors: first, the amount of demand imposed on the individual: eustress is associated with moderate levels of demands, whereas distress is associated with low and high levels of demands; second, the degree of control one has over the stressful situation: control as a situational belief is likely to influence whether a person experiences eustress (average to high control) or distress (little to no control) (Pluut et al., 2022). This is in line with the definition of 'coherence' in Antonovsky's (1972) salutogenic model: a pervasive confidence that the stimuli deriving from an individual's internal and external environments in life are predictable and explicable and the resources are available to the person to meet the demands posed by these stimuli. Antonovsky (1987) stated, a sense of coherence can make the difference between salutogenic tension management and pathogenic stress. When the amount of demand and people's perceived control on these demands keeps a balance, resulting in a sense of coherence, people can take actions to deal with the stressors in healthy and adaptive ways. Due to the positive relationship between stressors and the social and emotional skills (COL, EWO, OPN and TAP) in this study, it is likely that the stress was moderate and that the students perceived themselves with a sense of control (coherence).

According to Antonovsky's (1987) Salutogenic Model, the feeling of coherence grows from a person's life experiences and is influenced by their sociocultural background, childhood experiences, individual factors, and so forth. It is continually refined, tested, reinforced, and modified throughout life by experience. As stated previously, Suzhou students were relatively confident in their social and emotional skills of COL, EWO, OPN and TAP. These interpersonal skills or skills related to performance and actions, which were more related to problem-focused coping strategies (see 'Stress Appraisal and Coping Theory' section) (Lazarus & Folkman, 1984), were developed and confirmed consistently in their collectivistic social and academic environment. Consequently, this brought them a

sense of coherence when facing the moderate level of academic stressors from parents' and teachers' expectations. Therefore, these skills were stimulated because of the external expectation stressors, resulting in positive and supportive coping strategies and resources to help manage the attendant stress. Because the abilities of collaboration (COL) and engaging with others (EWO) may help them more easily get support from others, open-mindedness (OPN) may help them quickly find ways to deal with the challenges, and the ability of task performance (TAP) may make them focus on and stick to the current task. And these successful experiences in turn confirm and strengthen their COL, EWO, OPN and TAP skills. That is probably why these skills can be positively impacted by the academic stressors of external expectations. These results have been supported by some empirical studies. For example, after studying the interrelationship between stressors and coping strategies among Malaysian college students, Pariat et al. (2014) stated that the positive coping strategies like meditation, pursuing hobbies and sleep were found to be very helpful to combat academic stress, and they had a high degree of positive correlation with academic stress. Rashidi et al. (2022) found that perceived stress of nurses of patients with COVID-19 was significantly positively correlated with confrontative, distancing, self-controlling, seeking social support, accepting responsibility, planful problem-solving, and positive reappraisal strategies.

On the other hand, the results of the mediation model of emotional regulation (EMR) on academic stressors and well-being relationship, were overall not in line with the empirical evidence. Although the results in the literature are quite contradictory, some studies proved that students who engaged in problem-focused coping were more likely to be motivated and perform better than students who engaged in emotion-focused coping (e.g. Struthers et al., 2000), while some researchers stated students who used emotion-focused coping strategies tackled with stress better compare to those who used problem-focused strategies (e.g. Minchekar, 2017), the previous studies did prove that there is a significant relationship between academic stress and emotion-focused strategies. However, in this study, there was no significant relationship between the academic stressors (external expectations) and EMR, consequently, the indirect and total effect from academic stressors (external expectations) to well-being were not significant. The only significant path was the negative effect of EMR on well-being, and this is to some extent consistent with the previous studies. Because it is proved that some of the emotion-focused coping strategies like self-blame negatively predicted well-being (Orines & Sunga-Vargas, 2023), and Gonzalez et al. (2002) suggested well-being had a negative correlation with emotion-focused coping strategies, at the same time, they reported a positive correlation was observed between well-being and problem-focused coping. This supports the results in this study, because the other four social and emotional skills—COL, EWO, OPN and TAP, which are more related to problem-focused coping, were all proved to significantly and positively predict subjective-well-being. Carver et al. (1989), and Lazarus and Folkman (1984), supported the results from a theoretical perspective. They argued, as an active form of coping, problem-focused coping is more successful, because it promotes actions and addresses the problems directly, while passive forms of coping, like some strategies of emotion-focused coping, which generally avoids confrontation or behaviours, and just focuses on adjusting emotions, is less successful. Nevertheless, we still cannot determine the reason why the EMR mediation model showed the results. According to the data of this study, the Chinese students considered their emotional regulation skill (EMR) as poor, consequently it is possible they did not develop sense of control or coherence in this respect. Therefore, their EMR skill could not be mobilized by the expectation stressors, or this skill was too weak to transform to positive emotion-focused coping strategies, like stress resistance, optimism, and emotional control. This probably is one important reason why no mediating effect was formulated through EMR among these Chinese students.

The confounding effects of the three control variables- gender, SES and immigrant background, did not significantly influence the indirect effects of academic stressors (external expectations) through the social and emotional skills (COL, EWO, EMR, OPN and TAP). And in each model, not all the control variables imposed significant effects. Gender was the only variable that significantly impacted subjective well-being in all the five models, as a negative predictor. Since gender was a dummy

variable with male=0 and female=1, thus, the results mean, compared with boys, the Chinese girls had lower level of subjective well-being. This is typically consistent with the evidence in the literature, that women rate their subjective health lower than men (e.g. Baltes et al., 1999; Tesch-Römer & Wurm, 2006). But there are also some studies that showed there is no significant gender difference in the subjective well-being levels of the students (e.g. Dost, 2006). SES was demonstrated to have significant and positive effect on subjective well-being in the COL, EMR and TAP mediation models. This means, students with higher SES scored higher on subjective well-being than those with lower SES status. This relationship has been well-established by abundant studies in literature (J. J. X. Tan et al., 2020). And according to Diener & Diener (1996) socio-economic status is the strongest predictors of well-being. But in this study, as the predictors for well-being, gender was more stable and influential than SES. The last influential control variable in this study is immigrant background, which showed a negative association with subjective well-being only in the mediation model of OPN. With immigrant students assigned 1, this result means the perceived well-being of students who had immigrant background was lower than that of the local students. This result is generally supported by studies in this domain (e.g. Hadjar & Backes, 2013).

Conclusion

This study empirically supported the assumption that social and emotional skills may mediate the relationship between academic stressors and subjective well-being among Chinese adolescents. Although the stress-buffering function of these mediators was not confirmed, it provides evidence for the coping resources mobilization theory, alternatively, academic stressors mobilize social and emotional skills (Collaboration, Engaging with others, Open-mindedness, and Task performance). This is the most crucial premise to prove additive stress-buffering effect, which is the result of an activation, or a mobilization, of coping resources (social and emotional skills in this study) (Wheaton, 1985). Therefore, this study shows evidence for the possibility for future studies to test the stress-buffering function with more comprehensive measurement of academic stressors. This is important for the additive version of stress-buffering model, since as a more *complete* stress-buffering model, it has been ignored by mainstream research, and it needs more empirical evidence to support it.

For Chinese policy makers and educators, the study indicates that social and emotional skills, especially Collaboration (COL), Engaging with others (EWO), Open-mindedness (OPN), and Task performance (TAP), are beneficial to help students deal with academic stress. Moderate levels of academic stressors like parents' and teachers' expectations may even be transformed into motivations of study or promotions of well-being through the mastery of a certain level of social and emotional skills. Moreover, Chinese students are not confident with their Emotional regulation (EMR) skills, probably because of their daily experience like potential influence of social norms and culture, thus, they should get more support in this regard, to learn and practice positive emotion-focused strategies, like stress resistance, emotional control, and optimism. Therefore, it is important for Chinese policymakers and educators to promote social and emotional learning programs to help students practice and gradually build up more sense of coherence to manage academic stressors (Antonovsky, 1972).

Limitations and Future Research Recommendations

The limitations for this study mainly involve the following aspects. Firstly, the measurement of *academic stressors* was limited to SSES 2019. The selected items were not designed based on professional scales to measure stressor, therefore, only three items were kept constructing *parents' and teachers' expectation*. This scale only captures one important aspect of *academic stressors* and is more suitable for the Chinese background. This could be one potential threat to contribute to the insignificant direct effects between *academic stressors* and *subjective well-being* in the five mediation models. Secondly, the data of SSES 2019 were collected just before the pandemic, and the pandemic has been found to change the levels of students' stress, social and emotional skills, and subjective well-being (Evans et al., 2021; Lyons et al., 2020; Tavoracci et al., 2021; Villani et al., 2021; Wilson et al., 2021). Therefore, it is better for the future research to gather latest data of adolescents from different cultural backgrounds by implementing professional and comprehensive scales to measure *academic stressors*. Then the researchers will be more confident to test whether the mediating effects of different social and emotional skills can exert stress-buffering function under different cultural backgrounds, such that the evidence for the additive stress-buffering will be more widely applicable. Thirdly, due to the researcher's interest and the complexity of the measurement models of the five social and emotional skills, this study generally examined whether and how the five skills respectively mediate the relationship between academic stressors (external expectations) and subjective well-being, and the more detailed and in-depth relationships and issues were not touched. For example, how different levels of stressors impact on social and emotional skills and consequently, how this influences their direct and indirect effects on subjective well-being; whether gender, SES and immigrant background can mediate the effects of academic stressors is also valuable to be explored. These are all valuable directions that deserve the attention for future research. In addition, since some of the skills may correlate with each other, it is necessary for future research to simultaneously examine their mediating effects in one multiple-mediator model. Moreover, it is important to stress that this study is correlational in nature and cannot determine with certainty the direction of effects in the mediation models. Especially, for the positive relationship between the academic stressors and social and emotional skills, it could be that individuals with higher skills are more sensitive to academic stressors. Finally, to fully understand the stress-buffering effect of adolescents' social and emotional skills, only the additive (mediation) model is not enough. Future research should also test the interactive (moderation) model, to see whether social and emotional skills act as moderators in stress-buffering function, or whether the total effects of academic stressors were dual buffered by social and emotional skills among adolescents, which means the stress-buffering effects of social and emotional skills are formulated both via mediation and moderation.

Ethical Issues

Firstly, it is needed to acknowledge that all the implemented data were obtained from the public resources of OECD iLibrary, except that the social and emotional skills assessment items were acquired by an application to the SSES project team of OECD. According to their requirements, the researcher should be very cautious with the following aspects during the research process: the social and emotional skills assessment items can only be used in the sole context of this current research project; the researcher cannot share these confidential materials with other parties; the researcher has the responsibility to share with the OECD SSES project team, if there is any subsequent publication of results from this study. Secondly, informed consent has been obtained from participants during the primary data collection process and all SSES 2019 materials including all assessment materials, data, and draft materials designated as secure were kept confidential at all times. Confidentiality rules were in place for all approved project staff and only them could access or view these materials during the assessment session (Eva, 2021). And for the studied sample of this research—the 3,621 15-year-old students from Suzhou, all their identities were represented by ‘Student Full ID’, as well as ‘Site ID’ and ‘School ID’, to make sure that all participants’ private or identifiable information is hidden from the researchers and readers. Additionally, for a study using secondary data, the data quality and integrity must be guaranteed. Therefore, the researcher carefully went through the process of data collection and evaluated the validity and reliability of the data measurement, to get a clear sense of the whole dataset, especially for the studied sample. Bearing them in mind, the researcher tried the best to make it just and transparent when analysing the data, interpreting the results, and acknowledging the potential biases or limitations. Another point needs to be paid attention to is, any negative consequences that might arise from the analysis or findings should be minimized. For example, it was emphasized in this research, effects of the external expectation stressor can be a kind of motivation with the mediating effects of some social and emotional skills, therefore, people should realize it is not a good way to just dispel stressors. Finally, the researcher has no conflicts of interest that could influence the research findings or interpretations.

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DEPARTMENT OF EDUCATION AND SPECIAL EDUCATION

Appendix 1 Competences or Traits Related to Social and Emotional Skills

1.1 Self-Awareness and Self-Management, Ability to Solve Social Problems and Social Skills (Social Support)

According to Collaborative for Academic, Social, and Emotional Learning (CASEL), the proximal goals of Social and Emotional Learning (SEL) programs are to foster the development of five interrelated sets of cognitive, affective, and behavioural competencies: self-awareness, self-management, social awareness, relationship skills, and responsible decision making (CASEL, 2005). Therefore, self-compassion and self-regulation can be the outcomes of self-awareness and self-management. Ability to solve social problems can be achieved with social and emotional skills because people will have the abilities “to generate and coordinate flexible, adaptive responses to demands and to generate and capitalize on opportunities in the environment” (Waters & Sroufe, 1983, p. 80); social support can also be linked, because as an important component of social and emotional skills, relationships skills (also known as social skills) will help people get more social support.

1.2 Emotional Intelligence

The concept of emotional intelligence originates from Thorndike’s (1920) idea of ‘social intelligence’ and its ramification in Gardner’s (2011) distinction between interpersonal and intrapersonal abilities. Nowadays, many experts have equated emotional intelligence with the SEL movements in practical settings which identify social and emotional skills for healthy relationships and functioning, as well as promoting programs to enhance social and emotional skills (Elias et al., 1997; Saarni, 1997; Zins et al., 2007).

1.3 Mindfulness

Derived from eastern contemplative practices, mindfulness is a way of staying aware of emotions and considering one’s experiences in each present moment (Kabat-Zinn, 2003). Mindfulness has lots of similarities with the fundamental aspects of social and emotional skills. A literature review yielded 40 studies suggested a conceptual fit between mindfulness-based practices (MBP) applied in schools and a SEL framework using the five competency areas endorsed by CASEL (Feuerborn & Gueldner, 2019).

1.4 Resilience

Resilience and social and emotional skills are always closely linked. Resilience refers to an individual's ability to withstand and conquer challenging circumstances (G. A. L. Fuentes & Ivonne, 2016). (T. Wright, 2013) even defined resilience as the ability to use social and emotional skills to recover from the effects of stress in one's life. And the empirical evidence demonstrated that there is a positive and significant correlation between resilience and social skills in adolescents, indicating that higher levels of resilience are associated with better social abilities (Arboleda-Flórez & Stuart, 2012; M. M. P. B. Fuentes et al., 2013).

Appendix 2 Inclusion and Exclusion Criteria and Reviewed Publications for The Empirical Literature Review

2.1 Inclusion and Exclusion Criteria for The Systematic Literature Review on Relationships among Social and Emotional Skills Related Competences, (Academic)Stress, and Well-being among Adolescents

Inclusion Criteria	Exclusion Criteria
Written in English or Chinese	Written in language OTHER THAN English or Chinese
Students aged from 10 to 24 (adolescents) as the research samples	1) Samples including students younger than 10 or older than 24 2) Samples with diagnosed symptoms, like physical or psychological diseases
Academic stress or stress in school setting included	NO academic stress or stress in school setting
Any quantitative method as at least one of the research methods	ONLY qualitative methods used
Results include the relationship among students' SESs related competences, (academic) stress, and well-being	NO relationship among students' social and emotional skills related competences, (academic) stress and well-being studied
Published articles, book chapters, research reports, conference proceedings and master and PhD dissertations	Publications OTHER THAN published articles, book chapters, research reports, conference proceeding, master dissertations or PhD dissertations

2.2 Reviewed Publications

Aloia, L. S., & McTigue, M. (2019). Buffering Against Sources Of Academic Stress: The Influence of Supportive Informational and Emotional Communication on Psychological Well-Being. *Communication Research Reports*, 36(2), 126–135. <https://doi.org/10.1080/08824096.2019.1590191>

Austin, E. J., Saklofske, D. H., & Mastoras, S. M. (2010). Emotional intelligence, coping and exam-related stress in Canadian undergraduate students. *Australian Journal of Psychology*, 62(1), 42–50. <https://doi.org/10.1080/00049530903312899>

Berdida, D. J. E., & Grande, R. A. N. (2023). Academic stress, COVID - 19 anxiety, and quality of life among nursing students: The mediating role of resilience. *International Nursing Review*, 70(1), 34–42. <https://doi.org/10.1111/inr.12774>

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- Park, M., Hong, J., Park, J., & Chung, S. (2023). Impact of Resilience and Viral Anxiety on Psychological Well-Being, Intrinsic Motivation, and Academic Stress in Medical Students During the COVID-19 Pandemic. *Psychiatry Investigation*, 20(6), 524–530. <https://doi.org/10.30773/pi.2023.0019>
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Versteeg, M., & Kappe, R. (2021). Resilience and Higher Education Support as Protective Factors for Student Academic Stress and Depression During Covid-19 in the Netherlands. *Frontiers in Public Health*, 9, 737223. <https://doi.org/10.3389/fpubh.2021.737223>

Wang, X., Cai, L., Qian, J., & Peng, J. (2014). Social support moderates stress effects on depression. *International Journal of Mental Health Systems*, 8(1), 41. <https://doi.org/10.1186/1752-4458-8-41>

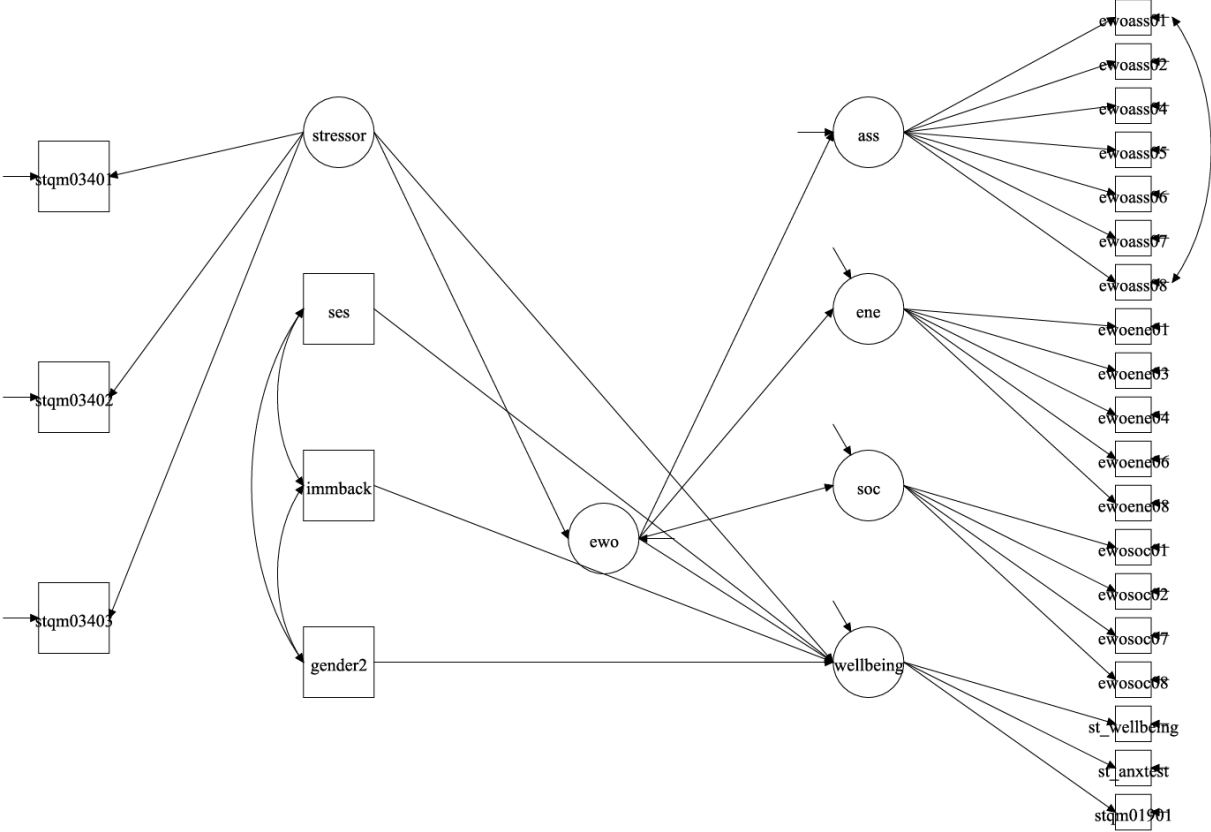
Weinstein, N., Brown, K. W., & Ryan, R. M. (2009). A multi-method examination of the effects of mindfulness on stress attribution, coping, and emotional well-being. *Journal of Research in Personality*, 43(3), 374–385. <https://doi.org/10.1016/j.jrp.2008.12.008>

Wen, X., Zhang, Q., Liu, X., Du, J., & Xu, W. (2021). Momentary and longitudinal relationships of mindfulness to stress and anxiety among Chinese elementary school students: Mediations of cognitive flexibility, self-awareness, and social environment. *Journal of Affective Disorders*, 293, 197–204. <https://doi.org/10.1016/j.jad.2021.06.038>

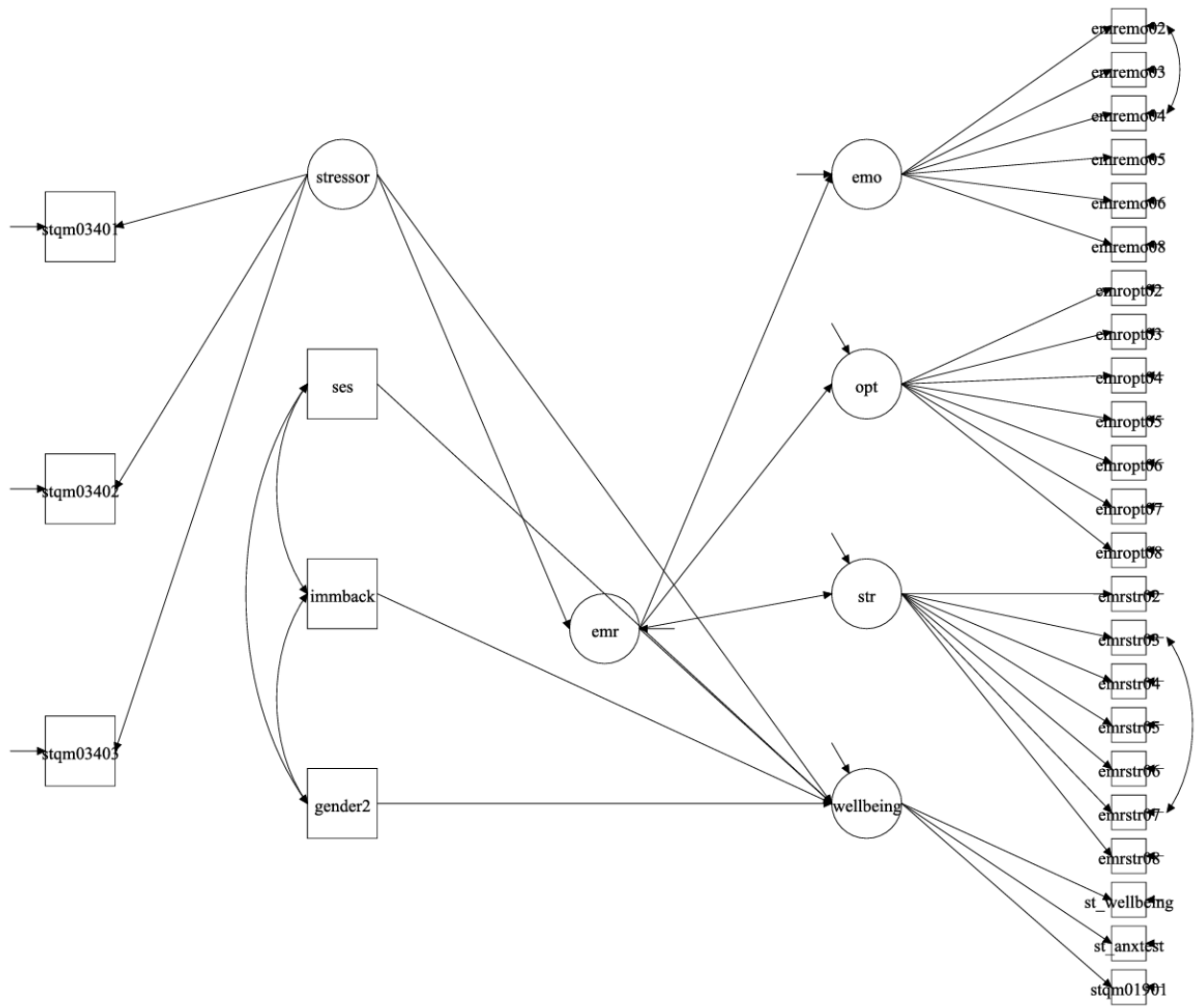
Zhong, L. F. (2009). Academic stress and subjective well-being: The moderating effects of perceived social support. *2009 16th International Conference on Industrial Engineering and Engineering Management*, 1321–1324. <https://doi.org/10.1109/ICIEEM.2009.5344424>

Appendix 3 The Hypothesized Mediation Models

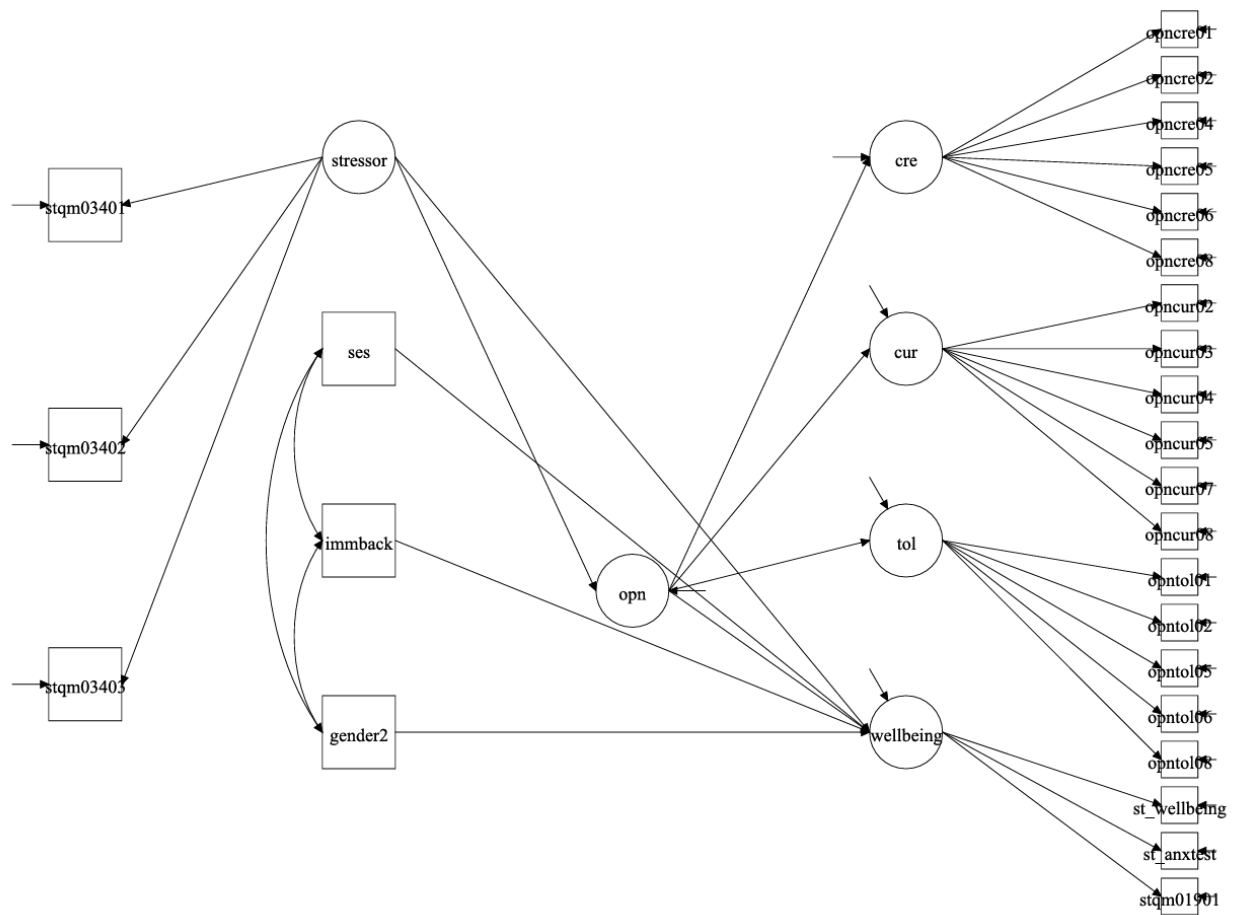
3.1 Hypothesized Structural Models



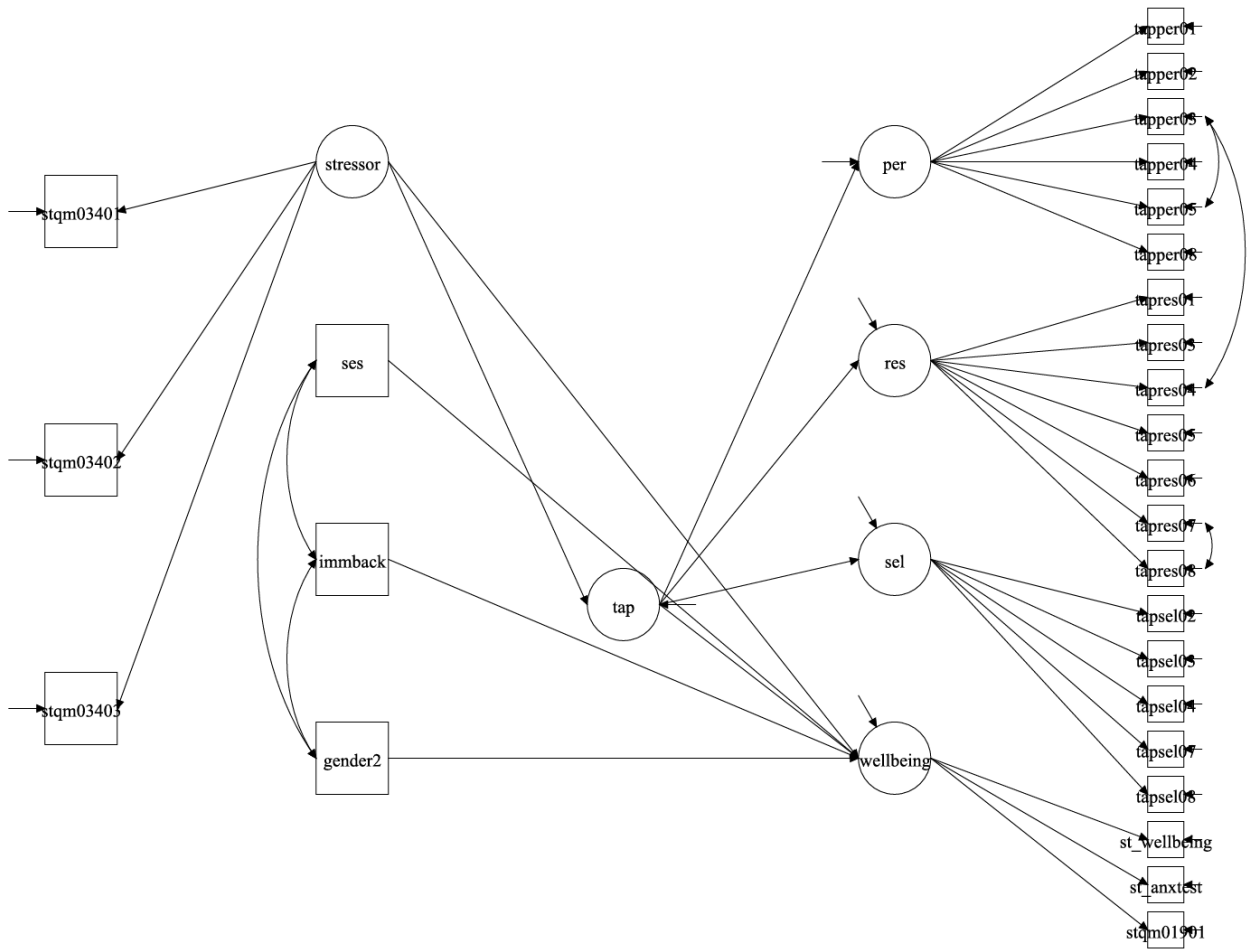
The hypothesized mediation model in SEM, presenting the indirect effect of academic stressors (external expectations) on subjective well-being through Engaging with others (EWO), accounting for gender, SES and immigrant background



The hypothesized mediation model in SEM, presenting the indirect effect of academic stressors (external expectations) on subjective well-being through Emotional regulation (EMR), accounting for gender, SES and immigrant background



The hypothesized mediation model in SEM, presenting the indirect effect of academic stressors (external expectations) on subjective well-being through Open-mindedness (OPN), accounting for gender, SES and immigrant background



The hypothesized mediation model in SEM, presenting the indirect effect of academic stressors (external expectations) on subjective well-being through Task performance (TAP), accounting for gender, SES and immigrant background

3.2 The Estimated Parameters in Each Hypothesized Model

In the COL mediation model, the factor loadings of STQM03401, COLCOO01, COLEMP01, COLTRU01, st_wellbeing and COO were constrained to 1; in the EWO mediation model, factor loadings of STQM03401, EWOASS01, EWOENE01, CEWOSOC01, st_wellbeing and ASS were assigned 1; in the EMR mediation model, the factor loadings of STQM03401, EMREMO02, EMROPT02, EMRSTR02, st_wellbeing and EMO were fixed at 1; in the OPN mediation model, factor loadings of STQM03401, OPNCRE01, OPNCUR01, OPNTOL01, st_wellbeing and CRE were assigned 1; in the TAP mediation model, the factor loadings of STQM03401, TAPPER01, TAPRES01, TAPSEL02, st_wellbeing and CRE that were constrained to 1. As a result, in the COL mediation model, the parameters that were freely estimated were 66 in total: 6 effect coefficients, 22 factor loadings, 34 variances and 4 covariance. In the EWO mediation model, 60 parameters were estimated, including 6 effect coefficients, 19 factor loadings, 31 variances, and 4 covariance. In the EMR mediation model, 69 parameters—6 effect coefficients, 23 factor loadings, 35 variances, and 5 covariances—were specified for estimation. In the OPN mediation model, 61 parameters were freely estimated: 6 effect coefficients, 20 factor loadings, 32 variances and 3 covariances. In the TAP mediation model, 66 parameters were estimated: 6 effect coefficients, 21 factor loadings, 33 variances, and 6 covariance.

Appendix 4 Initial Results of Confirmatory Factor Analysis (CFA)

Complex Scale	Scale	Item	Standardized Model Results (Est.)		CFI Acceptable: ≥0.90 Excellent: ≥0.95	TLI Acceptable: ≥0.90 Excellent: ≥0.95	RMSEA Acceptable: ≤0.08 Excellent: ≤0.05	SRMR Acceptable: ≤0.08 Excellent: ≤0.05	χ ² /df (P-Value)
			Factor loadings	Residual Variances					
Academic Stressors	Parent And Teacher Expectation	STQM03401	0.823	0.322	0.498	0.163	0.283	0.147	2614.358/9 (0.0000)
		STQM03402	0.816	0.334					
		STQM03403	0.657	0.569					
		STQM03404	0.408	0.834					
	School Competitiveness	STQM03803	0.193	0.963					
		STQM03804	0.179	0.968					
Subjective Well-being	Life satisfaction	STQM01901	0.697	0.515	1	1	0.000	0.000	0.0000/0 (0.0000)
	WHO-5 Wellbeing Index	STQM02001-05	0.819	0.330					
	Index of Test Anxiety	STQM04201-03	-0.274	0.925					
Collaboration (COL)	Empathy (EMP)	COLEMP01	0.662	0.562	0.871	0.857	0.055	0.051	2939.284/249 (0.0000)
		COLEMP02	0.462	0.787					
		COLEMP03	0.602	0.638					
		COLEMP04	0.563	0.684					
		COLEMP05	0.486	0.764					
		COLEMP06	0.626	0.608					
		COLEMP07	0.650	0.578					
		COLEMP08	0.426	0.818					
	Trust (TRU)	COLTRU01	0.606	0.632					
		COLTRU02	0.666	0.556					
		COLTRU03	0.649	0.579					
		COLTRU04	0.726	0.473					
		COLTRU05	0.436	0.810					
		COLTRU06	0.628	0.605					
		COLTRU07	0.796	0.366					
		COLTRU08	0.827	0.315					
	Cooperation (COO)	COLCOO01	0.682	0.535					
		COLCOO02	0.638	0.593					
		COLCOO03	0.677	0.541					
		COLCOO04	0.403	0.838					
	COLCOO05	0.572	0.673						
	COLCOO06	0.718	0.485						
	COLCOO07	0.654	0.573						
	COLCOO08	0.566	0.680						
Engaging With Others (EWO)	Sociability (SOC)	EWOSOC01	0.726	0.474	0.841	0.824	0.066	0.071	4215.071/249 (0.0000)
		EWOSOC02	0.746	0.443					
		EWOSOC03	0.485	0.765					
		EWOSOC04	0.372	0.862					
		EWOSOC05	0.490	0.760					
		EWOSOC06	0.485	0.765					
		EWOSOC07	0.802	0.357					
		EWOSOC8	0.687	0.528					
	Assertiveness (ASS)	EWOASS01	0.726	0.473					
		EWOASS02	0.653	0.573					
		EWOASS03	0.400	0.840					
		EWOASS04	0.756	0.429					
		EWOASS05	0.735	0.460					
		EWOASS06	0.582	0.661					
		EWOASS07	0.886	0.215					
		EWOASS08	0.773	0.402					
	Energy (ENE)	EWOENE01	0.747	0.443					
		EWOENE02	0.503	0.747					
		EWOENE03	0.565	0.680					
		EWOENE04	0.720	0.481					
		EWOENE05	0.489	0.761					
		EWOENE06	0.594	0.647					
		EWOENE07	0.290	0.916					
		EWOENE08	0.708	0.499					

Emotional Regulation (EMR)	Stress resistance (STR)	EMRSTR01	0.475	0.775	0.857	0.841	0.069	0.077	4540.445/ 249 (0.0000)
		EMRSTR02	0.704	0.504					
		EMRSTR03	0.581	0.662					
		EMRSTR04	0.745	0.446					
		EMRSTR05	0.825	0.319					
		EMRSTR06	0.828	0.314					
		EMRSTR07	0.714	0.490					
		EMRSTR08	0.831	0.310					
	Optimism (OPT)	EMROPT01	0.438	0.593					
		EMROPT02	0.667	0.555					
		EMROPT03	0.636	0.596					
		EMROPT04	0.714	0.491					
		EMROPT05	0.560	0.686					
		EMROPT06	0.741	0.451					
		EMROPT07	0.770	0.408					
		EMROPT08	0.669	0.553					
Emotional control (EMO)	EMREMO01	0.517	0.733						
	EMREMO02	0.622	0.613						
	EMREMO03	0.730	0.467						
	EMREMO04	0.607	0.631						
	EMREMO05	0.779	0.393						
	EMREMO06	0.605	0.634						
	EMREMO07	0.402	0.838						
	EMREMO08	0.803	0.355						
Open-mindedness (OPN)	Curiosity (CUR)	OPNCUR01	0.497	0.753	0.845	0.829	0.060	0.062	3517.726/249 (0.0000)
		OPNCUR02	0.573	0.672					
		OPNCUR03	0.590	0.652					
		OPNCUR04	0.655	0.572					
		OPNCUR05	0.748	0.440					
		OPNCUR06	0.533	0.716					
		OPNCUR07	0.691	0.523					
		OPNCUR08	0.572	0.673					
	Tolerance (TOL)	OPNTOL01	0.553	0.694					
		OPNTOL02	0.655	0.571					
		OPNTOL03	0.374	0.860					
		OPNTOL04	0.533	0.716					
		OPNTOL05	0.739	0.454					
		OPNTOL06	0.680	0.537					
		OPNTOL07	0.482	0.768					
		OPNTOL08	0.831	0.310					
	Creativity (CRE)	OPNCRE01	0.661	0.563					
		OPNCRE02	0.761	0.421					
		OPNCRE03	0.475	0.775					
		OPNCRE04	0.642	0.588					
		OPNCRE05	0.744	0.446					
		OPNCRE06	0.615	0.621					
		OPNCRE07	0.543	0.705					
		OPNCRE08	0.618	0.618					
Task Response (TAP)	Responsibility (RES)	TAPRES01	0.584	0.659	0.833	0.815	0.062	0.062	3725.915/249 (0.0000)
		TAPRES02	0.473	0.776					
		TAPRES03	0.600	0.640					
		TAPRES04	0.694	0.519					
		TAPRES05	0.579	0.664					
		TAPRES06	0.696	0.516					
		TAPRES07	0.586	0.657					
		TAPRES08	0.639	0.591					
	Self-control (SEL)	TAPSEL01	0.161	0.974					
		TAPSEL02	0.559	0.687					
		TAPSEL03	0.736	0.459					
		TAPSEL04	0.616	0.620					
		TAPSEL05	0.281	0.921					
		TAPSEL06	0.403	0.837					
		TAPSEL07	0.765	0.415					
		TAPSEL08	0.596	0.645					
	Persistence (PER)	TAPPER01	0.700	0.510					
		TAPPER02	0.622	0.613					
		TAPPER03	0.701	0.509					
		TAPPER04	0.722	0.479					
		TAPPER05	0.731	0.465					
		TAPPER06	0.492	0.758					
		TAPPER07	0.472	0.777					
		TAPPER08	0.693	0.520					

Note: All the item factor loadings and residual variances were SIGNIFICANT, and their P-values <0.001.

Appendix 5 Modification Procedures for Problematic Measurement Models in Confirmatory Factor Analysis (CFA)

The initial measurement model of *Academic Stressors* showed a very bad model fit (CFI = 0.498, TLI=0.163, SRMR=0.147, RMSEA=0.283) (See Appendix 4). Thus, firstly, the two items for *school competitiveness*—STQM03803 and STQM03804 were deleted because they had quite low factor loadings, 0.193 and 0.179 respectively. Then the Standardized residual variances of the items were checked, and the item STQM03404 showed a residual variance of 0.834, then it was also deleted. After the deletions of the three items, the adjusted measurement model of *Academic Stressors* reached a perfect model fit (CFI = 1, TLI=1, SRMR=0.000, RMSEA=0.000) (see Table 6).

The model fit indices of the preliminary measurement of *Collaboration (COL)* were CFI=0.871, TLI=0.857, RMSEA=0.055, SRMR=0.05 (see Appendix 4). Both the values for CFI and TLI were under the acceptable threshold. Therefore, items of COLCOO04, COLEMP02, COLEMP05, COLEMP08 and COLTRU05 were deleted with high values of residual variance, which ranged from 0.764 to 0.838. After this, the model fit reached almost acceptable level, with a slightly low TLI (0.895). Then a parameter for the correlation between COLTRU03 and COLTRU02 was added in the model, because ‘COLTRU03 WITH COLTRU02’ had a highest modification index, and the correlation between the two indicators (0.584) was higher than most other pairs. In the end, the re-modified model had a totally acceptable model fit (CFI=0.921, TLI= 0.908, RMSEA=0.051, SRMR=0.041) (see Table 6).

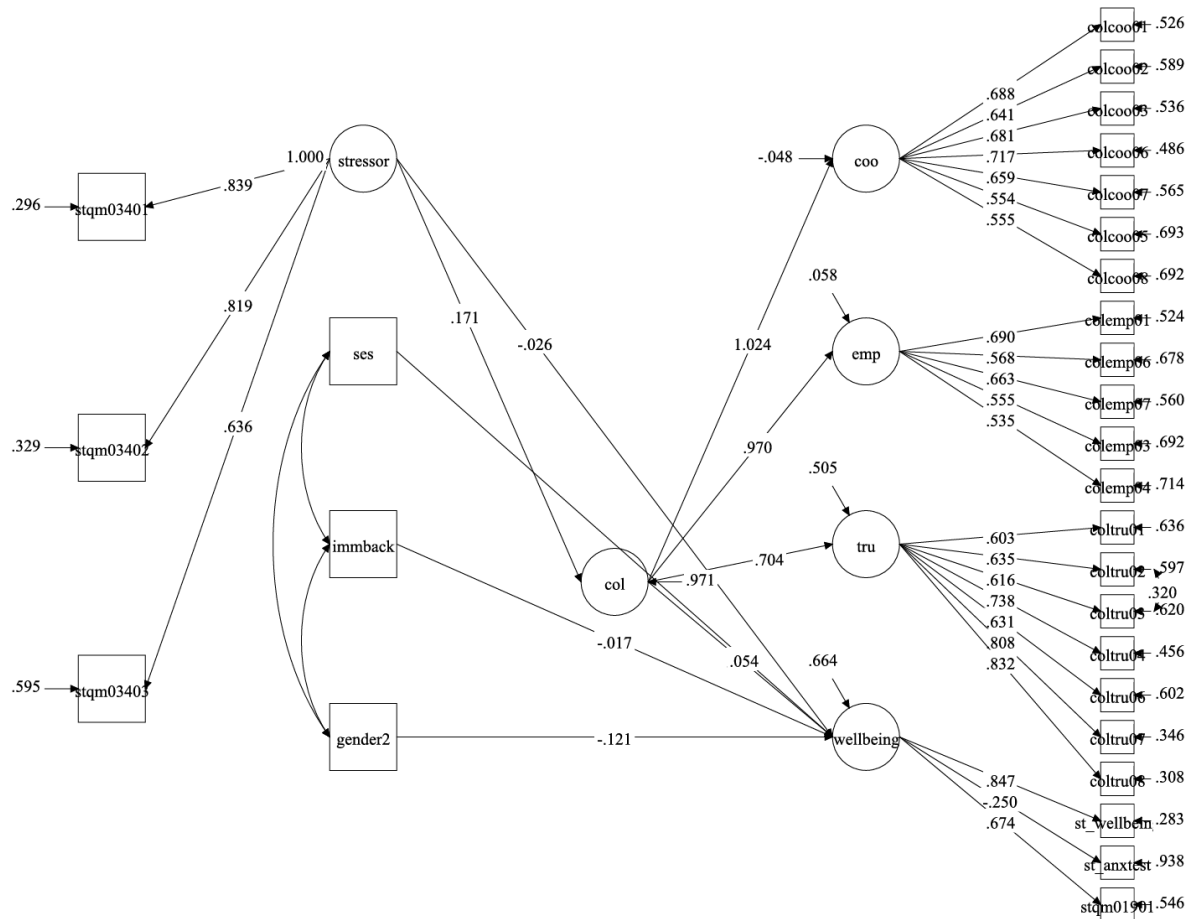
The initial measurement model of *Engaging with Others (EWO)* showed an unacceptable model fit (CFI =0.841, TLI=0.824, SRMR=0.066, RMSEA=0.071) (see Appendix 4). To achieve an acceptable model, eight items were excluded from the model. EWOASS03, EWOENE07 and EWOSOC04 were deleted because they had quite low factor loadings, which were 0.400, 0.290 and 0.372 respectively; and EWOENE02, EWOENE05, EWOSOC03, EWOSOC05 and EWOSOC06 were deleted because of the high residual variances, which varied from 0.747 to 0.86. After this operation, the model was almost acceptable with only a slightly low TLI that had a value of 0.897. Since in this model the modification index indicated a highest value for ‘EWOASS08 WITH EWOASS01’, and the correlation between the two items was high (0.643), the covariance of the two indicators was allowed in the model, hence leading to an acceptable model (CFI =0.921, TLI=0.905, SRMR=0.062, RMSEA=0.058) (see Table 6).

Similarly, the first measurement model of Emotional Regulation (EMR) also had an unacceptable model fit (CFI=0.857, TLI=0.841, RMSEA=0.055, SRMR=0.05) (see Appendix 4). EMREMO01, EMREMO07, EMROPT01 and EMRSTR01 were deleted because they had residual variances that were over 0.70. With those deletions, the model fit was still not satisfying. Then according to the results of the modification indices, the slightly high correlations between EMREMO04 and EMREMO02, EMRSTR07 and EMRSTR03 were detected (0.559 and 0.588 respectively) one after another. Therefore, the parameters of correlation on the two pairs of indicators were estimated in the re-defined models step by step, finally achieving an acceptable model fit with CFI=0.913, TLI=0.900, RMSEA=0.059, SRMR=0.06 (see Table 6).

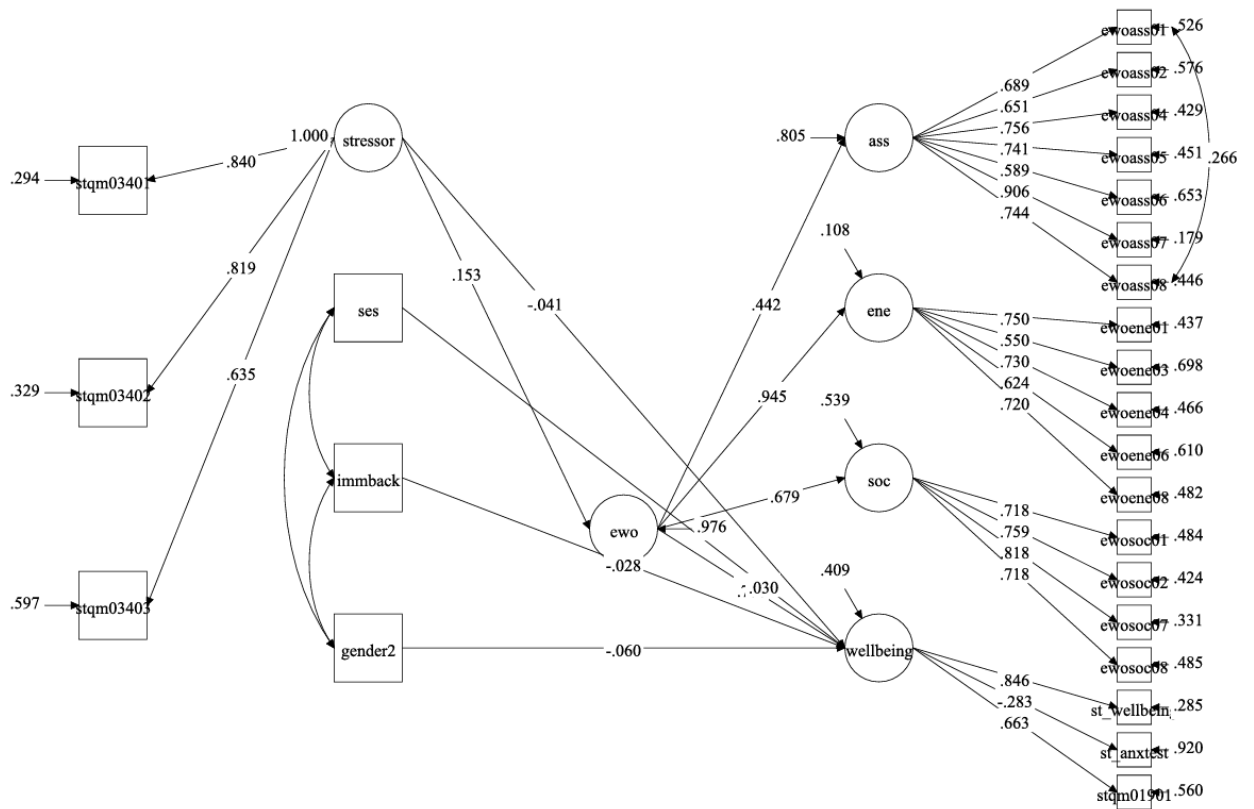
Measurement of Open-mindedness (OPN) also did not reach a satisfying model fit at the beginning, with CFI=0.845, TLI=0.829, RMSEA=0.060, SRMR=0.06 (see Appendix 4). To improve the model, OPNTOL03 was deleted with a low factor loading of 0.374, and OPNCRE03, OPNCRE07, OPNCUR01, OPNCUR06, OPNTOL04 and OPNTOL07 were excluded because of their high residual variances, which ranged from 0.716 to 0.775. After these deletions, the adjusted model had an acceptable model fit with CFI=0.924, TLI=0.910, RMSEA=0.052, SRMR=0.04 (see Table 6).

Model fit of initial Task Performance (TAP) measurement was even worse (CFI=0.833, TLI=0.815, RMSEA=0.062, SRMR=0.062) (see Appendix 4). Firstly, TAPSEL01 and TAPSEL05 were deleted because of their quite low factor loadings, which were 0.161 and 0.281 respectively; TAPPER06, TAPPER07, TAPRES02 and TAPSEL06 were deleted because they had high residual variances that were over 0.70. Then four times of modification indices were performed, to constantly re-evaluate and re-adjust the model, with the second time adding correlations between TAPRES08 and TAPRES07, the third time adding correlation between TAPRES04 and TAPPER03, and the fourth time adding correlation between TAPPER05 and TAPPER03 into the redefined models, because the three pairs of indicators presented the highest modification index in each redefined model and each pair had a high correlation (0.598, 0.611 and 0.631 respectively). After those repeated model modifications, the model fit achieved an acceptable level, with CFI=0.916, TLI=0.901, RMSEA=0.054, SRMR=0.05 (see Table 6).

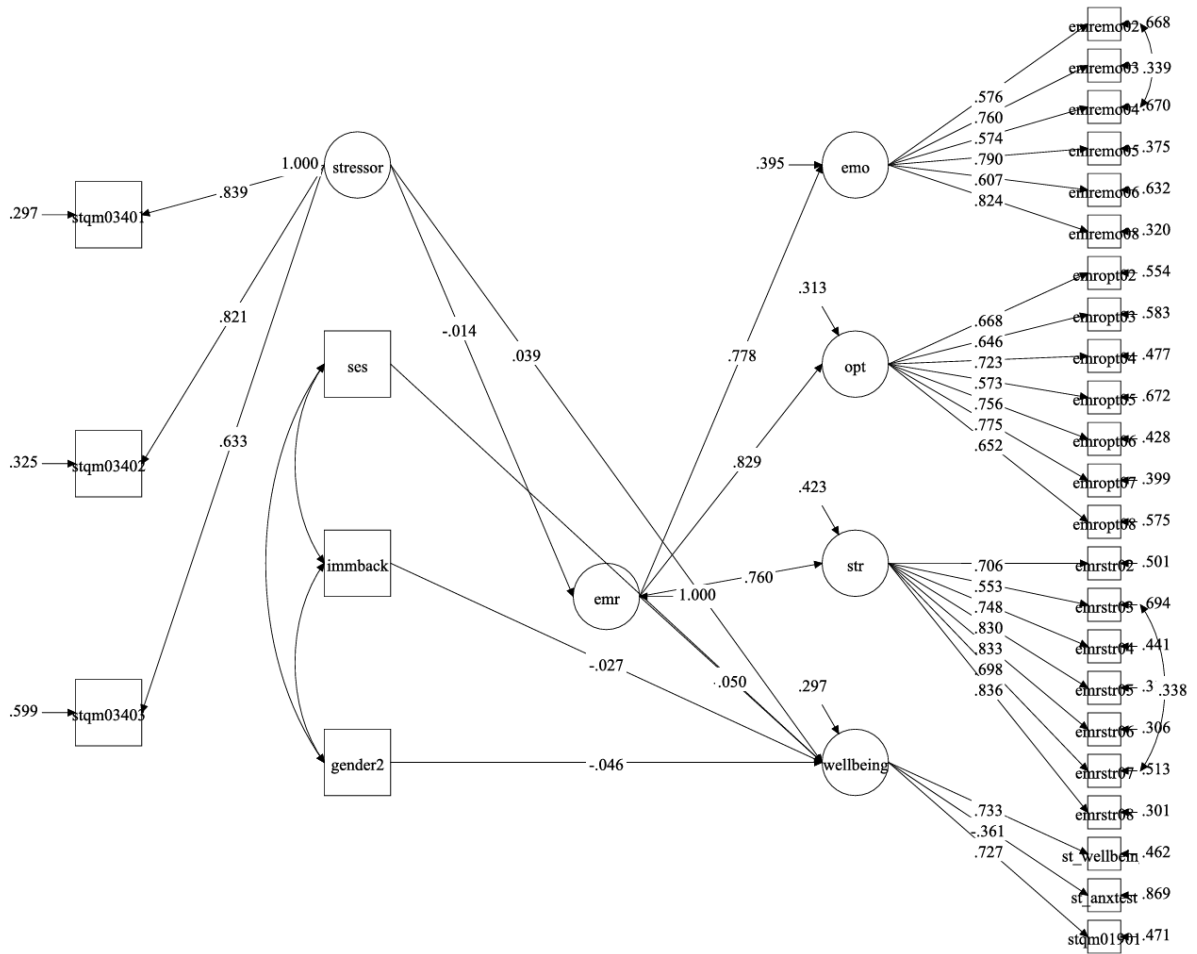
Appendix 6 Structural Equation Modelling (SEM) Diagrams with final results of Mediation models



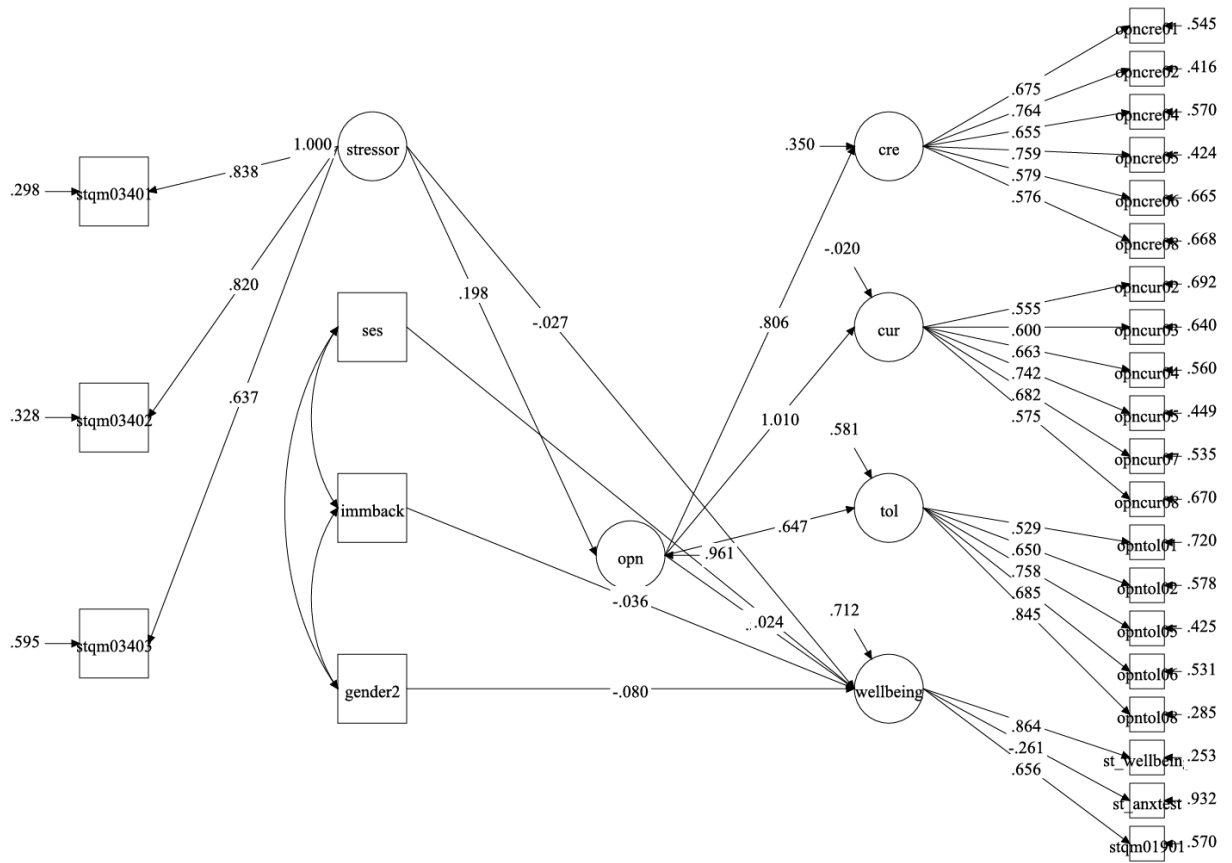
Mediation model presenting the indirect effect of academic stressors on subjective well-being through Collaboration (COL) after accounting for gender, SES and immigrant background



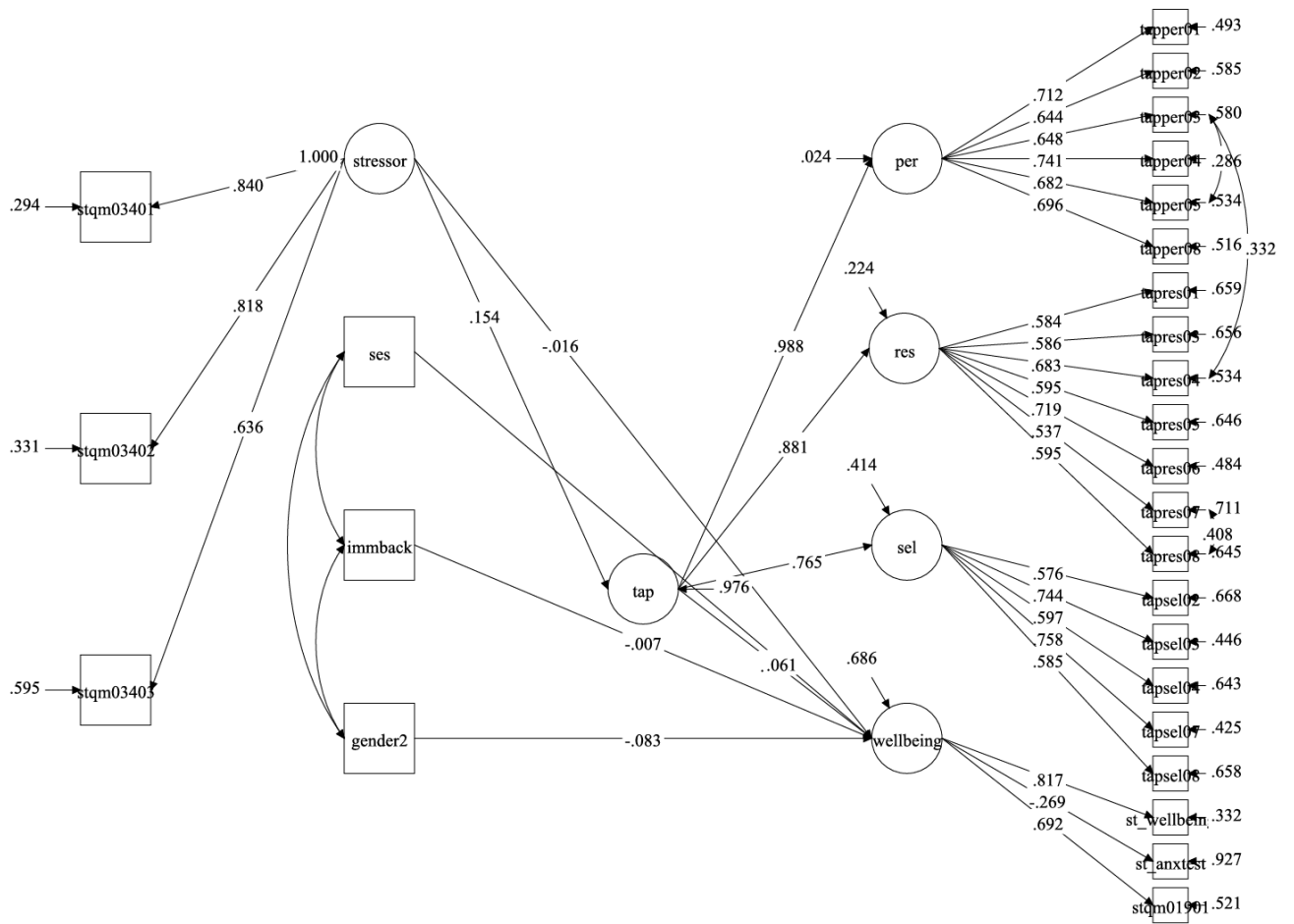
Mediation model presenting the effect of academic stressors on subjective well-being through Engaging with others (EWO) after accounting for gender, SES and immigrant background



Mediation model presenting the effect of academic stressors on subjective well-being through Emotional Regulation (EMR) after accounting for gender, SES and immigrant background



Mediation model presenting the effect of academic stressors on subjective well-being through Open-mindedness (OPN) after accounting for gender, SES and immigrant background



Mediation model presenting the effect of academic stressors on subjective well-being through Task performance (TAP) after accounting for gender, SES and immigrant background

Appendix 7 Input of mediation models with control variables (COL as an example)

TITLE: FINAL MEDIATION MODELS WITH CONTROL VARIABLES;

DATA: FILE is China_Older Cohort.dat;

VARIABLE: NAMES = FullID CohortID SiteID SchID StdID EWOASS01 EWOASS02
EWOASS03 EWOASS04 EWOASS05 EWOASS06 EWOASS07 EWOASS08
COLCOO01 COLCOO02 COLCOO03 COLCOO04 COLCOO05 COLCOO06
COLCOO07 COLCOO08 OPNCRE01 OPNCRE02 OPNCRE03 OPNCRE04
OPNCRE05 OPNCRE06 OPNCRE07 OPNCRE08 OPNCUR01 OPNCUR02
OPNCUR03 OPNCUR04 OPNCUR05 OPNCUR06 OPNCUR07 OPNCUR08
EMREMO01 EMREMO02 EMREMO03 EMREMO04 EMREMO05 EMREMO06
EMREMO07 EMREMO08 COLEMP01 COLEMP02 COLEMP03 COLEMP04
COLEMP05 COLEMP06 COLEMP07 COLEMP08 EWOENE01 EWOENE02
EWOENE03 EWOENE04 EWOENE05 EWOENE06 EWOENE07 EWOENE08
EMROPT01 EMROPT02 EMROPT03 EMROPT04 EMROPT05 EMROPT6
EMROPT7 EMROPT8 TAPPER01 TAPPER02 TAPPER03 TAPPER04
TAPPER05 TAPPER06 TAPPER07 TAPPER08 TAPRES01 TAPRES02 TAPRES03
TAPRES04 TAPRES05 TAPRES06 TAPRES07 TAPRES08 TAPSEL01 TAPSEL02
TAPSEL03 TAPSEL04 TAPSEL05 TAPSEL06 TAPSEL07 TAPSEL08 EWOSOC01
EWOSOC02 EWOSOC03 EWOSOC04 EWOSOC05 EWOSOC06 EWOSOC07
EWOSOC08 EMRSTR01 EMRSTR02 EMRSTR03 EMRSTR04 EMRSTR05
EMRSTR06 EMRSTR07 EMRSTR08 OPNTOL01 OPNTOL02 OPNTOL03
OPNTOL04 OPNTOL05 OPNTOL06 OPNTOL07 OPNTOL08 COLTRU01
COLTRU02 COLTRU03 COLTRU04 COLTRU05 COLTRU06 COLTRU07
COLTRU08 WT2019 st_wellbeing st_anxtest STQM01901 SES IMMBACK gender2
STQM03401 STQM03402 STQM03403 STQM03404 STQM03803 STQM03804;

USEVAR = COLCOO01 COLCOO02 COLCOO03 COLCOO05 COLCOO06
COLCOO07 COLCOO08 COLEMP01 COLEMP03 COLEMP04 COLEMP06
COLEMP07 COLTRU01 COLTRU02 COLTRU03 COLTRU04 COLTRU06
COLTRU07 COLTRU08 STQM03401 STQM03402 STQM03403
st_wellbeing st_anxtest STQM01901 SES IMMBACK gender2;

USEOBSERVATIONS are SiteID==11;
MISSING = ALL (9999);
WEIGHT= WT2019;
CLUSTER= SchID;

ANALYSIS: ESTIMATOR=MLR; (**OR** ESTIMATOR=ML; BOOTSTRAP= 500;)
TYPE= COMPLEX;

MODEL: stressor by STQM03401 STQM03402 STQM03403;
coo by COLCOO01 COLCOO02 COLCOO03 COLCOO06 COLCOO07 COLCOO05

COLCOO08;
emp by COLEMP01 COLEMP06 COLEMP07 COLEMP03 COLEMP04;
tru by COLTRU01 COLTRU02 COLTRU03 COLTRU04 COLTRU06 COLTRU07
COLTRU08;
COLTRU03 WITH COLTRU02;
COL by coo emp tru;
wellbeing by st_wellbeing st_anxtest STQM01901;
wellbeing on stressor COL SES IMMBACK gender2;
COL on stressor;

MODEL INDIRECT: wellbeing ind stressor;

OUTPUT: SAMPSTAT STANDARDIZED;

(*OR* SAMPSTAT STANDARDIZED CINT(BCBOOTSTRAP);)