

Université de Montréal

The Role of Coping Style in the Relationship between Stressful Life Events and Depressive  
Symptoms in Young Adults

*Par*

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## Résumé

**Introduction :** Identifier des mécanismes sous-tendant l'association entre les événements stressants et la dépression est essentiel pour développer des interventions de santé publique ciblées. Pour faire face aux événements stressants, les individus adoptent des styles d'adaptation qui sont associés différemment aux symptômes dépressifs. Cependant, aucune étude n'a évalué si le style d'adaptation est médiateur et/ou modérateur de cette association.

**Objectifs :** Examiner chacun des styles soit l'adaptation centrée sur le problème, l'adaptation centrée sur les émotions et l'adaptation évitante comme médiateur et/ou modérateur de l'association entre les événements stressants et les symptômes dépressifs chez les jeunes adultes.

**Méthodes :** Nicotine Dependence in Teens (NDIT) est une étude longitudinale portant sur 1294 participants recrutés en secondaire I dans 10 écoles secondaires de Montréal, Québec entre 1999–2000. L'analyse actuelle utilise les données ( $n = 782$ ) de questionnaires auto-rapportés recueillis après le secondaire entre 2011–2012. En utilisant la décomposition en quatre parties de VanderWeele, l'effet total d'événements stressants sur les symptômes dépressifs a été décomposé en composantes représentant la modulation uniquement, la médiation uniquement, l'interaction médiée et ni la médiation ni la modulation par chaque style d'adaptation.

**Résultats :** Nous avons observé une modulation par l'adaptation centrée sur le problème ( $\hat{\beta}$ (IC à 95%)=-1.51(-2.22, -1.06)) et une médiation (0.15(0.05, 0.17)) et une modulation (1.16(1.05, 1.68)) par l'adaptation centrée sur les émotions. L'adaptation évitante n'a ni médiatisé ni modéré cette association. Ainsi, les individus ayant une adaptation centrée sur le problème présentent moins de symptômes dépressifs lorsqu'ils sont exposés à plus d'événements stressants. Ceux ayant une adaptation centrée sur les émotions présentent plus de symptômes dépressifs.

**Conclusion :** Ces résultats suggèrent que les interventions préventives contre la dépression chez les jeunes adultes devraient inclure des éléments pour renforcer les stratégies d'adaptation centrées sur le problème et pour minimiser les stratégies d'adaptation centrées sur les émotions.

**Mots-clés :** événements stressants, styles d'adaptation, dépression, jeunes adultes, médiation



## Abstract

**Introduction:** Identifying potential mechanisms underpinning the association between stressful life events and depression is key to developing targeted public health interventions. To cope with stressful experiences, individuals adopt coping styles which are differentially associated with depressive symptoms. However, no study has assessed whether coping style mediates and/or moderates this association.

**Objectives:** To examine each of problem-focused, emotion-focused and avoidant coping style as a mediator and/or moderator of the association between stressful life events and depressive symptoms in young adults.

**Methods:** The Nicotine Dependence in Teens (NDIT) is a longitudinal study including 1294 participants recruited in grade 7 from 10 high schools in Montreal Quebec between 1999–2000. The current analysis uses data ( $n = 782$ ) from self-report questionnaires collected post-high school between 2011–2012. Using VanderWeele’s four-way decomposition approach, the total effect of stressful life events on depressive symptoms was decomposed into components representing moderation only, mediation only, mediated interaction and neither mediation nor moderation by each coping style.

**Results:** We observed moderation by problem-focused coping ( $\hat{\beta}(95\%CI)=-1.51(-2.22, -1.06)$ ) and mediation ( $0.15(0.05, 0.17)$ ) and moderation ( $1.16(1.05, 1.68)$ ) by emotion-focused coping. An avoidant coping style neither mediated nor moderated this association. Thus, individuals reporting more problem-focused coping experienced fewer depressive symptoms when exposed to more stressful life events; those reporting more emotion-focused coping experienced more depressive symptoms.

**Conclusion:** These results suggest that preventive interventions for depression in young adults should include components to reinforce problem-focused coping strategies and should minimize negative emotion-focused coping strategies.

**Keywords :** stressful life events, coping style, depression, young adults, mediation analysis.



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## List of Acronyms and Abbreviations

CANMAT: Canadian Network for Mood and Anxiety Treatments

CCHS: Canadian Community Health Survey

CDE: Controlled Direct Effect

CI: Confidence Interval

CISS: Coping Inventory for Stressful Situations

DAG: Directed Acyclic Graph

FDA: Food and Drug Administration

GPA: Grade Point Average

INT<sub>med</sub>: Mediated Interaction

INT<sub>ref</sub>: Reference Interaction

MDI: Major Depression Inventory

NDE: Natural Direct Effect

NDIT: Nicotine Dependence in Teens

NIE: Natural Indirect Effect

PDE: Pure Direct Effect

PIE: Pure Indirect Effect

SD: Standard Deviation

SRRS: Social Readjustment Rating Scale

TE : Total Effect

TIE: Total Indirect Effect

WHO: World Health Organization



*To my mom and dad who have always been by my side*



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## Chapter 1 – Introduction

Depression is a major cause of disability that is characterized primarily by a depressed mood and loss of interest in activities previously enjoyed, with symptoms lasting at least two weeks (American Psychiatric Association, 2013). People with depression may also experience changes in weight or appetite, sleep difficulties, fatigue, feelings of worthlessness or guilt, suicidal thoughts and difficulty concentrating (American Psychiatric Association, 2013). These symptoms can interfere with the individual's social life, close relationships and work performance (L Findlay, 2012; Lepine & Briley, 2011). Early onset of depression can negatively affect students' academic performance in terms of poorer school attendance, incomplete assignments and a lower grade point average (Hysenbegasi, Hass, & Rowland, 2005). A recent study estimates that the economic burden in Canada due to depression-related work absences amounts to a mean annual cost of \$2061 CAN per person (Evans-Lacko & Knapp, 2016).

The risk of developing depression is only partly inheritable suggestive that depression can be explained by other factors that are potentially modifiable (Saveanu & Nemeroff, 2012; Sullivan, Neale, & Kendler, 2000). Besides parental history of depression (Ebert et al., 2019), the main risk factors associated with depressive symptoms in young adults are gender (females present an increased risk of depressive symptoms), childhood adversities and neurotic or psychotic personality traits (Liu et al., 2019). Numerous studies suggest that stressful life events (i.e., experiences disturbing everyday life and causing important life changes) are also an important predictor of depressive symptoms (Manczak, Skerrett, Gabriel, Ryan, & Langenecker, 2018; Sund, Larsson, & Wichstrem, 2003; Young & Dietrich, 2015). Stressful life events can occur any time throughout the life course from childhood through to adulthood. However, the transition from adolescence to young adulthood is often characterized by important changes and events such as enrolling in college or university, exploring different life directions, entering the workforce, and establishing a stable relationship with a long term partner (Arnett, 2000), all of which can be associated with high stress levels (American College Health Association, 2019). To cope with stressful life events, individuals employ one or a combination of coping styles which are typically

characterized as problem-focused, emotion-focused or avoidant (Endler & Parker, 1994; Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986). These coping styles comprise positive and/or negative strategies, and have differential associations with depressive symptoms (Morris, Evans, Rao, & Garber, 2015; Rafnsson, Jonsson, & Windle, 2006). However, few studies examine the role of coping style in the association between stressful life events and depressive symptoms. Understanding coping mechanisms is important for public health interventions since they are potentially modifiable traits which diversify in adolescence (Zimmer-Gembeck & Skinner, 2010). Positive coping strategies for example, may be reinforced by intervention at an early stage of youth development, that aims to promote and sustain positive mental health and prevent symptoms of mental disorders.

This thesis explores the association between stressful life events and depressive symptoms in young adults by studying coping style as a potential mediator and/or moderator in this association. The following Chapter overviews the epidemiology of depression and presents a review of the literature on the associations among stressful life events, coping styles and depressive symptoms. The objectives and hypotheses of the research question are stated in Chapter 3. The sample was drawn from the Nicotine Dependence in Teens Study (NDIT); the study design, variables and measures and analysis used to investigate our objectives are described in Chapter 4. Chapter 5 presents the results and the interpretation of the findings in a manuscript format. The discussion and public health implications of the results are discussed in Chapter 6. Chapter 7 concludes this thesis.

## Chapter 2 – Literature Review

This chapter provides recent evidence on the prevalence, risk factors and treatments for depression and depressive symptoms in young adults. Stressful life events and coping styles are defined and their associations with depressive symptoms are described. Studies examining the role of coping styles on the stressful life events and depressive symptoms pathway are presented, as well as the limitations of these studies.

### 2.1 Prevalence of Depression

Between 2005 and 2015, the prevalence of depression increased by 18.4% worldwide (World Health Organization, 2017). Estimates show that there are 322 million people living with depression worldwide, representing 4.4% of the global population (World Health Organization, 2017). Globally, the prevalence of depression is more frequent in females (5.1%) than in males (3.6%) (World Health Organization, 2017). In the US, compared to all other age groups, more young adults age 18 to 25 years met the criteria for depression in the past year (Bose, Hedden, Lipari, & Park-Lee, 2018). Similarly in Canada, the 2012 Canadian Community Health Survey (CCHS) reported that youth age 15 to 24 had the highest rates of mood (i.e., bipolar disorders, depression) and anxiety disorders (i.e., panic disorder, phobias and generalized anxiety disorder) (American Psychiatric Association, 2013), and among this age group 7% reported past year depression (5.3% among males and 9.0% among females) (L Findlay, 2012; Pearson, Janz, & Ali, 2013). Among post-secondary Canadian students, 25.3% reported feeling very sad and 21.2% reported feeling so depressed that it was difficult to function in the last 12 months (American College Health Association, 2019).

Depression is associated with decreased work productivity, absenteeism, increased unemployment and lower income (Brody, Pratt, & Hughes, 2018; Lepine & Briley, 2011). For example, individuals with depression report missing on average 25 days related to work or other daily activities due to their symptoms in the last year (L Findlay, 2012). Among students, depression is also associated with decreased academic performance such as a lower grade point

average (GPA), increased number of missed classes, assignments (Hysenbegasi et al., 2005) and college drop-outs (Auerbach et al., 2016) as well as severe role impairment in home management, college-related work, personal relationships and social life (Alonso et al., 2018). Depression increases the risk of death by suicide; there is excess suicide mortality in depressed males and females (i.e., the standardized mortality ratios are 20.9 and 27.0 respectively) compared to the general population (Lepine & Briley, 2011; Osby, Brandt, Correia, Ekblom, & Sparén, 2001). Moreover, a diagnosis of a mood disorder such as depression increases the risk of developing other mental illnesses including substance use or anxiety disorders (Davis, Uezato, Newell, & Frazier, 2008). This comorbidity between mental disorders poses a major treatment challenge for clinicians and increases the chances of depression recurrence in patients (Davis et al., 2008; Newman, Moffitt, Caspi, & Silva, 1998). Individuals with comorbid mental disorders experience more severe symptoms, have greater functional impairment (Davis et al., 2008), slower recovery and have an increased risk of mental disorder chronicity (Hirschfeld, 2001; Holzel, Harter, Reese, & Kriston, 2011). Thus, the burden of mental disorders is important especially in young adults.

## **2.2 Risk Factors for Depression**

Most observational studies investigating factors associated with depression measure depressive symptoms rather than clinical depression because of the greater feasibility of administering self-report questionnaires assessing depressive symptoms severity (Vahle, Andresen, & Hagglund, 2000). Many depressive symptoms self-report questionnaires present acceptable levels of reliability and validity (Bech, Timmerby, Martiny, Lunde, & Soendergaard, 2015; Vahle et al., 2000). These questionnaires can detect a gradient in depressive symptoms from mild to severe. Depressive symptoms are more prevalent than major depression (Shim, Baltrus, Ye, & Rust, 2011) and although they may never meet diagnostic criteria, subclinical depressive symptoms still negatively impact individual functioning (L. H. Brown, Strauman, Barrantes-Vidal, Silvia, & Kwapil, 2011).

Individuals with a familial history of depression are at higher risk of developing this mental disorder (Garber, 2006), which can relate at least partially to genetic variations in pathways

involving serotonin and dopamine neurotransmitters (Shadrina, Bondarenko, & Slominsky, 2018). Depression is only partly related to genetic differences suggesting that others factors such as the psychosocial environment influence depression (Sullivan et al., 2000). For example, psychosocial risk factors for depression include neurotic and psychotic personality traits, social support, childhood adversities, self-esteem, self-mastery and social networks (Colman et al., 2014; Liu et al., 2019; Orth, Robins, Trzesniewski, Maes, & Schmitt, 2009). A meta-analysis showed that young adults with neurotic or psychotic traits have an increased risk of depressive symptoms (OR =1.26) compared to individuals without these personality traits (Liu et al., 2019). Findings on social support vary such that some studies report no association with depressive symptoms (Liu et al., 2019), while others find an inverse association suggesting that more social support is associated with fewer depressive symptoms (Anderson, Salk, & Hyde, 2015; O'Sullivan, 2004; Tuithof et al., 2018). Childhood adversities such as violence, physical or sexual abuse and neglect increase the risk of early onset depression (Ebert et al., 2019; McLaughlin, Conron, Koenen, & Gilman, 2010; Oldehinkel, Ormel, Verhulst, & Nederhof, 2014). Other risk factors associated with depressive symptoms are gender (Liu et al., 2019), low socioeconomic status (Athar, Mukhtar, Shah, & Mukhtar, 2017) and other mental disorders (Ebert et al., 2019; Tuithof et al., 2018). Finally, stressful life events and coping styles have also been identified as risk factors for depression (Friis, 2002; Morris et al., 2015). College students experiencing three or more life events in the past year have 4.29 times the risk of depression onset than students without any stressful life events (Ebert et al., 2019).

## **2.3 Treatment of Depression**

The Canadian Network for Mood and Anxiety Treatments (CANMAT) presents evidence-based treatment guidelines for health professionals and for patients with major depressive disorder (Parikh et al., 2016). Main treatments recommended include antidepressant medication and psychotherapy. However, alternative treatments are now also recommended such as physical activity, yoga and natural health products as first- or second-line treatments for mild to moderate depression (Parikh et al., 2016; Ravindran et al., 2016). Antidepressants are most effective in treating severe depression in adults, but less effective in patients with mild or moderate

symptoms of depression (Fournier et al., 2010). The US Food and Drug Administration (FDA) has also warned that antidepressants are related to an increased risk of suicidal thoughts in adolescents and young adults (Cipriani et al., 2018; Olfson & Gerhard, 2015), although the evidence linking antidepressant use to suicidal risk remains contradictory (Cheung et al., 2015; Olfson & Gerhard, 2015). According to CANMAT, highly recommended psychotherapeutic methods are cognitive behavioural therapy (i.e., changing negative thoughts), interpersonal therapy (i.e., dealing with problematic relationships) and behavioural activation (i.e., engaging in more pleasant activities) (Parikh et al., 2016). These treatments are based on communication between a mental health care professional and a patient in order to resolve symptoms (Parikh et al., 2016). Both pharmacological and psychological treatments are effective, and based on CANMAT guidelines combining both treatments can be beneficial for patients with moderate to severe depression (Parikh et al., 2016). However, despite the effectiveness of both pharmacotherapy and psychotherapy, only 12% of young adults in the general population accessed mental health services in 2012; 42% of those with lifetime depression (i.e., met the criteria for depression in their lifetime based on diagnostic algorithms) consulted a professional in 2012 in Canada (L Findlay, 2012; LC. Findlay & Sunderland, 2014). Because of low consultation rates, preventive interventions for mental illness and in particular in depression, are becoming increasingly important.

## **2.4 Stressful Life Events**

### **2.4.1 Defining Stressful Life Events**

Stressful life events are experiences occurring at a specific point in time that disrupt daily activities, and that are appraised as harmful or uncontrollable by the individual (S. Cohen, Gianaros, & Manuck, 2016; Epel et al., 2018). For example, an event may be perceived as stressful if the individual believes that they are not equipped with effective coping strategies (S. Cohen et al., 2016). Also, one or more events may be required to attain a stress response depending on the individual's perception of the situation (S. Cohen et al., 2016; S. M. Cohen, MLM. Prather AA., 2019). These events can be categorized into those related to family, school, health, network/peer,

or financial-related events (Meng, Tao, Wan, Hu, & Wang, 2011; Rafnsson et al., 2006; Undheim & Sund, 2017), and include for example, parental divorce, death of a relative, poor academic achievement, serious illness, friendship conflict or a financial crisis (Sun, 2017; van Doeselaar, Klimstra, Denissen, Branje, & Meeus, 2018). Others describe stressful life events as dependent or independent events. Dependent events are those related to the individual's behaviour or actions such as a romantic break-up or a divorce (Boardman, Alexander, & Stallings, 2011). In contrast, independent events are those out of the individual's control such as job loss due to factory closure or death of a relative (Harkness et al., 2010).

#### **2.4.2 Measuring Stressful Life Events**

Stressful life events are often measured using checklists in which participants identify events that have occurred in the past year. Initially, the Social Readjustment Rating Scale (SRRS) developed by Holmes and Rahe was used to measure stressful life events which were quantified as the amount of change required by an individual to adapt to the stressful experience (S. Cohen et al., 2016; Holmes & Rahe, 1967). Thus, a life event that required more change was considered as more stressful and was assigned a higher score (S. Cohen et al., 2016; Holmes & Rahe, 1967). Since these scores do not account for contextual factors associated with the life events, the scale assumes that all individuals adapt to the situation in a similar way (Kessler, 1997). Other checklists measure the accumulation of stress as the total number of life events reported by each person (Hamlat, Stange, Abramson, & Alloy, 2014; Manczak et al., 2018; Rafnsson et al., 2006; Riglin et al., 2016). However, these cumulative life event scores may not capture the impact of specific life events on health, since certain events may be more stressful than others (S. Cohen et al., 2016; Low et al., 2012). To address limitations of the SRRS and other checklists, further objective methods for measuring stressful life events have been developed. For example, to create scores of stress based on context, some studies (Harkness et al., 2010; Kopala-Sibley, Klein, Perlman, & Kotov, 2017; Muscatell, Slavich, Monroe, & Gotlib, 2009) use structured interviews and a panel of researchers to rate the level of threat for each event. Raters then categorize events as dependent/independent of the individual (Kleiman, Liu, Riskind, & Hamilton, 2015; Shapero et al., 2014), as positive/negative (Friis, 2002; Sawyer, Pfeiffer, & Spence, 2009) or as severe/non-severe

(Harkness et al., 2010). Contrary to objective scores, in psychology, it is thought that stress experienced by each event varies according to an individual's perception, and thus certain types of questionnaires have been developed to use subjective ratings (S. Cohen et al., 2016; You & Conner, 2009). For example, surveys such as the Life Experience Survey calculate subjective scores by asking participants to rate the impact the event had on their lives and to categorize events based on self-reported severity (You & Conner, 2009). Overall, there are different methods for measuring stressful life events. Even though interviews capture more detail on events, checklists predict psychopathology similarly to interviews suggesting that one method is not superior over the other (Duggal et al., 2000; Lewinsohn, Rohde, & Gau, 2003).

### **2.4.3 Association between Stressful Life Events and Depressive Symptoms**

Experiencing more stressful life events during a specific time period has been linked to higher depressive symptoms in children (Evans et al., 2015), adolescents (Johnson, Whisman, Corley, Hewitt, & Rhee, 2012; Sawyer et al., 2009) and young adults (Dyson & Renk, 2006; Manczak et al., 2018). Friis et al., (2002) suggest that the course of depression (i.e., onset, improvement or deterioration in symptoms, and chronicity) is differentially associated with the type and controllability of life events. Negative events (OR = 1.61), uncontrollable events (OR = 1.49) and family-related events (OR = 1.77) are associated with onset of depression, while youth experiencing more stressful life events have 2.88 times the risk of developing chronic depression (Friis, 2002). Similarly, Bomysoad and Francis (2020) indicate that the odds of having depression increase by twofold for adolescents exposed to one stressful experience and by tenfold for those exposed to four or more stressful experiences compared to adolescents without any stressful experience. This strongly suggests that the accumulation of stressful life events is associated with depression. Subsequently, severe acute events defined by high levels of threat in a short time period are associated with greater symptom severity while chronic stressors lasting at least a year are not, suggestive that acute stress may be more important than chronic stress in clinical manifestations of depression (Muscatell et al., 2009). Horesh et al., (2010) observed that stressful life events in the year prior to first major depressive episode were critical for depression development indicating the importance of recent events. Some studies indicate that specific

stressful life events such as self-related health or illness (Suzuki et al., 2018), family-related events (Ge, Natsuaki, Neiderhiser, & Reiss, 2009) and peer stress (Hazel, Oppenheimer, Technow, Young, & Hankin, 2014) are associated with depressive symptoms. Among all stressful life events, personal health problems present a greater risk (OR = 2.68) for depressive symptoms (Nguyen, Nguyen, Pham, Pham, & Nakamura, 2018). Overall, studies support hypotheses suggesting that cumulative effects, specificity and recency of stressful events are associated with depression.

Mechanisms underpinning stressful life events as a primary risk factor for depressive symptoms, may comprise both physiological and psychological responses to stress (Epel et al., 2018). Even though life events occur at a particular moment in time, they can induce a state of stress over a longer period because of the higher demands of the situation (Epel et al., 2018). Long-term activation of biological stress-related pathways is associated with dysregulation of serotonin and dopamine pathways leading to depression (Gustavo E. Tafet & Charles B. Nemeroff, 2016). However, not all individuals exposed to stressful life events develop depressive symptoms, suggesting that some people are resilient (Sheerin et al., 2018). These individuals may have the ability to adapt positively to stressful situations, which can protect them from their negative effects (Sheerin et al., 2018). The psychological response to stressful life events comprises the individual's appraisal of the situation. The stress-coping theory by Folkman and Lazarus (1986) suggested that an individual who appraises a situation as threatening, harmful or challenging and who is lacking resources, will perceive it as stressful. Thus, under stressful circumstances an individual will evoke their coping skills to handle the demands (Folkman et al., 1986).

In sum, the association between stressful life events and depression is well-established. However, it is unclear whether this association is characterised by specific mechanisms (i.e., other factors mediate this association) or varies according to other factors (i.e., other factors moderate this association). Investigating factors that mediate or moderate the association is of interest since these factors can improve our understanding of the stressful life events – depression association. A potential factor of interest is coping style since it is a stress response (Folkman et al., 1986) and since individuals have different ways of coping with stressful situations (Jackson, Huffhines, Stone, Fleming, & Gabrielli, 2017). Also, coping style is positively and negatively related to depression

(Hampel & Petermann, 2006) supporting a closer look at its role in the stressful life events – depression association.

## **2.5 Coping Styles**

### **2.5.1 Defining Coping Styles**

Coping styles are cognitive components that can generate vulnerability or resilience to stress (Campbell-Sills, Cohan, & Stein, 2006). These are defined as behavioural efforts used to handle demands that are perceived as exceeding the individual's capacities (Folkman et al., 1986). Coping styles can be adaptative or maladaptive. They comprise both positive and negative strategies to cope with stress (Vinberg, Froekjaer, & Kessing, 2010) and thus can have a beneficial and detrimental impact on mental health (Krattenmacher et al., 2013). Coping styles are often characterized as problem-focused, emotion-focused, or avoidant (Endler & Parker, 1994; Folkman et al., 1986). Other studies describe them as primary control engagement and disengagement coping (Evans et al., 2015), but these coping styles share some similarities with problem-focused, emotion-focused and avoidant coping.

Problem-focused coping targets the cause of stress and aims to resolve the stressful situation (Folkman et al., 1986). Some examples of problem-focused coping strategies are active coping (i.e., taking direct action), planning and seeking instrumental support. This is similar to primary control engagement except the latter also includes emotional support seeking (Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000; Dyson & Renk, 2006; Evans et al., 2015). An individual employing problem-focused coping takes action and seeks resources that will help him/her solve the problem (Folkman et al., 1986). Thus, problem-focused coping includes positive coping strategies and is considered an adaptive coping style (Vinberg et al., 2010).

Emotion-focused coping implies reducing emotional distress using strategies such as acceptance, positive reappraisal and seeking emotional support (Brougham, Zail, Mendoza, & Miller, 2009; Rafnsson et al., 2006). However, most studies describe emotion-focused coping by negative strategies such as self-blaming, rumination and catastrophizing and is generally viewed as a

maladaptive coping style (Garnefski, Legerstee, Kraaij, Van Den Kommer, & Teerds, 2002; Michl, McLaughlin, Shepherd, & Nolen-Hoeksema, 2013; Rafnsson et al., 2006; Vinberg et al., 2010). Because of broad coping categorisations in the literature, emotion-focused coping shares some similarities with primary control engagement. In addition to directly targeting the situation, primary control engagement also focuses on dealing with one's emotional reaction to the situation in a positive manner which is similar to emotion-focused coping except the latter also includes negative strategies (Connor-Smith et al., 2000; Evans et al., 2015).

Lastly, avoidant coping which is also considered a maladaptive coping style (Vinberg et al., 2010), is defined as a way of escaping the stress causation through distraction or withdrawal. It is similar to the disengagement coping construct (S. M. Brown, Begun, Bender, Ferguson, & Thompson, 2015; Connor-Smith et al., 2000; Evans et al., 2015). Individuals using avoidant coping will engage in activities that do not deal directly with the situation or with their emotions. Negative coping strategies include watching more TV than usual, eating and wishful thinking (Endler & Parker, 1994; Folkman et al., 1986).

### **2.5.2 Development of Coping Styles**

Development of coping skills begins in childhood and the range of skills becomes more diverse in adolescence due to development of metacognitive abilities (i.e., the ability to introspect on behaviours and emotions) (Garnefski et al., 2002; Skinner & Zimmer-Gembeck, 2007; Weil et al., 2013). Specifically meta-cognitive-related coping strategies are added to their pre-existing pool such as planful problem solving, positive self-talk and rumination (Weil et al., 2013; Zimmer-Gembeck & Skinner, 2010). Youth also report using different coping strategies depending on the situation, suggestive that coping is a dynamic process (Jackson et al., 2017). Thus, adolescents widen their scope of coping skills which allows them to select coping strategies perceived as effective depending on the stressor (Zimmer-Gembeck & Skinner, 2010) and tend toward a more adaptive approach as they enter young adulthood (Wingo, Baldessarini, & Windle, 2015). For example, in young people ages 17 to 33 years, problem-focused coping increased between ages 17 and 24 and then stabilised in the mid-twenties, while emotion-focused coping decreased

suggestive of a tendency toward a more adaptive coping style (i.e., problem-focused coping) (Wingo et al., 2015).

Gender differences are apparent in coping styles such that females tend to use more emotion-focused coping than males (Brougham et al., 2009; Scott, Hides, Allen, & Lubman, 2013) and typically score higher than males in positive and negative coping strategies, suggestive that females use more diverse coping strategies (Lee, Silins, & Frank, 2019).

### **2.5.3 Association between Coping Styles and Depressive Symptoms**

Coping styles relate differentially to various mental health indicators. Problem-focused coping is inversely associated with emotional problems and substance use (Hampel & Petermann, 2006; Rafnsson et al., 2006). Depressive symptoms in adults are associated with lower problem-focused coping (Morris et al., 2015). Time varying effect modeling shows that problem-focused coping strategies such as planning and taking direct action is negatively associated with depressive symptoms between ages 17 and 24, but there is no significant association between ages 14 and 17, suggesting that these associations may be age dependent (Vannucci, Flannery, & McCauley Ohannessian, 2018). Also, problem-focused coping is positively associated with resilience, which is the capacity to adapt well even in aversive situations (Campbell-Sills et al., 2006). This suggests that problem-focused coping is protective in stressful situations and may therefore be of great interest in terms of public health interventions.

In some studies emotion-focused coping is positively associated with depressive symptoms (Rafnsson et al., 2006; Undheim, Wallander, & Sund, 2016), but negatively associated in others (Hampel & Petermann, 2006; Krattenmacher et al., 2013). For example, emotion-focused coping strategies such as rumination (i.e., repetitive thoughts of one's feelings toward the situation), catastrophizing (i.e., thinking the situation is worse than it actually is) and self-blame are positively associated with depressive symptoms (Kraaij et al., 2003). However, other emotion-focused coping strategies such as positive reappraisal (i.e., perceiving the situation in a positive manner) is negatively associated with depressive symptoms (Kraaij et al., 2003). Adolescents and young adults using coping strategies such as acceptance and emotional support, showed

decreases in depressive symptoms over time (Morris et al., 2015) compared to those employing strategies such as venting emotions and denial (Vannucci et al., 2018). Thus, emotion-focused coping comprises strategies that can have either a positive or negative effect on depressive symptoms.

Avoidant coping is considered a risk factor for depression in adolescents and young adults (Dyson & Renk, 2006; Morris et al., 2015; Romero, Riggs, & Ruggero, 2015). Adolescents who used avoidant coping scored higher in depressive symptoms two years later than adolescents who used other coping styles (Seiffge-Krenke & Klessinger, 2000). This suggests that avoidant coping possibly has a long-term effect on depressive symptoms. A possible mechanism is that using avoidant coping in the long-term may generate more worry or stress since the problem is still present, leading to depressive symptoms (Holahan, Moos, Holahan, Brennan, & Schutte, 2005).

In sum, coping styles are differentially associated with depressive symptoms. They could be potentially targeted to prevent depressive symptoms since coping styles such as problem-focused coping seem to have a positive effect on depressive symptoms.

#### **2.5.4 Association between Stressful Life Events and Coping Styles**

Among adolescent females, emotion-focused coping is strongly associated with high levels of school stress (i.e., a category of stress including school-related stressful life events and/or chronic stressors) (Undheim & Sund, 2017). Similarly, Shikai et al., showed that perceived stressful life events predicted emotion-focused coping in adult females (2009). However, family stressful events are more strongly associated with avoidant coping among males (Undheim & Sund, 2017). Network stress (i.e., a category including friend-related stressful life events such as problems among friends) is related to all three coping styles, but in different directions (Undheim & Sund, 2017). Problem-focused coping was positively associated with stress due to friends with serious problems (i.e., network stress) in a cross-sectional analysis, but negatively associated in a longitudinal analysis (Undheim & Sund, 2017). Adolescents who experienced low network stress at age 14 used more problem-focused coping a year later, suggesting that a stable network environment may be required to develop positive coping strategies in the long-term (Undheim &

Sund, 2017). Emotion-focused and avoidant coping were significantly associated with high network stress when analysed cross-sectionally (Undheim & Sund, 2017). These results illustrate the potential influence that friends have on coping mechanisms in adolescents and suggest that stressful events relate differently to coping styles depending on type of stressor, gender and possibly on time since the stressful life event.

Evans et al., (2015) reported a negative correlation between stressful life events and primary control engagement, which comprises positive strategies from problem-focused and emotion-focused coping styles. However, disengagement coping which includes avoidant strategies was positively correlated with stressful life events (Evans et al., 2015). These results suggest that under higher stress levels, youth use more negative coping strategies. Some studies suggest that youth employ more than one coping style even when facing one stressful life event (Jackson et al., 2017; Krattenmacher et al., 2013). Among adolescents coping with parental illness, over 50% report using problem solving, distraction, acceptance and wishful thinking to cope but perceived higher efficacy for problem-focused coping (Krattenmacher et al., 2013). Moreover, Jackson et al. (2017) reported that youth prefer a direct coping approach to deal with problems over time, and they used more than one coping mechanism depending on the problem, suggesting flexibility in coping strategies (Jackson et al., 2017). Some studies, however, report no association between stressful events and coping. For example, a study of college freshmen showed that family stress and college change stress did not predict coping style (Dyson & Renk, 2006). Overall, these findings suggest that youth apply more negative coping strategies under high stress levels and may use multiple coping strategies to deal with stressful events.

## **2.6 Coping Style as a Mediator**

Few studies examine coping style as a mediator in the relationship between stressful life events and depression. These studies used either cross-sectional or longitudinal designs to study mediation and are presented in the next section as well as their limitations.

### **2.6.1 Cross Sectional Studies**

Dyson and Renk (2006) observed a significant direct effect from family/college change stress (i.e., stressful changes experienced by family members and by students transitioning to college) to depressive symptoms. Also, a significant indirect effect was observed from those stressful events to depressive symptoms through coping styles (Dyson & Renk, 2006). However, they found no association between family/college change stress and problem-focused, emotion-focused or avoidant coping styles (Dyson & Renk, 2006). A study in Chinese adolescents ages 12-19 concluded that positive and negative coping strategies were partial mediators in this relationship, and that positive coping was a weaker mediator than negative coping (Meng et al., 2011). Avoidant coping measured as taking off, quitting or dropping out of school and substance use did not mediate the association between negative life events and depressive symptoms in high-risk girls ages 11-21 (Goodkind, Ruffolo, Bybee, & Sarri, 2008).

However, cross-sectional studies using mediation analysis have been subject to many critiques because the design limits causal inference. Temporality is essential in mediation analysis due to the underlying hypothesis that exposure causes the mediator, which then causes the outcome. This is important because previous literature has indicated that depressive symptoms could predict emotion-focused coping suggesting that coping style may be a consequence of depressive symptoms (Undheim & Sund, 2017). Healthy individuals at risk of familial affective disorders use more emotion-focused and avoidant coping styles (Vinberg et al., 2010). The directionality issue also applies to the direct stressful events-depression pathway. Although most research supports a unidirectional association between stressful events and depression, there is also evidence that individuals with depression may experience more stressful events (Johnson et al., 2012).

### **2.6.2 Longitudinal Studies**

Among extant longitudinal studies, Shikai et al. (2009) examined emotion-focused coping as a mediator in the association between stressful life events and depressive symptoms in adults ages 19-32. They concluded that emotion-focused coping did not mediate the association (Shikai et al., 2009) although the small sample size ( $n = 97$ ) may have limited statistical power in their analyses.

Michl et al. (2013) reported that rumination (i.e., a negative emotion-focused coping strategy) was a mediator in the relationship between stressful life events and depression, although this study focused on a single coping strategy only. Finally, Evans et al. (2015) concluded that primary control coping (i.e., a combination of problem-focused coping and some emotion-focused coping strategies) and disengagement coping (i.e., avoidant coping) partially mediated the association between stressful life events and depressive symptoms in children and adolescents, and suggested that coping is a possible pathway between stressful events and depressive symptoms (Evans et al., 2015).

## **2.7 Coping Style as a Moderator**

Among the few studies investigating the moderating role of coping styles in the association between stressful life events and depressive symptoms, Scott et al. (2013) found a significant interaction for emotion-focused coping and stressful life events. Their results suggest that under stressful situations, individuals with high emotion-focused coping experience depressive symptoms while those with low emotion-focused coping do not develop depressive symptoms (Scott et al., 2013). In contrast, Lewis, Abramowitz, Koenig, Chandwani, and Orban (2015) did not observe any interaction between an active coping style (i.e., taking direct action, problem solving, social support) and stressful life events. However, these cross-sectional studies recruited high risk participants such as ecstasy users (Scott et al., 2013) and HIV-infected adolescents (Lewis et al., 2015) which limits generalization to the larger population. In a cross-sectional study, Kraaij et al. (2003) found that the moderating role of coping strategies such as self-blame, rumination and positive reappraisal explained 43.5% of the variance of the stressful life events – depression pathway. Coping strategies had a moderating effect such that adolescents who used self-blame, rumination and less positive reappraisal were more vulnerable to depressive symptoms when exposed to stressful life events (Kraaij et al., 2003). Similarly, a longitudinal study in adolescents observed that the interaction between negative life events and negative coping strategies increased depressive symptoms at time 2, but only in males (Sawyer et al., 2009). Overall few studies examined coping style as a moderator in the association between stressful life events and depressive symptoms.

## 2.8 Summary

The high depression prevalence in young adults in combination with the low use of mental health services argue compellingly for preventive interventions. Stressful life events increase the risk of depressive symptoms, but some people are resilient suggesting that other factors influence this association. Coping style which is a response to stressful life events is associated with depressive symptoms. However, the mediating role of coping styles in the association between stressful life events and depressive symptoms is understudied. Among the few mediation studies to date, the authors conclude that coping style partially mediates the stressful life events – depressive symptoms pathway (Dyson & Renk, 2006; Evans et al., 2015; Goodkind et al., 2008; Meng et al., 2011; Shikai et al., 2009). The few studies examining the moderating effect of coping style support a buffering-effect in the relationship between stressful life events and depressive symptoms (Kraaij et al., 2003; Lewis et al., 2015; Sawyer et al., 2009; Scott et al., 2013). However, no study to date has investigated both mediation and moderation of this association by coping style. Identifying the role and effect of each coping style in this association could inform depressive symptom-related preventive interventions about coping styles that are helpful in dealing with stressful events.



## Chapter 3 – Objectives and Hypotheses

The research question addressed in this MSc thesis is: Does coping style mediate and/or moderate the relationship between stressful life events and symptoms of depression in young adulthood?

The specific objectives are:

- (i) To describe the associations between stressful life events and depressive symptoms, between stressful life events and coping styles, and between coping styles and depressive symptoms. We hypothesize that stressful life events decreases problem-focused coping and increases emotion-focused coping, avoidant coping and depressive symptoms. We also hypothesize that problem-focused coping decreases depressive symptoms while both emotion-focused coping and avoidant coping increase depressive symptoms.
- (ii) To assess whether each coping style (i.e., problem-focused, emotion-focused, avoidant coping) is a mediator of the association between stressful life events and depressive symptoms. We hypothesize that the association between stressful life events and depressive symptoms is partially explained by each coping style.
- (iii) To assess whether each coping style (i.e., problem-focused, emotion-focused, avoidant coping) is a moderator of the association between stressful life events and depressive symptoms. We hypothesize that low problem-focused coping, high emotion-focused coping and high avoidant coping levels increase the magnitude of the association between stressful life events and depressive symptoms.



## Chapter 4 – Methods

This thesis includes a secondary analysis using data from the Nicotine Dependence in Teens (NDIT) study. This chapter presents the study design, sampling and study variables, analytic method and ethical considerations of the NDIT study.

### 4.1 NDIT Study Design and Sampling

NDIT study is an ongoing longitudinal study that investigates the natural course of cigarette smoking onset and nicotine dependence, and identifies factors associated with smoking initiation and nicotine dependence in adolescents and young adults (O'Loughlin et al., 2015). In addition to its primary focus, NDIT also collected data on a wide variety of other variables including obesity, blood pressure, diet, physical activity, sleep, sedentary behaviour, gambling, alcohol use, stress and mental health (O'Loughlin et al., 2015). Self-report questionnaires were completed by NDIT participants, parents and school administrators or teachers. NDIT data collection also incorporated collection of DNA samples as well as anthropometric measures, blood pressure measures and accelerometer data.

Participants were recruited in 1999–2000. Thirteen high schools in or near Montreal, Quebec were purposively selected to include both English and French schools, schools located in urban, suburban and rural areas and schools representing low, moderate and high socio-economic status neighborhoods (O'Loughlin et al., 2015). The final sample retained 10 high schools – two schools had low parental consent and one school could not guarantee continued participation throughout high school. Among the 10 high schools retained, 1294 of 2325 eligible grade 7 students completed baseline questionnaires, which is equivalent to a 56% participation proportion (O'Loughlin et al., 2015). NDIT participants completed self-report questionnaires every 3 months during the 10-month school year from 1999 until 2005, for a total of 20 cycles during high school. Data collection occurred post-graduation in 2007–2008 when participants were age 20 years on average (cycle 21), 2011–2012 at age 24 on average (cycle 22) and 2017–2020 at age 31 on average (cycle 23). The data collection timeline is shown in Figure 1.

# NDIT Study Design

( $n = 1294$ )

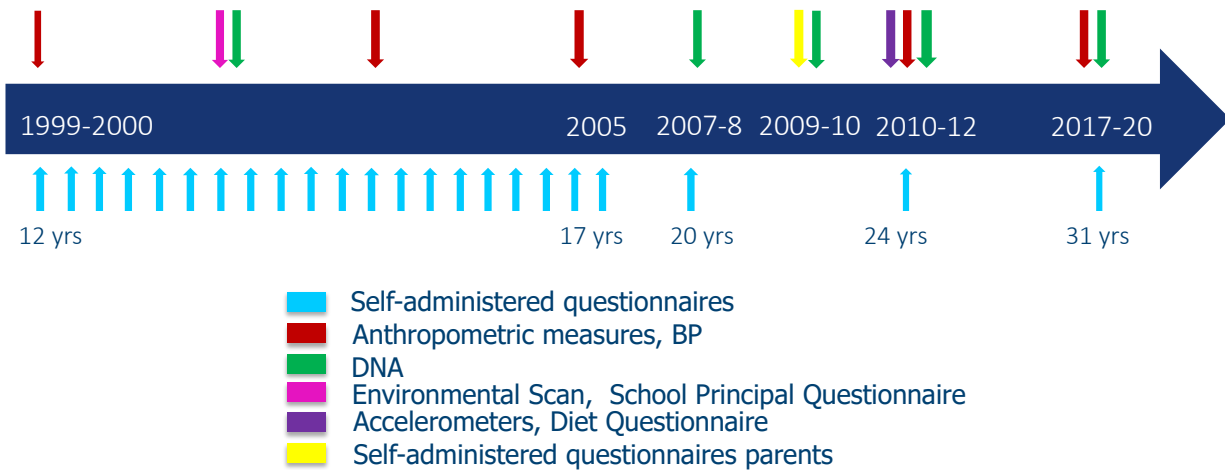


Figure 1. NDIT study data collection timeline from 1999-2020

The primary variables of interest in this thesis were stressful life events, coping styles and depressive symptoms, all measured in cycle 22. Although assessed in the same data collection cycle, stressful life events were measured referring to a past-year time frame and the depressive symptom outcome was measured referring to a past two-week time frame. The mediator/moderator coping style was measured as a usual response to a stressful event. This temporality is important since mediation analysis assumes that the exposure occurs before the mediator and that both occur before the outcome. Thus, the 12-month time frame for experiencing stressful life events occurred (more or less) before reports of experiencing depressive symptoms. Since coping style is assumed to be a response following stressful life events, the time interval for both these variables precedes depressive symptoms, which were measured in the last two weeks. While data on stressful life events were also available in cycle 21, they were not used in our analyses since the time gap between cycles 21 and 22 was approximately 3-4 years. Since past-year stressful life events are associated with depressive symptoms (Horesh & Iancu, 2010), using stressful life events assessed closer in time to depressive symptoms is more appropriate. To assure that exposure to covariates of interest in this analysis

(i.e., age, sex, education, and earlier depressive symptoms) preceded exposure to the primary variables of interest, data for the covariates investigated were drawn from cycle 21.

## **4.2 Study Variables**

### **4.2.1 Depressive symptoms**

Depressive symptoms were assessed in cycles 21 and 22 using the Major Depression Inventory (MDI) which is a 10-item self-report scale based on the DSM-IV and ICD-10 (Bech et al., 2015). Participants were asked to report the frequency of symptoms in the last two weeks on a 6-point scale ranging from “*at no time*” scored 0 to “*all the time*” scored 5. Items 8 and 10 each have two sub-items *a* and *b*, so only the highest score between *a* and *b* was retained for scoring (Appendix A). The total score ranged from 0 to 50 points, with higher scores indicating a higher frequency of depressive symptoms. The MDI scale has been previously validated and is reliable in adults (Bech, Rasmussen, Raabaek Olsen, Noerholm, & Abildgaard, 2001). In NDIT, the Cronbach alpha coefficient for internal consistency of the MDI scale was 0.88 in cycle 21 and 0.89 in cycle 22.

### **4.2.2 Stressful Life Events**

Stressful life events were measured using questionnaire items adapted from the List of Threatening Experiences and from the Long-term Difficulties Inventory (Brugha & Cragg, 1990; Rosmalen, Bos, & de Jonge, 2012). In cycle 22, participants were asked “*Did you experience any of the following in the past 12 months?*” and “*If yes, how stressed were you by the experience?*” (response choices included not at all, a little, somewhat, a lot). For the first question, participants checked off yes if they experienced the event or left the checkbox blank if they did not experience it. The absence of the “no” checkbox apparently caused some confusion among participants. Specifically,  $n = 96$  participants (12%) left the checkbox blank, but provided a positive response (i.e., a little, somewhat, a lot) for the second question on stress. We classified these participants as “yes” (i.e., experienced event) despite the box being left blank. Participants ( $n = 123$ , 16%) who left the checkbox blank and checked off “not at all” stressed in the following question were

classified as “no” (i.e., did not experience event). Patterns of responses and re-coding strategy is presented in detail in Appendix B.

The 23 life events included in the questionnaire were: *breakup of relationship or marriage, kicked out of school, serious car accident, pregnancy, lost a job, major health problem, major and/or chronic financial problems, began college or university, sought psychological or psychiatric care, established a new steady relationship with a partner, got married, problems at work (with boss or co-worker), changed job, problems with the law, death of a parent or other family member, major argument with parents, birth of a child, close relative or friend had a serious illness or injury, your spouse, parent, sibling or child died, another close relative died, you had serious problems with a close friend, neighbor or relative, you became much better off financially and other stressful event.*

As often reported in the literature examining stressful life events checklists (Hamlat et al., 2014; Manczak et al., 2018; Rafnsson et al., 2006; Riglin et al., 2016), we summed all life events experienced to form a cumulative stressful life events score (range: 0 – 23).

### **4.2.3 Coping Style**

Coping style was measured using the short-form of the Coping Inventory for Stressful Situations (CISS) which includes 21 items and assesses three types of coping styles: problem-focused, emotion-focused and avoidant coping (Endler & Parker, 1990, 1994). Participants were asked the following question in cycle 22: *“People react to difficult, stressful, or upsetting situations in different ways. How often do you do each of the following when you experience such a situation?”* They responded on a five-point scale from *“never”* which was coded as 1 to *“very often”* which was coded as 5 (see Appendix C). Each subscale contains 7 items which are shown in Table 1. Since there are no recommended cut-off scores for categorizing coping style in the literature, an average score was calculated for each subscale by summing responses and dividing by the number of items responded to. As stated in Chapter 2, emotion-focused coping can be positive or negative. The CISS scale used herein measures emotion-focused coping using negative items. Each coping subscale has good internal consistency in our sample (i.e., problem-focused coping:  $\alpha = 0.88$ , emotion-focused coping:  $\alpha = 0.86$ , avoidant coping:  $\alpha = 0.78$ ).

Table 1. Items in each subscale of coping styles

Problem-focused coping	Emotion-focused coping	Avoidant coping
1. Focus on the problem and see how I can solve it	1. Blame myself for having gotten into this situation	1. Treat myself to a favorite food or snack
2. Determine a course of action	2. Feel anxious about not being able to cope	2. Phone a friend
3. Think about how I solved similar problems	3. Blame myself for being too emotional about the situation	3. Go out for a snack or meal
4. Work to understand the situation	4. Become very upset	4. Buy myself something
5. Take corrective action immediately	5. Blame myself for not knowing what to do	5. Visit a friend
6. Think about the event and learn from my mistakes	6. Wish that I could change what has happened or how I felt	6. Spend time with a special person
7. Analyze the problem before reacting	7. Focus on my general inadequacies	7. Take time off and get away from the situation

#### 4.2.4 Covariates

Our analyses controlled for age, sex, level of education and earlier depressive symptoms, all of which are potential confounders of the associations between stressful life events and depressive symptoms (Ge et al., 2009; Johnson et al., 2012; O'Sullivan, 2004), between stressful life events and coping styles (Brougham et al., 2009) and between coping styles and depressive symptoms (Meng et al., 2011; Undheim & Sund, 2017) (see Figure 2). Age at the current cycle was used in the analysis. To assess level of education in cycle 21, participants were asked “how far have you gone in school?”. Participants checked off whether they had attended or graduated high school, attended or graduated CEGEP, community/technical college, attended university (or teacher’s college) or graduated university with either a bachelor’s degree, master’s degree or PhD or specified any other level of education not listed above. Participants who specified any other education were reassigned to one of the above categories that best fit their answer. The level of education variable was dichotomised for analysis into attended or graduated high school and attended or graduated CEGEP, technical college or university. This variable is an appropriate



## 4.3 Statistical Analysis

### 4.3.1 Analytical sample

In cycle 22, 858 participants completed the self-report questionnaire, but only 782 were retained for analysis (Figure 3). Sixty-three participants who completed cycle 22 but not cycle 21 were excluded because they were missing data on covariates measured in cycle 21. Thirteen participants were excluded due to missing data on variables included in the analytical models: one participant was missing data on stressful life events, one on level of education, two on baseline depressive symptoms in cycle 21, seven on depressive symptoms in cycle 22 and two on coping styles.

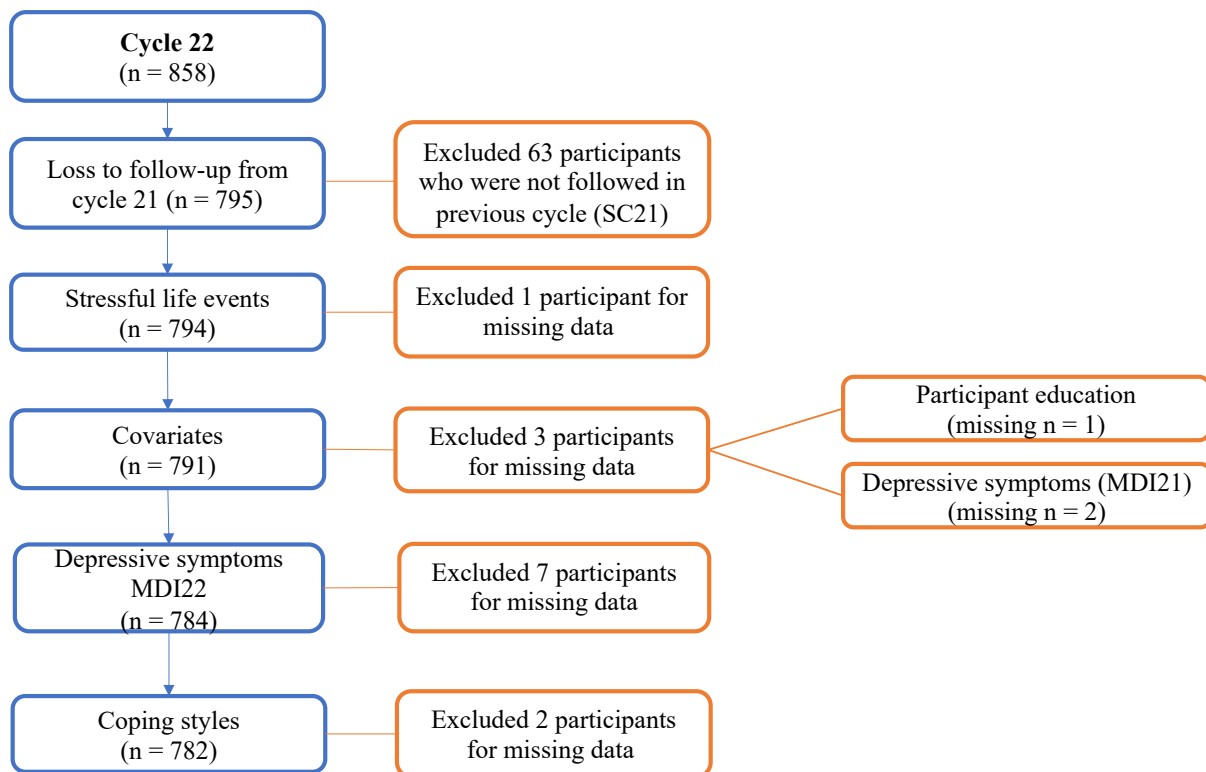


Figure 3. Flow chart of participants retained for analysis; NDI Study 2011–2012

### **4.3.2 Regression analysis**

Given that graphical representations of the variables of interest illustrated a relatively linear relationship, the associations between stressful life events, coping styles and depressive symptoms were examined using multiple linear regression. Stressful life events, coping styles and depressive symptoms were treated as continuous variables in the regression models. By keeping these variables continuous, we were able to estimate the average effect of adding one stressful life event and the effect of a one-unit score increase in coping style on the depressive symptoms score. The three estimated models were: (1) the association between stressful life events and depressive symptoms; (2) the association between stressful life events and each coping style and (3) the relationship between coping styles and depressive symptoms. All models were adjusted for age, sex, education and earlier depressive symptoms. Analyses were run using R software version 3.6.1 [RStudio version 1.2.5019] (see Appendix E for R code).

### **4.3.3 Mediation and Moderation Analysis**

The causal inference method based on counterfactual definitions of natural direct and indirect effect was used for mediation analyses. This method extends the Baron and Kenny mediation approach to include an interaction term in the models and depends on the assumption of no unmeasured confounding. More specifically, the causal interpretations of mediation analysis rely on the following four assumptions: (i) no unmeasured confounding between exposure and outcome; (ii) no unmeasured confounding between exposure and mediator; (iii) no unmeasured confounding between mediator and outcome and (iv) exposure should not affect any confounder in the association between mediator and outcome (VanderWeele & Vansteelandt, 2009). This mediation approach allows decomposition of the total effect (TE) into a natural direct effect (NDE) and a natural indirect effect (NIE) and depends on the assumption of no unmeasured confounding between exposure and outcome, between exposure and mediator, and between mediator and outcome (VanderWeele & Vansteelandt, 2009). NDE represents the effect of the exposure on the outcome while fixing the mediator at a value it would have taken if unexposed (VanderWeele & Vansteelandt, 2009). NIE expresses the effect of the mediator on the outcome in presence of the

exposure (VanderWeele & Vansteelandt, 2009). However, since the mediating and/or moderating role of coping style in the stressful life events – depressive symptoms association is less understood, applying the four-way decomposition approach can disentangle the portions of TE that are attributable to each mediation and moderation. Based on Vanderweele’s four-way decomposition (Figure 4), TE is decomposed into controlled direct effect (CDE), reference interaction ( $INT_{ref}$ ), mediated interaction ( $INT_{med}$ ) and pure indirect effect (PIE) (VanderWeele, 2014). CDE is the direct effect of the exposure on the outcome in absence of the mediator (i.e., effect due to neither mediation or moderation) (VanderWeele, 2014).  $INT_{ref}$  represents the effect due to moderation only, which is the effect of the exposure on the outcome in presence of the mediator if the exposure is not necessary for the mediator to be present (VanderWeele, 2014).  $INT_{med}$  represents the effect due to both mediation and moderation which is the effect of the exposure on the outcome in presence of the mediator if the exposure is necessary for the mediator to be present (VanderWeele, 2014). PIE is the effect due to mediation only which is the effect of the mediator on the outcome if the exposure is necessary for the mediator to be present (VanderWeele, 2014). Overall, this decomposition method allows a detailed exploration of both mediation and moderation at the same time and thus provides a better understanding of the association as a whole.

As shown in Figure 4, CDE and  $INT_{ref}$  together represent the pure direct effect (PDE) while  $INT_{med}$  and PIE together form the total indirect effect (TIE). Added together, PDE and TIE represent TE. Thus, the TE of an association can be decomposed into various components.

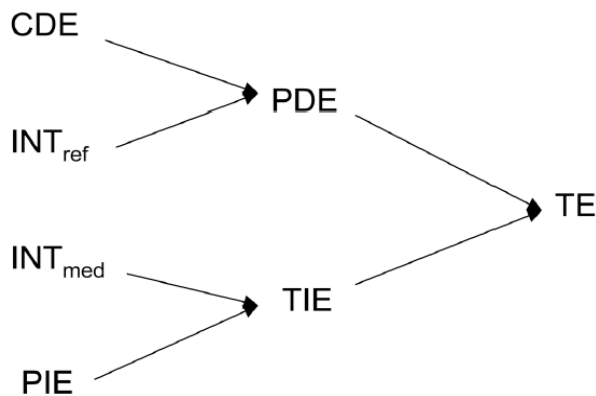


Figure 4. Four-way decomposition of the total effect (TE) into controlled direct effect (CDE), reference interaction ( $INT_{ref}$ ), mediated interaction ( $INT_{med}$ ) and pure indirect effect (PIE)

Three models were constructed one for each coping style as potential mediator/moderator (i.e., problem-focused coping, emotion-focused coping, avoidant coping) as represented in Figure 2 and in Figure 5. The models included stressful life events as the exposure, coping style as the mediator/moderator and depressive symptoms as the outcome. Since mediation analysis based on the causal inference approach assumes no unmeasured confounding between stressful life events and depressive symptoms, between stressful life events and coping style, and between coping style and depressive symptoms (VanderWeele & Vansteelandt, 2009), all identified potential confounders were included in the models. Thus, the models controlled for age, sex, participant education and earlier depressive symptoms. To estimate NDE and NIE, we used the Medflex package in R for mediation testing of natural effect models which computes confidence intervals using the robust sandwich variance estimator for linear regression (Steen, Loeys, Moerkerke, & Vansteelandt, 2017). The components of the four-way decomposition were obtained using the R code in Appendix E and its confidence intervals were estimated by bootstrap resampling.

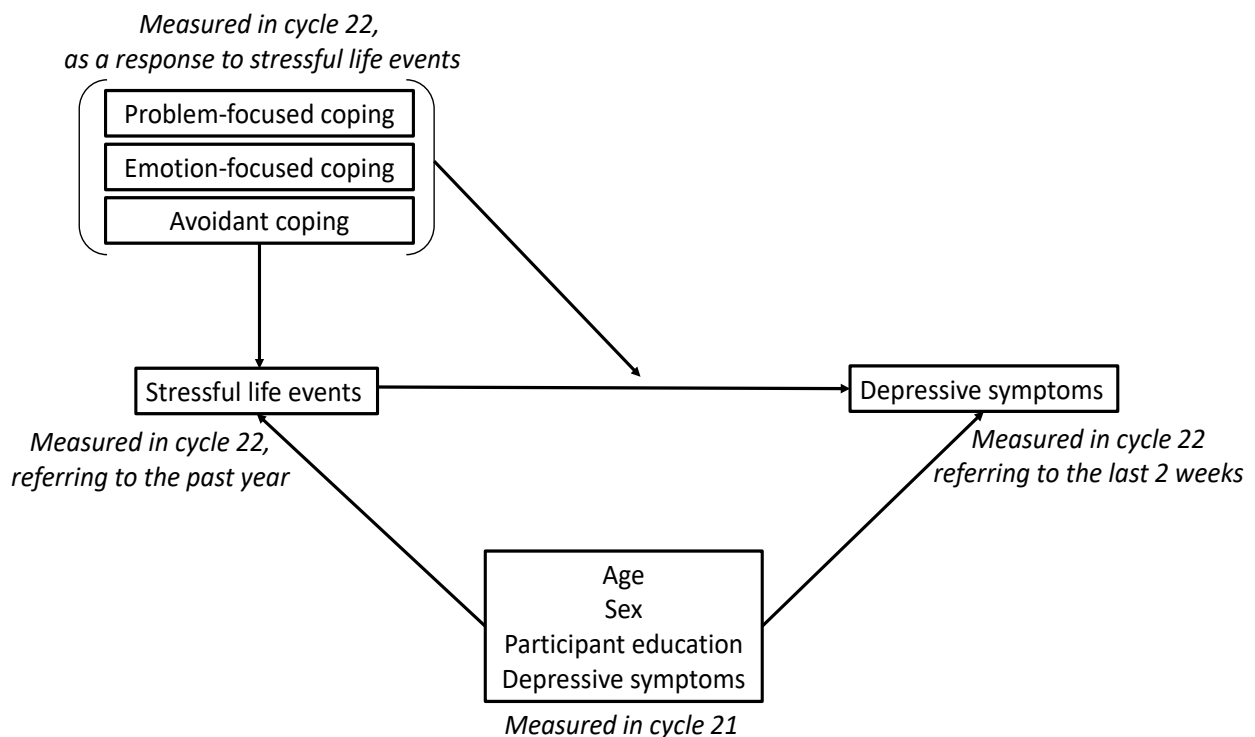


Figure 5. Directed Acyclic Graph representing the potential moderating effect of coping styles in the association between stressful life event and depressive symptoms

#### **4.3.4 Sensitivity Analysis**

Since individuals may use more than one coping style, additional analyses were conducted to check whether controlling for other coping styles changed the initial results. Thus, in addition to age, sex, participant education and earlier depressive symptoms, each natural effect model and four-way decomposition model also controlled for the other coping styles not included in the equation. For example, if model 1 included problem-focused coping as a mediator, then emotion-focused and avoidant coping styles were added as covariates. Results are presented in Appendix F (Table A2 & Table A3).

#### **4.4 Ethical considerations**

At the beginning of the study, a letter describing NDIT and a consent form were sent home to all parents or legal guardians of eligible participants. The principal investigator presented the study in all selected schools and answered questions from teachers and students. Thus, consent was obtained from parents or legal guardians by signing the consent form when NDIT participants were in high school. Post high school, it was indicated at the top of the questionnaire, that participants who completed the questionnaire consented to participating in the study. Participants received 50 \$ to cover costs associated with their participation in the study post high school. Data collected from participants are kept anonymous using a coding system and all material with identifying information is locked in filing cabinets accessible only to the project coordinator and the principal investigator.

This thesis project is part of the NDIT study which has received ethics approval from the Montreal Department of Public Health Ethics Review Committee, the McGill University Faculty of Medicine Institutional Review Board, the Ethics Research Committee of the Centre de Recherche du Centre Hospitalier de l'Université de Montréal and the University of Toronto (see Appendix G).



## Chapter 5 – Results

### 5.1 Manuscript Presentation and Contribution

This chapter presents a manuscript ready for submission, which is entitled *Mediation by coping style in the association between stressful life events and depressive symptoms in young adults*. The targeted journal is the *American Journal of Epidemiology*. As first author, the candidate completed the literature review, conducted the analyses and wrote the manuscript. Jennifer O’Loughlin and Isabelle Doré supervised this research project, participated in decisions related to analyses and critically reviewed the manuscript. Marie-Pierre Sylvestre critically reviewed the manuscript. All authors approved the final version.

## 5.2 Manuscript

**Title:** Mediation by coping style in the association between stressful life events and depressive symptoms in young adults

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**Abbreviations**

CDE: Controlled direct effect

CI: Confidence Interval

INT<sub>ref</sub>: Reference interaction

INT<sub>med</sub>: Mediated Interaction

NDIT: Nicotine Dependence in Teens

PIE: Pure indirect effect

SD: Standard deviation

TE: Total effect

## Abstract

The association between stressful life events and depressive symptoms is well-established, but the role of coping style in this association is less clear. We examined whether problem-focused, emotion-focused or avoidant coping style mediated and/or moderated the association in young adults. Data collected in self-report questionnaires were drawn from a longitudinal investigation that recruited 1294 students (age 12-13) from 10 high schools in Montreal, Canada in 1999-2000. The analytic sample included 782 participants age 24 years on average. Using VanderWeele's four-way decomposition approach, the total effect of stressful life events on depressive symptoms was decomposed into components representing moderation only, mediation only, mediated interaction and neither mediation nor moderation, by coping style. We observed mediation by emotion-focused coping ( $\hat{\beta}(95\%CI)=-0.15(0.05, 0.17)$ ) and moderation by problem-focused coping ( $\hat{\beta}(95\%CI)=-1.51(-2.22, -1.06)$ ) and emotion-focused coping ( $\hat{\beta}(95\%CI)=1.16(1.05, 1.68)$ ). Individuals reporting more problem-focused coping experienced fewer depressive symptoms after exposure to stressful life events; those reporting more emotion-focused coping experienced more depressive symptoms. Avoidant coping did not mediate or moderate this association. Overall, moderation was more important than mediation by coping style. Interventions that aim to reduce depressive symptoms in young adults should reinforce problem-focused coping and minimize emotion-focused coping strategies.

**Keywords:** coping style, depression, mediation, stressful life events, young adults

## Introduction

Depression is a disabling mental disorder that is highly prevalent in young adults – 13% of young adults ages 18-25 in the US met the criteria for depression in 2017 (Bose et al., 2018). One-quarter of post-secondary students in Canada in 2019 reported feeling very sad and 21% reported having difficulty functioning due to their depressed mood (American College Health Association, 2019). Experiencing depressive symptoms can have negative consequences on academic performance (Hysenbegasi et al., 2005), personal relationships, social life (Alonso et al., 2018) and work performance (Lepine & Briley, 2011).

Stressful life events are risk factors commonly associated with depressive symptoms (Dyson & Renk, 2006). Certain stressful life events or conditions including illness (Suzuki et al., 2018), trouble with family members (Suzuki et al., 2018), death of a family member or parental separation (Friis, 2002), and peer pressure or problems with friends (Hazel et al., 2014) are strongly associated with depressive symptoms. Although life events can occur at any time during the life course, the transition from adolescence to young adulthood is a particularly turbulent life stage, often characterized by important life changes such as leaving high school to begin college or university, entering the workforce and establishing long-term relationships (Arnett, 2000). Because stressful life events often occur at this age and because depressive symptoms are highly prevalent and associated with an increased risk of major depression and functional impairment, investigations in this age group can be particularly useful in understanding the mechanisms underpinning the association between stressful life events and depressive symptoms. Importantly, better knowledge of this association could inform and guide preventive intervention aimed at reducing depression in young adulthood.

Not all individuals exposed to stressful life events develop depressive symptoms, and one possible adaptive mechanism underpinning this association could relate to resilience (Sheerin et al., 2018). Some individuals have the ability to adapt positively to stressful experiences (Sheerin et al., 2018). More specifically, the stress-coping theory (Folkman et al., 1986) posits that when a life event occurs, an individual cognitively appraises the situation by assessing whether it is threatening, harmful or challenging (i.e., stressful). Throughout this cognitive process, the individual evaluates

what can be done to deal with the situation, which results in use of a coping strategy (Folkman et al., 1986). Coping style refers to strategies individuals employ to deal with stressful life events, and is typically characterised as problem-focused (i.e., targeting the cause of stress), emotion-focused (i.e., reducing emotional distress) or avoidant (i.e., escaping the cause of stress) (Endler & Parker, 1994; Folkman et al., 1986). Problem-focused coping is considered an adaptive coping style that can enhance resilience (Campbell-Sills et al., 2006), while emotion-focused and avoidant coping are generally considered maladaptive coping styles (Vinberg et al., 2010). Individuals may have a dominant coping style, but may also use more than one style depending on the situation causing the stress (Jackson et al., 2017). Also, an accumulation of stressful life events during a certain time period is associated with lower levels of problem-focused coping, higher levels of avoidant coping (Evans et al., 2015) and higher levels of emotion-focused coping (Undheim & Sund, 2017). Overall these studies (Evans et al., 2015; Undheim & Sund, 2017) suggest that an aggregation of stressful life events could be associated with higher stress levels that lead to the use of negative coping approaches (i.e., emotion-focused or avoidant coping).

Coping styles are differentially associated with depressive symptoms. Problem-focused coping is inversely associated with depressive symptoms; and avoidant coping is positively associated (Dyson & Renk, 2006). In contrast, emotion-focused coping is both positively (Rafnsson et al., 2006) and negatively (Morris et al., 2015) associated with depressive symptoms. Negative emotion-focused coping strategies such as rumination (i.e., repetitive thoughts of one's feelings toward the situation) and self-blame increase depressive symptoms (Michl et al., 2013; Rafnsson et al., 2006) whereas positive emotion-focused coping strategies such as acceptance and emotional support decrease depressive symptoms (Morris et al., 2015). Thus, certain coping styles could be protective against depressive symptoms, while others are not.

Although stressful life events, coping styles and depressive symptoms are clearly inter-related, the mechanisms underpinning how they affect each other is less understood. First, if coping styles are stable over time and characterize the way individuals deal with stressful situations, then coping styles may moderate the association between stressful life events and depressive symptoms. Studies report no significant moderation by problem-focused coping strategies (Lewis

et al., 2015), but support moderation by emotion-focused coping (Scott et al., 2013). More specifically, Scott et al. (2013) found that individuals with high levels of emotion-focused coping experienced depressive symptoms when encountering stressful life events. Second, if coping styles are influenced by stressful life events and thus change over time, then coping styles may mediate the association between stressful life events and depressive symptoms. Dyson and Renk (2006) found that stressful life events did not predict any coping style, but both stressful life events and avoidant coping did predict depressive symptoms. However, Evans et al. (2015) found an indirect effect of stressful life events on depressive symptoms through primary control engagement (i.e., a combination of problem-focused coping and some positive emotion-focused coping strategies) and avoidant coping. Since a variable can be both a mediator and a moderator (VanderWeele, 2014) and since the role of coping style is unclear, investigating mediation and moderation simultaneously could elucidate these underlying mechanisms.

Our objectives in this current analysis, were to examine each coping style as a potential mediator and/or moderator of the association between stressful life events and depressive symptoms using the four-way decomposition method, which permits decomposition of the total effect into portions attributable to each of mediation and moderation.

## **Methods**

Data were drawn from the Nicotine Dependence in Teens (NDIT) Study, an ongoing longitudinal study which recruited 1294 participants in 1999–2000 from 10 high schools in Montreal, Canada. Schools were purposively selected to include both English and French schools, schools located in urban, suburban and rural areas and schools representing low, moderate and high socio-economic status neighborhoods (O'Loughlin et al., 2015). The study received ethics approval from the Montreal Department of Public Health Ethics Review Committee, the McGill University Faculty of Medicine Institutional Review Board, the Ethics Research Committee of the Centre de Recherche du Centre Hospitalier de l'Université de Montréal and the University of Toronto.

The current analysis includes data from self-report questionnaires collected post high school (cycle 22 conducted in 2011–12) when participants were age 24 years on average. Cycle 22

included 858 participants; our analyses were restricted to participants with complete data on the main study variables and covariates (n = 782).

### **Study variables**

***Depressive symptoms.*** Data on depressive symptoms were collected using the Major Depression Inventory (MDI), a 10-item self-report scale based on DSM-IV and ICD-10 criteria for depression (Bech et al., 2015). Participants reported the frequency of symptoms experienced in the last two weeks on a six-point scale ranging from “*at no time*” to “*all the time*” scored 0 to 5. Items 8 and 10 each have two sub-items *a* and *b* – only the highest score between *a* and *b* was retained for scoring (Appendix H; Table A4). The total score ranged from 0 to 50 points, with higher scores indicating a higher frequency of depressive symptoms. The MDI scale has been validated and is reliable in adults (Bech et al., 2001). The Cronbach alpha coefficient for internal consistency of the MDI scale in NDIT was 0.89.

***Stressful life events.*** Data on stressful life events were obtained using questionnaire items adapted from the List of Threatening Experiences and from the Long-term Difficulties Inventory (Brugha & Cragg, 1990; Rosmalen et al., 2012). The following question was used to measure stressful life events: “*Did you experience any of the following in the past 12 months?*”. Twenty-three events/circumstances were listed in the questionnaire and participants were given the option to specify any other life event not included in the list. As is often done in research using stressful life events checklists (Manczak et al., 2018; Rafnsson et al., 2006), a cumulative stressful life events during the past year score was created by summing all events (range 0 – 23).

***Coping style.*** The short-form of the Coping Inventory for Stressful Situations (CISS) was used to measure coping style, which includes 21 items and assesses three coping styles: problem-focused, emotion-focused and avoidant coping (Endler & Parker, 1990, 1994). Each subscale contains 7 items. Coping style was assessed using the following question: “*People react to difficult, stressful, or upsetting situations in different ways. How often do you do each of the following when you experience such a situation?*” Participants responded on a five-point scale from “*never*” to “*very often*” scored from 1 to 5. For each subscale, responses were summed and divided by the number

of items responded to, to create an average score for each coping style (possible range 1.00 – 5.00). In NDIT, the internal consistency of each coping subscale was good (i.e., problem-focused coping:  $\alpha = 0.88$ , emotion-focused coping:  $\alpha = 0.86$ , avoidant coping:  $\alpha = 0.78$ ).

**Covariates.** We identified age, sex, participant education and earlier depressive symptoms as potential confounders of the associations among stressful life events, coping style and depressive symptoms (Brougham et al., 2009; Ge et al., 2009; Johnson et al., 2012; Undheim & Sund, 2017). Data for all covariates were drawn from cycle 21, which was conducted in 2007–8. We used participant education (coded attended/graduated high school or attended/graduated CEGEP (i.e., Collège d'enseignement général et professionnel) or university)). CEGEPs are post-secondary educational institutions in Quebec that offer programs that prepare students for university or for employment. Education was used as a proxy for socioeconomic status since it is associated with future employment and income (Galobardes et al., 2006). Earlier depressive symptoms were measured using the MDI scale.

### **Data Analysis**

T-tests and chi-square tests were conducted to assess differences in means and proportions between participants retained and not retained for analysis. To examine mediation and moderation of each coping style, we used VanderWeele's four-way decomposition approach (VanderWeele, 2014) which decomposes the total effect of stressful life events on depressive symptoms (TE) into four components, some of which account for coping styles: controlled direct effect (CDE), reference interaction ( $INT_{ref}$ ), mediated interaction ( $INT_{med}$ ) and pure indirect effect (PIE). CDE is the effect of stressful life events on depressive symptoms not due to either mediation or moderation by coping style.  $INT_{ref}$  is the effect due to moderation only (i.e., the effect of stressful life events on depressive symptoms that operates in the presence of the coping style, if stressful life events are not necessary for using a coping style).  $INT_{med}$  is the effect due to both mediation and moderation (i.e., the effect of stressful life events on depressive symptoms that operates in presence of coping style if stressful life events are necessary for using a coping style). The last component, PIE is the effect due to mediation only (i.e., the effect of coping style on depressive symptoms if stressful life events are necessary for employing a coping style).

Three models were constructed, one for each coping style as a potential mediator/moderator, with stressful life events as the exposure, and depressive symptoms as the outcome (all of which were entered as continuous variables). Since the mediation hypothesis assumes that the exposure occurs before the mediator and that both occur before the outcome, the temporality for the reference periods for these variables is important. Although data for stressful life events, coping style and depressive symptoms were collected in the same data collection cycle, the reference period was “past year” for stressful life events and “past two weeks” for depressive symptoms (Figure 2). Since the potential mediator, coping style was measured as a usual response to stressful life events (i.e., coping style may precede stressful life events) and since stressful life events predict coping style (Evans et al., 2015; Undheim & Sund, 2017), we assume herein that stressful life events and coping style occurred before depressive symptoms. To assure that exposure to covariates preceded exposure to the main variables of interest, data on age, sex, education and earlier depressive symptoms were drawn from cycle 21 conducted in 2007–08.

All models were adjusted for age, sex, participant education and earlier depressive symptoms. Since some studies support a bidirectional relationship between stressful life events and depressive symptoms (Johnson et al., 2012; March-Llanes et al., 2017) and between coping styles and depressive symptoms (Undheim & Sund, 2017), we also adjusted for earlier depressive symptoms. Analyses were conducted using R software version 3.6.1 [RStudio version 1.2.5019]. Confidence intervals were computed using bootstrap resampling.

## **Results**

Table 1 compares selected characteristics of participants retained (n = 782) and not retained (n = 512) for analysis. Among participants excluded, 436 did not participate in the data collection in 2011–12 (cycle 22), 66 were missing data on covariates and 10 were missing data on the exposure, mediator or outcome (Appendix H; Table A5). Compared to those not retained, participants in the analytical sample were younger on average, higher proportions were female, born in Canada, had university-educated mothers and had attended or graduated from CEGEP or university. There were no significant differences between included and excluded participants in language, number of stressful life events, coping style or depressive symptoms.

Table 1. Characteristics of participants retained and not retained for analysis (n =1294), NDIT Study 1999–2012.

Characteristics	Retained (n=782)	Not retained <sup>a</sup> (n=512)	p-value <sup>b</sup>
	n (%) or mean (SD)	n (%) or mean (SD)	
Age at baseline, mean (SD)	12.7 (0.5)	12.9 (0.6)	< 0.001
Female, n (%)	432 (55.2)	239 (46.7)	0.003
Mother university-educated, n (%)	330 (46.6)	105 (38.9)	0.030
Participant attended/graduated CEGEP/university, n (%)	636 (81.3)	60 (61.9)	< 0.001
Canadian-born, n (%)	731 (93.5)	460 (90.0)	0.024
French-speaking, n (%)	241 (30.8)	148 (29.0)	0.477
Stressful life events, mean (SD)	2.9 (2.3)	3.2 (2.5)	0.387
Coping style, mean (SD)			
Problem-focused coping	3.5 (0.8)	3.5 (0.8)	0.667
Emotion-focused coping	2.4 (0.8)	2.5 (1.0)	0.304
Avoidant coping	2.5 (0.8)	2.7 (0.8)	0.075
Depressive symptoms, mean (SD)			
At age 20	9.7 (7.8)	9.7 (8.0)	0.966
At age 24	8.4 (7.8)	9.6 (9.6)	0.293

<sup>a</sup>Participants who did not complete cycle 22 at age 24 or who were excluded due to missing data on covariates from cycle 21 at age 20

<sup>b</sup>Differences between means and proportions were calculated using t-tests and chi-square tests  
SD: standard deviation

Table 2 presents the four-way decomposition of the TE between stressful life events and depressive symptoms for each coping style. For all three coping style models, stressful life events were positively associated with depressive symptoms. In the problem-focused coping model, INT<sub>med</sub> and PIE were zero with very narrow confidence intervals indicating that problem-focused coping did not mediate the association between stressful life events and depressive symptoms. The only statistically significant components were CDE ( $\hat{\beta}$ (95% CI) = 2.26(1.78, 3.02)) and INT<sub>ref</sub> ( $\hat{\beta}$ (95% CI) = -1.51(-2.22, -1.06)). CDE implies that there is a positive association between stressful life events and depressive symptoms in the absence of problem-focused coping. The INT<sub>ref</sub> estimate indicates that there is an important portion of the association between stressful life events and depressive symptoms that is due to moderation, and that the interaction between

stressful life events and problem-focused coping decreases depressive symptoms. More specifically, the association between stressful life event and depression was weaker among participants who used problem-focused coping relative to the association among participants who did not use problem-focused coping, suggestive that problem-focused coping mitigates the effect of stressful life events on depressive symptoms.

Table 2. Beta coefficients and 95% confidence intervals for the four-way decomposition of each potential mediator/moderator of the association between stressful life events and depressive symptoms, NDIT Study 2011–2012.

	Potential mediator		
	Problem-focused coping	Emotion-focused coping	Avoidant coping
	$\beta$ (95% CI)	$\beta$ (95% CI)	$\beta$ (95% CI)
CDE	<b>2.26 (1.78, 3.02)</b>	<b>-0.83 (-1.27, -0.74)</b>	<b>0.40 (0.01, 0.89)</b>
INT <sub>ref</sub>	<b>-1.51 (-2.22, -1.06)</b>	<b>1.16 (1.05, 1.68)</b>	0.23 (-0.12, 0.53)
INT <sub>med</sub>	0.00 (0.00, 0.01)	<b>0.03 (0.03, 0.04)</b>	0.01 (0.00, 0.02)
PIE	0.00 (-0.01, 0.01)	<b>0.15 (0.05, 0.17)</b>	0.05 (-0.03, 0.07)
TE	<b>0.75 (0.72, 0.80)</b>	<b>0.52 (0.42, 0.52)</b>	<b>0.69 (0.53, 0.83)</b>

Adjusted for age, sex, participant education, depressive symptoms (cycle 21).

CDE: Controlled direct effect, INT<sub>ref</sub>: Reference interaction, INT<sub>med</sub>: Mediated interaction, PIE: pure indirect effect, TE: Total Effect, CI: Confidence Interval

Bold indicates confidence intervals that do not include the null

In the emotion-focused coping model, all four decomposition components were non-zero with precise confidence intervals suggesting that mediation and moderation were present. More specifically, these results indicate that a portion of TE is explained by CDE ( $\hat{\beta}$ (95% CI) = -0.83(-1.27, -0.74)) which suggests that in the absence of emotion-focused coping, stressful life events are negatively associated with depressive symptoms. Second, an important portion of TE is explained by moderation only ( $\hat{\beta}$ (95% CI) = 1.16(1.05, 1.68)) which indicates that the interaction between stressful life events and emotion-focused coping increases depressive symptoms. Also, INT<sub>med</sub> ( $\hat{\beta}$ (95% CI) = 0.03(0.03, 0.04)) and PIE ( $\hat{\beta}$ (95% CI) = 0.15(0.05, 0.17)) were statistically significant suggesting that some of the effect was mediated by emotion-focused coping. This suggests that stressful life events increases the use of emotion-focused coping which in turn increases depressive symptoms. However, INT<sub>med</sub> and PIE were smaller compared to INT<sub>ref</sub>

indicating that moderation by emotion-focused coping is more important than mediation. Specifically, the results mostly support that emotion-focused coping modifies the stressful life events – depressive symptoms association rather than emotion-focused coping being in the causal pathway between stressful life events and depressive symptoms.

Finally, in the avoidant coping model, only CDE ( $\hat{\beta}$ (95% CI) = 0.40(0.01, 0.89)) was statistically significant suggesting that avoidant coping did not mediate or moderate the stressful life events – depressive symptoms association. These results indicate that the mechanisms through which stressful life events are associated with depressive symptoms do not require avoidant coping.

Overall, our results indicate that the association between stressful life events and depressive symptoms is more due to moderation than mediation by coping style.

## **Discussion**

To our knowledge, this is the first study using the four-way decomposition approach to disentangle the mediating and/or moderating role of coping style in the association between stressful life events and depressive symptoms in young adults. As expected (Dyson & Renk, 2006; Suzuki et al., 2018), stressful life events was associated with depressive symptoms, adding longitudinal evidence to the extant literature that this association is robust in young adults. Three key findings emerged from the four-way decomposition analyses.

First, problem-focused coping did not mediate, but it did moderate the association between stressful life events and depressive symptoms. Consistent with Dyson and Renk (2006), problem-focused coping was not affected by stressful life events. However individuals who used problem-focused coping to deal with stressful situations experienced fewer depressive symptoms. As suggested in previous studies (Dyson & Renk, 2006; Morris et al., 2015), problem-focused coping may be protective of depressive symptoms. However contrary to our findings, Lewis et al. (2015) found no moderation by problem-focused coping strategies, possibly because their study included high-risk HIV-positive adolescents who may cope differently than healthy adolescents. Our findings also differed from Evans et al. (2015) who found that problem-focused coping strategies mediated the association. Measurement of problem-focused coping differed across

studies (i.e., Evans et al. combined problem-focused coping with several positive emotion-focused coping strategies) which could partially account for differences in results. Further, Evans et al. studied children and adolescents whose coping strategies are in the process of developing and becoming more diverse (Zimmer-Gembeck & Skinner, 2010). Aligned with Wingo et al. (2015) who found that problem-focused coping increased from age 17 to 24, but stabilised in the mid-twenties, problem-focused coping may be more stable among the young adults studied herein.

Second, emotion-focused coping mediated and moderated the association between stressful life events and depressive symptoms. The presence of mediation indicates that stressful life events increased the use of emotion-focused coping which increased depressive symptoms. Although Dyson and Renk (2006) found no association between stressful life events and emotion-focused coping in college students, their measure of emotion-focused coping included mostly positive strategies (i.e., acceptance, emotional support) whereas our measure included negative strategies only (i.e., self-blame, focusing on one's general inadequacies). Thus, stressful life events seem to lead to negative emotion-focused coping, which is consistent with Undheim & Sund (2017), who showed that individuals tend to use maladaptive coping styles following stressful situations. Since life events occur at specific moments in time, but can induce a state of stress over a longer period because of higher demands of the situation (Epel et al., 2018), we hypothesize that increased stress is associated with coping impairment. In addition to mediation, a substantial portion of the association was explained by moderation. As reported elsewhere (Scott et al., 2013), individuals using more emotion-focused coping in stressful situations experience more depressive symptoms. Since a more important portion of the association is due to moderation by emotion-focused coping, this could suggest that certain individuals may be using emotion-focused coping more frequently to deal with stressful life events, and thus this coping style may be more or less stable over time.

Lastly, although previous studies support associations between avoidant coping and both stressful life events and depressive symptoms (Dyson & Renk, 2006; Seiffge-Krenke & Klessinger, 2000; Undheim & Sund, 2017), we found no mediation or moderation by avoidant coping. Our findings suggest that stressful life events are associated with depressive symptoms in pathways

not involving avoidant coping. This is contrary to Evans et al. (2015) who found that behavioural (i.e., quit trying; reducing efforts to reach goal) or mental disengagement (i.e., sleep; watch TV; denial) mediated the association. While our measure of avoidant coping also included strategies to avoid thinking about the stressor, few items reflected social activities or interaction (i.e., going out for a meal; calling or visiting a friend) which could have positive impact in the short-term. Future studies will need to consider broader conceptualizations of avoidant coping and examine avoidant coping subscales to better clarify its role in the association between stressful life events and depressive symptoms.

### **Strengths and Limitations**

Although data on stressful life events, coping style and depressive symptoms were collected in the same cycle, the reference time frame for each variable permitted longitudinal analyses, which is important for causal mediation analysis. Strengths of this study include use of an analytical approach which allowed simultaneous assessment of mediation and moderation compared to traditional mediation methods. Limitations include that selection-bias due to loss to follow-up may have affected the estimates and that purposive sampling could limit generalizability. Also, self-report measures of stressful life events using checklists are subject to misclassification due to information bias (i.e., long recall periods can lead to underreporting of stressful life events). Also, cumulative stressful life event scores cannot distinguish events that are more stressful than others. Although number of life events predicts health outcomes (S. M. Cohen, MLM. Prather AA., 2019), future studies should consider investigating these mechanisms using interview-based stressful life event measures to improve understanding of the type and severity of events in these associations. Future research should also consider using hetero-evaluation measures as another avenue for replicating these findings.

### **Conclusion**

The present study clarifies the role of each coping style (problem-focused, emotion-focused and avoidant) in the association between stressful life events and depressive symptoms. We found mediation only through emotion-focused coping, and moderation by both problem-focused

coping and emotion-focused coping. Our findings indicate that the effect of stressful life events on depressive symptoms is primarily attributable to moderation by coping style, rather than mediation. Based on these findings, preventive interventions for depressive symptoms in young adults should focus on reinforcing problem-focused coping strategies and discouraging use of negative emotion-focused coping strategies in dealing with stressful life events.

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## 5.3 Additional Results

### 5.3.1 Regression analysis

The first objective of this thesis was to describe the associations among stressful life events, coping styles and depressive symptoms (Appendix I; Table A6). Using adjusted linear regression, stressful life events were positively associated with depressive symptoms ( $\hat{\beta}$ (95% CI) = 0.75(0.54, 0.97)), with emotion-focused coping mean scores ( $\hat{\beta}$ (95% CI) = 0.06(0.04, 0.09)) and with avoidant coping mean scores ( $\hat{\beta}$ (95% CI) = 0.08(0.06, 0.10)), but not with problem-focused coping mean scores ( $\hat{\beta}$ (95% CI) = -0.01(-0.04; 0.02)). In the regression model including all three coping styles as predictors of depressive symptoms, problem-focused coping and emotion-focused coping were associated with depressive symptoms, but not avoidant coping. Problem-focused coping was inversely associated with depressive symptoms ( $\hat{\beta}$ (95% CI) = -1.24(-1.77; -0.70) while emotion-focused coping was associated with increased depressive symptoms ( $\hat{\beta}$ (95% CI) = 4.26(3.67; 4.84)).

### 5.3.2 Mediation Analysis – Natural Effect Models

NDE, NIE and TE estimates for each mediation model are presented in Table 4. The NDE of stressful life events on depressive symptoms was statistically significant for all three coping style models. The NIE was only present in the emotion-focused coping model. The NDE suggests that a one-unit increase in stressful life events increases depressive symptoms score by 0.74 (95% CI = 0.50, 0.97) when holding problem-focused coping constant, by 0.26 when holding emotion-focused coping constant (95% CI = 0.06, 0.46) and by 0.63 (95% CI = 0.34, 0.92) when holding avoidant coping constant. Since NIE was significant for emotion-focused coping ( $\hat{\beta}$ (95% CI) = 0.14(0.03, 0.25)) and NIE for the other two coping styles was nearly zero, this suggests that there may be mediation between stressful life events and depressive symptoms through emotion-focused coping only. The NIE suggests that a one-unit increase in the emotion-focused average score increases depressive symptoms score by 0.14 when suppressing the effect of stressful life events on depressive symptoms.

Table 2. Beta coefficients and 95% confidence intervals for the natural direct, natural indirect and total effects of each potential mediator of the association between stressful life events and depressive symptoms, NDIT Study 2011–2012.

	Potential mediator		
	Problem-focused coping	Emotion-focused coping	Avoidant coping
	$\beta$ (95% CI)	$\beta$ (95% CI)	$\beta$ (95% CI)
NDE	<b>0.74 (0.50, 0.97)</b>	<b>0.26 (0.06, 0.46)</b>	<b>0.63 (0.34, 0.92)</b>
NIE	0.00 (-0.02, 0.02)	<b>0.14 (0.03, 0.25)</b>	0.05 (-0.01, 0.11)
TE	<b>0.74 (0.50, 0.97)</b>	<b>0.40 (0.18, 0.62)</b>	<b>0.68 (0.38, 0.98)</b>

Adjusted for age, sex, participant education, depressive symptoms (cycle 21).

NDE: Natural Direct Effect, NIE: Natural Indirect Effect, TE: Total Effect, CI: Confidence Interval

Bold indicates confidence intervals that do not include the null



## Chapter 6 – Discussion

The purpose of this MSc thesis was to study mediation and moderation by coping style of the stressful life events – depressive symptoms association. We assessed direct and indirect effects using natural effect models and further decomposed these effects using the four-way decomposition method to disentangle portions attributable to each of mediation and moderation. The following chapter presents a summary and interpretation of the findings, the strengths and limitations of the study and its research implications.

### 6.1 Summary and Interpretation of Findings

In the NDIT study, young adults reported on average 3 stressful life events in the past year which is similar to a sample of university students in the United States (3-4 stressful life events in the past 6 months) (Manczak et al., 2018). Among other young adult populations (Klakk et al., 2018; Otiende et al., 2017), depressive symptoms scores ranged between 8-9 which is similar to the MDI scores in the NDIT study (MDI = 9.7 at age 20 and 8.4 at age 24). Thus, our results confirm that on average the young adult population experiences low levels of depressive symptoms.

Since mediation analysis assumes causal associations among the exposure, mediator and outcome, we first assessed the associations among stressful life events, coping style and depressive symptoms using linear regression. Our results indicated that stressful life events were positively associated with emotion-focused coping, avoidant coping and depressive symptoms, but not with problem-focused coping. Thus, experiencing more stressful life events seemed to increase the use of maladaptive coping styles. Also, problem-focused coping was inversely associated with depressive symptoms while emotion-focused was positively associated with depressive symptoms suggesting differential associations between coping style and depressive symptoms.

Next, using natural effect models to assess mediation through each coping style, we found a direct effect of stressful life events on depressive symptoms and an indirect effect through emotion-focused coping. This implies that stressful life events increased depressive symptoms

independent of coping style (i.e., stressful life events can also affect depressive symptoms through other pathways not involving coping style). Also, the indirect effect suggested that individuals encountering stressful life events tended to use more emotion-focused coping which in turn increased depressive symptoms. Therefore, partially in line with our hypothesis, a portion of the association between stressful life events and depressive symptoms was explained by emotion-focused coping. However, contrary to our hypothesis, we did not find any mediation through problem-focused coping or avoidant coping.

Finally, to provide further insight on the role of coping style as mediator and or moderator, we applied the four-way decomposition method. Based on our analysis, we identified problem-focused coping as moderating the association between stressful life events and depressive symptoms. This suggests that individuals employing more frequently problem-focused coping were less likely to experience depressive symptoms when encountering stressful life events. Also, we identified a more substantial portion of the association between stressful life events and depressive symptoms that was moderated by emotion-focused coping than mediated by emotion-focused coping. This implies that while stressful life events may increase the use of emotion-focused coping, individuals who tend to use emotion-focused coping more frequently are more likely to experience depressive symptoms when exposed to stressful life events. Contrary to our hypothesis, avoidant coping did not mediate or moderate the association between stressful life events and depressive symptoms.

The association between stressful life events and depressive symptoms is well-established in the literature (Dyson & Renk, 2006; Evans et al., 2015; Sawyer et al., 2009) and our findings confirm this association. While studies show that coping style is associated with both stressful life events (Undheim & Sund, 2017) and depressive symptoms (Rafnsson et al., 2006), the role of coping style in this association is unclear. Thus, this study contributes to the literature by showing that each coping style has a differential role in the stressful life events – depressive symptoms association. More specifically, problem-focused coping was a moderator, emotion-focused coping was both a mediator and a moderator while avoidant coping was neither.

In terms of problem-focused coping, our findings differ those from Lewis et al. (2015) who found no moderation between strategies relating to a problem-focused coping style. However, their sample population included high-risk HIV-positive adolescents which may not be applicable to our study population. Thus, high-risk individuals may cope differently with stressful life events than healthy individuals. Our results also differed from Evans et al. (2015) who found that primary control engagement (i.e., combination of problem-focused coping and positive emotion-focused coping strategies) partially mediated the association between stressful life events and depressive symptoms. However, the conceptualization of coping styles differs between the COPE Inventory (Connor-Smith et al., 2000) used in the Evans et al. study and the CISS scale (Endler & Parker, 1994) used in the current study. For example, the primary control engagement coping style in the COPE Inventory does not distinguish between problem-focused and emotion-focused coping strategies. Thus, the coping style constructs may not be directly comparable. More importantly, differences in our results may relate to the population sampled. Our study included young adults while Evans et al. included children and adolescents. The coping literature indicates that coping strategies begin developing in childhood and diversify in adolescence (Zimmer-Gembeck & Skinner, 2010). Thus, coping styles such as problem-focused coping may be more stable among young adults compared to children and adolescents, which could explain why we found moderation by problem-focused coping and not mediation. This aligns with Wingo et al. (2015) who found that from late adolescence to mid-twenties, problem-focused coping increased and then stabilised suggesting that individuals tended toward an adaptive coping style with maturity. Hence, it is possible that young adults who develop and tend to use problem-focused coping more often are less or unaffected by stressful life events and as a result experience fewer depressive symptoms. This is in part supported by Dyson and Renk (2006) who found that stressful life events did not predict problem-focused coping among young adults.

Regarding emotion-focused coping, we found mediation which is contrary to Dyson and Renk (2006) who found that stressful life events did not predict emotion-focused coping and when entered in the same equation with stressful life events did not predict depressive symptoms. Our results may differ because Dyson and Renk (2006) use the Baron and Kenny mediation method which does not account for moderation in the equations and thus could lead to different results.

Also, the items used to measure emotion-focused coping in their study included a mix of positive strategies (e.g., acceptance, emotional support, positive reinterpretation) and a negative strategy (i.e., denial) while emotion-focused coping in our study comprised negative strategies only. However, our results support studies indicating that individuals tend to use maladaptive coping styles following stressful life events (Shikai et al., 2009; Undheim & Sund, 2017). Even though stressful life events occur at specific time points, they may cause a state of stress for a longer period due to consequences following these events (Epel et al., 2018). Thus, increased stress over time may be associated with adopting maladaptive coping styles. In terms of moderation, our results aligned with Scott et al. (2013) who found that individuals with higher levels of emotion-focused coping experienced depressive symptoms when encountering stressful life events. This could be explained by the strategies that form the emotion-focused coping style such as self-blame, becoming upset or focusing on one's general inadequacies which could have a negative impact on the emotional state when used more frequently. Based on our results, it seems that stressful life events predict negative strategies rather than positive ones and that individuals using emotion-focused coping more often are more likely to experience depressive symptoms.

Although previous studies indicate that avoidant coping has long-term effects on depressive symptoms (Seiffge-Krenke & Klessinger, 2000) and that certain stressful life events are associated with avoidant coping (Undheim & Sund, 2017), we found no mediation or moderation by avoidant coping. This is contrary to Evans et al. (2015) who found that disengagement coping (i.e., avoidant coping strategies) mediated this association. Our results also partly disagree with Dyson and Renk (2006) who concluded partial mediation through avoidant coping, but as mentioned previously, our mediation methods differ which could partially explain why our results are different. Further, discrepancies may also be explained by the conceptualization of avoidant coping between studies. Both studies (Dyson & Renk, 2006; Evans et al., 2015) measure avoidant coping as behavioural disengagement (i.e., quit trying, reducing efforts to reach goal), mental disengagement (i.e., sleep, watch TV) and denial. Although the coping scale used in our study also included strategies to avoid thinking about the stressor, some of our items reflected social activities/interactions such as going out for a meal, calling a friend or visiting a friend. These

strategies are quite different and, in some cases, might have a positive impact in the short-term which is possibly why we observed no association with depressive symptoms.

## **6.2 Strengths and Limitations**

Compared to traditional mediation methods, the four-way decomposition method allows for simultaneous analysis of mediation and moderation. This method permits decomposition of the total effect of an association into portions attributable to each of mediation, moderation or both which allows for better understanding of the association as a whole. Based on this analytical method, we were able to assess which proportions of mediation or moderation by coping style were more important in the association between stressful life events and depressive symptoms. However, the causal inference method relies on the no unmeasured confounding assumption for associations among stressful life events, coping style and depressive symptoms. In order to limit any confounding as much as possible, DAGs for each association (stressful and depressive symptoms; stressful life events and coping style; coping style and depressive symptoms) were created based on a review of the literature and are presented in Appendix D.

The time frame for measuring our main variables permitted a longitudinal analysis even though data on the study variables were collected at one point in time. Also, since our data were drawn from a longitudinal study, our potential confounders were measured before exposure, mediator and outcome. This temporality is important since causal associations are assumed among the variables. However, our results should be interpreted with caution given that depressive symptoms measured in the last two weeks does not assume onset of depressive symptoms.

Given that data were measured using self-report questionnaires, stressful life events might be subject to misclassification since long recall periods can lead to underreporting of stressful life events. Also, as mentioned in Chapter 4, the absence of the “no” checkbox in the stressful life events question lacked clarity for some participants. To correct for any confusion related to this question, we carefully considered responses given by participants as detailed in Appendix B and recoded them in the database as accurately as possible.

Since data were drawn from a longitudinal study, selection bias may have occurred if loss to follow-up was associated with the exposure and the outcome. In this case, bias may have arisen if participants lost to follow-up were more likely to experience stressful life events and depressive symptoms than participants remaining in the study. Thus, this could have resulted in underestimation of the association between stressful life events and depressive symptoms. Also, some participants were excluded from the analytical sample because of missing data on covariates, which may have induced selection bias if included and excluded participants differed on our variables of interest. However, t-tests indicated no significant differences between participants retained and not retained for analysis in terms of stressful life events, coping styles or depressive symptoms scores which makes selection bias less likely.

Since participants were recruited from schools using purposive sampling, this may limit generalizability of our results to other populations. The majority of our sample were Canada-born (93%) and white (79%) and thus our results may not generalize to other cultures that may experience different stressful life events and cope differently.

### **6.3 Implications**

Our results indicate that young adults using problem-focused coping more frequently are less likely to experience depressive symptoms when exposed to stressful life events. Thus, problem-focused coping can be viewed as a potential protective factor for depressive symptoms. This suggests that preventive interventions for depressive symptoms should focus on reinforcing problem-focused coping strategies in young adults. Also, given that problem-focused coping seems more stable in young adults, intervening in childhood or in adolescence may have a greater impact since coping style is still developing during this period in the life course. Thus, school-based interventions should consider teaching problem-focused coping strategies in youth. Moreover, stressful life events increased the use of emotion-focused coping indicating that interventions should focus on discouraging emotion-focused coping strategies such as self-blame, becoming upset or focusing on one's general inadequacies when facing stressful life events. Since some individuals may use emotion-focused coping more often to deal with stressful life events, this sub-population could benefit from learning positive coping strategies.

Overall, implementing school-based interventions may be an effective approach to teach children and adolescents positive coping strategies since a considerable amount of time is spent at school where social interactions with teachers and peers are important in shaping youth development (Paulus, Ohmann, & Popow, 2016). Given that coping strategies are developing during childhood and adolescence, elementary and high schools should consider implementing workshops in which teachers or school counsellors discuss with students about effective ways to deal with stressful life events. By promoting problem-focused coping strategies (i.e., planning, taking control, seeking information or support) and discussing less effective strategies (i.e., self-blame), students may be equipped with better tools for dealing with stressful life events which can prevent depressive symptoms in young adulthood. Because the way parents cope with stressful situations and their parenting style influence coping styles in their children (Skinner & Zimmer-Gembeck, 2007; Undheim & Sund, 2017), these workshops could be extended to the home setting through assignments involving parent-child interactions.

Furthermore, the COVID-19 pandemic is a stressful situation that has given rise to many stressful life events (ex: unemployment, financial problems, parenting challenges and death/illness of family members and friends) which has challenged individuals' coping strategies. Given the current pandemic context, public health authorities should consider outlining guidelines including positive coping strategies pertaining to COVID-related stressful situations such as encouraging individuals to seek support.

## **6.4 Future Directions**

Based on our findings, avoidant coping did not seem to be an important factor in the stressful life events – depressive symptoms association in young adults. Given studies supporting an association between avoidant coping and depressive symptoms (Evans et al., 2015; Seiffge-Krenke & Klessinger, 2000), more research is needed to understand the pathway in which avoidant coping is involved in young adults. More importantly, since conceptualization of avoidant coping differs across studies, future research should take this into consideration to improve understanding of this coping style in the association between stressful life events and depressive symptoms.

Future research should also consider exploring other factors contributing to the associations among stressful life events, coping styles and depressive symptoms. For example, differences in coping styles exist across ethnic groups (African American and White young adults) (Van Gundy, Howerton-Orcutt, & Mills, 2015) suggesting that cultural factors may underpin the development of coping styles. Also, family social support moderates the association between problem-focused and avoidant coping styles and depressive symptoms while a higher socioeconomic status is associated with problem-focused coping only (Romero et al., 2015; Undheim & Sund, 2017). These factors suggest a potential role of the family environment, and thus investigating them in depth could usefully inform public health authorities intervention.

Also, although cumulative stressful life event scores are associated with health outcomes (S. M. Cohen, MLM. Prather AA., 2019), they cannot distinguish events that are more stressful than others. Since certain stressful life events may be more stressful depending on the individual and the context, future studies should replicate these results using interview-based stressful life events measures. These measures could better capture whether the role of coping style differs in the stressful life events – depressive symptoms association if stressful life events are controllable/uncontrollable or severe/non-severe.

Lastly, to improve understanding on how coping styles develop and evolve, future research should consider a longitudinal study following coping styles that are adopted when encountering stressful life events from adolescence to young adulthood. This could provide insight on the flexibility or stability of coping styles over time and inform optimal timing for intervention.

## Chapter 7 – Conclusion

This thesis clarifies the role of coping styles in the association between stressful life events and depressive symptoms in young adults by assessing the mediating and/or moderating effect of coping style. More specifically, three natural effect mediation models were presented to assess the direct and indirect effects of problem-focused, emotion-focused and avoidant coping styles in the stressful life events – depressive symptoms association. These models suggested that mediation was only present in the emotion-focused coping model. Further, to disentangle the role of mediation and moderation, these direct and indirect effects were decomposed using the four-way decomposition approach by VanderWeele. Portions of the total effect attributable to moderation only, to mediation only, to both mediation and moderation and due to neither mediation nor moderation were presented for each coping style. Results from this analytical approach indicated that problem-focused coping was a moderator, emotion-focused coping was both a mediator and a moderator and avoidant coping was neither. These results support that each coping style has a differential effect on the stressful life events – depressive symptoms association and that moderation by coping style has a more substantial role in this association than mediation.

Individuals using more problem-focused coping experience fewer depressive symptoms, and those using a more emotion-focused coping style experience more depressive symptoms. Based on these findings, preventive interventions for depressive symptoms in young adults should consider reinforcing positive coping styles such as problem-focused coping. Since coping styles begin developing in childhood and diversify in adolescence, youth could also benefit from learning adaptive coping strategies at an early stage in the life course.



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# Appendices

## Appendix A: Major Depression Inventory Scale

Reference: Bech, P., Timmerby, N., Martiny, K., Lunde, M., & Soendergaard, S. (2015). Psychometric evaluation of the Major Depression Inventory (MDI) as depression severity scale using the LEAD (Longitudinal Expert Assessment of All Data) as index of validity. BMC Psychiatry, 15, 190. doi:10.1186/s12888-015-0529-3

### 84. In the past two weeks, how much of the time have you...?

	At no time	Some of the time	Slightly less than half of the time	Slightly more than half of the time	Most of the time	All the time
Felt low in spirits or sad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lost interest in, or could no longer enjoy your daily activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Felt lacking in energy and strength	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Felt less self-confident	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Had a bad conscience or feelings of guilt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Felt that life wasn't worth living	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Had difficulty concentrating (when reading the newspaper or watching TV)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Felt very restless	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Felt subdued or slowed down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Had trouble sleeping at night or waking up too early	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Suffered from reduced appetite	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Suffered from increased appetite	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note: For sub-items 8a “Felt very restless” and 8b “Felt subdued or slowed down” and for sub-items 10a “Suffered from reduced appetite” and 10b “Suffered from increased appetite”, the highest score between a and b was retained for scoring

## Appendix B: Recoding Stressful Life Events Question in Cycle 22

Stressful life events in cycle 22 were measured using two questions; (1) Did you experience any of the following in the past 12 months? and (2) If yes, how stressed were you by the experience? The absence of the “no” checkbox in the stressful life events question caused some confusion among participants. Some participants did not check off “yes”, but still reported a positive stress response. Various patterns of responses were observed in the database due to this confusion and were recorded in detail. The following table presents these issues and the modifications done to address them. In total, this question was recoded in the database for 163 out of 782 (21%) participants retained for analysis.

Table A1. Detailed information about the issues and modifications related to the stressful life events question in cycle 22, NDIT  
2011–2012

Issue	Number of cases	Participants PIN		Modification proposed
Participants did not check off “yes” for any event (i.e., coded as “no” in the database), but still answered the following question as “not at all” stressed for all events.	15	200003 260008 310003 430008 460008 500010 550005 740001	780002 1210003 1410008 1590001 1600006 1840004 1910004	The yes/no question was kept as “1 = no” and the question on stress experienced was modified from “1 = not at all” to “NA”.
Participants did not check off “yes (i.e., coded as “no” for the event in the database) and answered “not at all” stressed only for the first or second event, but correctly filled out the rest of the event checklist.	8	10001 100008 230007 710009	1130007 1360008 1630001 2590010	The yes/no question was kept as “1 = no” for the event and the question on stress experienced was modified from “1 = not at all” to “NA”.
Participants did not check off “yes (i.e., coded as “no” for the event in the database) and answered “not at all”	15	130005 490008 500001	780010 1450006 1570010	The yes/no question was kept as “1 = no” for the event and the question on stress

stressed for the first few events, but correctly filled out the rest of the event checklist.		560010 660006 690009 770008 780006	1640007 1650009 2180007 2490010	experienced was modified from "1 = not at all" to "NA".	
Participants checked off "yes" when they experienced the event and for most or all events in which they did not check off "yes" they checked off "not at all" stressed.	29	120004 190006 380007 420003 490009 570006 600009 650010 720005 790002	800010 910007 950003 950007 1100006 1320010 1380007 1460007 1470006 1500006	1520010 1530009 1610004 1690008 1730010 1840009 2130006 2570009 2600004	The yes/no question was kept as "1 = no" for the event and the question on stress experienced was modified from "1 = not at all" to "NA".
Participants did not check off "yes" for any event (i.e., coded as "no" in the database), but still answered the following question as "1 = not at all", "2 = a little", "3 = somewhat" or "4 = a lot".	33	30007 60008 230004 350006 480004 610006 660004 720003 810003 900008 950006	1010009 1050010 1080004 1200004 1330005 1330008 1340007 1390007 1440008 1490004 1510004	1850001 1890001 1930001 2030010 2070004 2220010 2310009 2460007 2590004 90490051 90820091	If they gave a positive answer for stress such as "2 = little", "3 = somewhat" or "4 = a lot", the first question was modified to "2 = yes" for the event and the answer for stress experienced was kept as is.  If participants checked "not at all" stressed, then the previous question was kept as "1 = no" and stress experienced was modified to "NA".
Participants did not check off "yes" for one or more events (i.e., coded as "no" for that event in the database) in which a positive answer for stress was given for that particular event.	40	20007 60003 100002 110010 320010	900003 940003 1020003 1030001 1070001	1390005 1430002 1470004 1810009 1910007	For events in which participants gave a positive response for stress such as "2 = a little", "3 = somewhat" or "4 = a lot", the yes/no question was modified from "1 = no"

However, the other events in the checklist were filled out correctly.		370002 420007 470002 480006 490010 510010 580005 680010 870003	1090001 1110009 1240001 1290002 1310007 1360009 1360010 1380010	2000006 2050010 2160001 2220007 2200009 2350006 2850007 3040010	to "2 = yes" and stress experienced was kept as is.
Other (mixed responses – more than one of the above issues)	23	190010 200010 270006 480007 730003 730005 790006 800001	870005 1110006 1210002 1230007 1340010 1530007 1700004 1940007	2150004 2150006 2180010 2250007 2510010 2650007 3090010	See above modifications proposed

## Appendix C: Coping Inventory for Stressful Situations

Reference: Endler, N. S., & Parker, J. D. A. (1990). *Coping inventory for stressful situations (CISS) : manual*. Toronto: Multi-Health Systems.

**110. People react to difficult, stressful, or upsetting situations in different ways. How often do you do each of the following when you experience such a situation?**

	Never	Rarely	Some-times	Often	Very Often
Focus on the problem and see how I can solve it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blame myself for having gotten into this situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Treat myself to a favorite food or snack	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Think about how I have solved similar problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Feel anxious about not being able to cope	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Go out for a snack or meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Determine a course of action and follow it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blame myself for being too emotional about the situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Buy myself something	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Work to understand the situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Become very upset	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visit a friend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Take corrective action immediately	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blame myself for not knowing what to do	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spend time with a special person	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Think about the event and learn from my mistakes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wish that I could change what has happened or how I felt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Phone a friend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Analyze the problem before reacting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Focus on my general inadequacies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Take time off and get away from the situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Appendix D: Directed Acyclic Graphs representing potential confounders

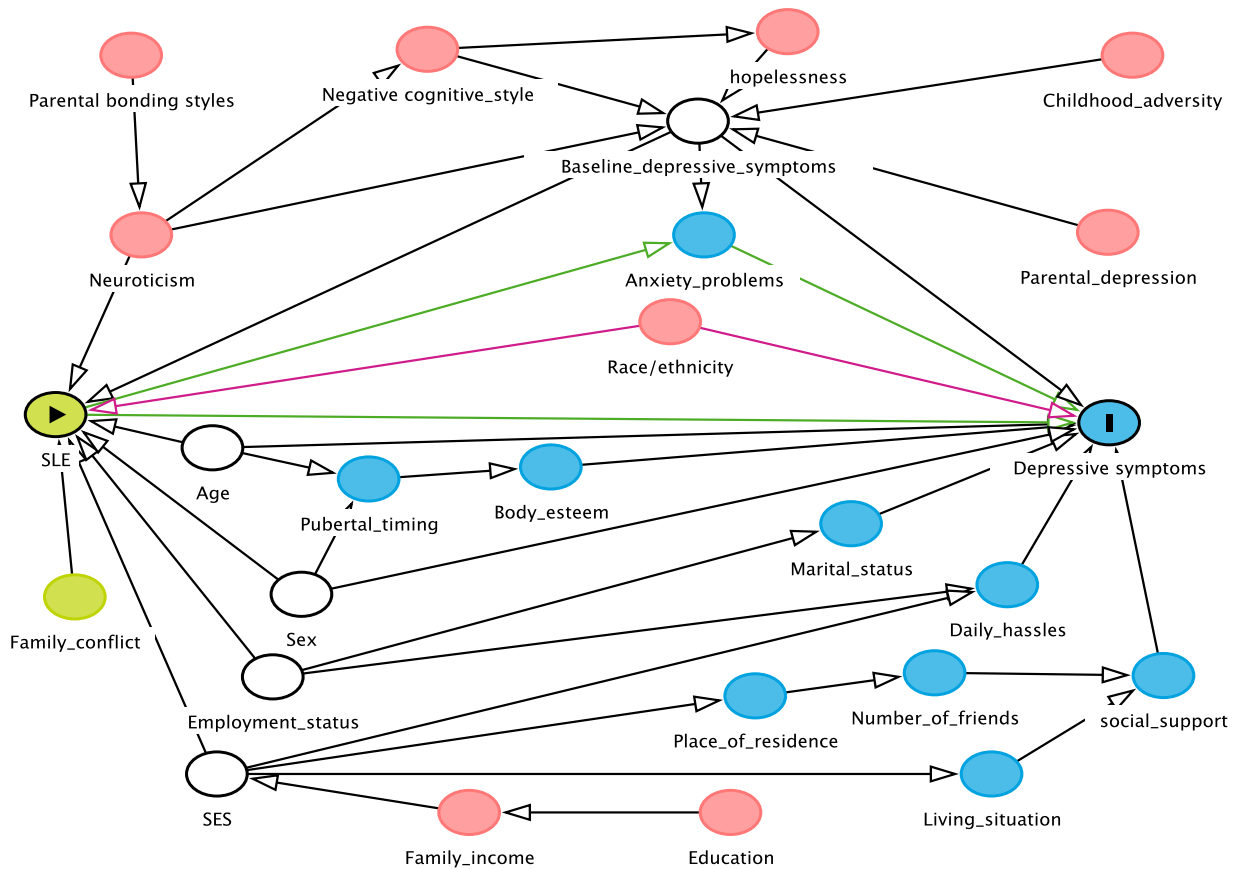


Figure 6. Directed Acyclic Graph (DAG) of the association between stressful life events and depressive symptoms

Green: exposure or ancestor of exposure; Blue: outcome or ancestor of outcome; Pink: ancestors of both exposure and outcome (confounder); white: adjusted variable.

Note: A directed acyclic graph (DAG) was modeled to analyse causal assumptions between stressful life events and depressive symptoms using the online software DAGitty (Textor, Hardt, & Knüppel, 2011). This causal diagram helped identify confounding variables to control for the association between stressful life events and depressive symptoms. Variables included in the diagram were identified by searching the literature for articles studying the association between stressful life events and depressive symptoms/depression. Thus, variables associated with stressful life events and/or with depressive symptoms and variables controlled for in those studies were included in the DAG. The direction of arrows were also based on the literature.

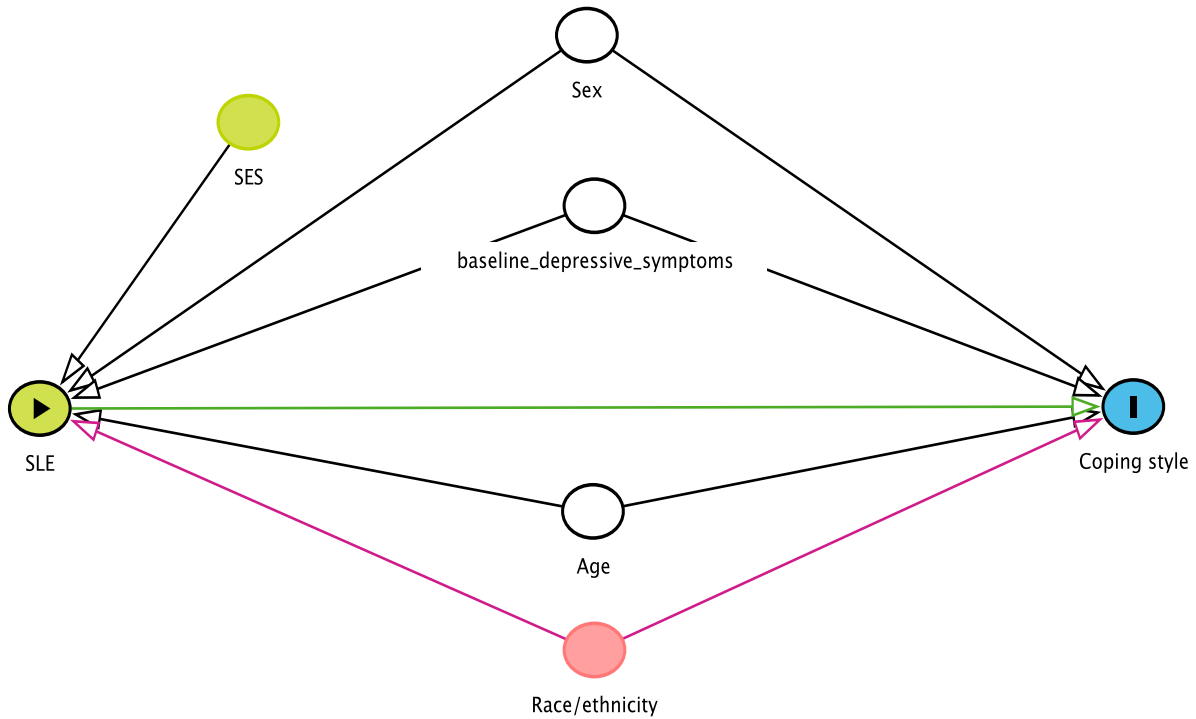


Figure 7. Directed Acyclic Graph (DAG) of the association between stressful life events and coping styles

Green: exposure or ancestor of exposure; Blue: outcome or ancestor of outcome; Pink: ancestors of both exposure and outcome (confounder); white: adjusted variable

Note: A directed acyclic graph (DAG) was modeled to analyse causal assumptions between stressful life events and coping styles using the online software DAGitty (Textor et al., 2011). This causal diagram helped identify confounding variables to control for the association between stressful life events and coping styles. Variables included in the diagram were identified by searching the literature for articles studying the association between stressful life events and coping styles. Thus, variables associated with stressful life events and/or with coping styles and variables controlled for in those studies were included in the DAG. The direction of arrows were also based on the literature.

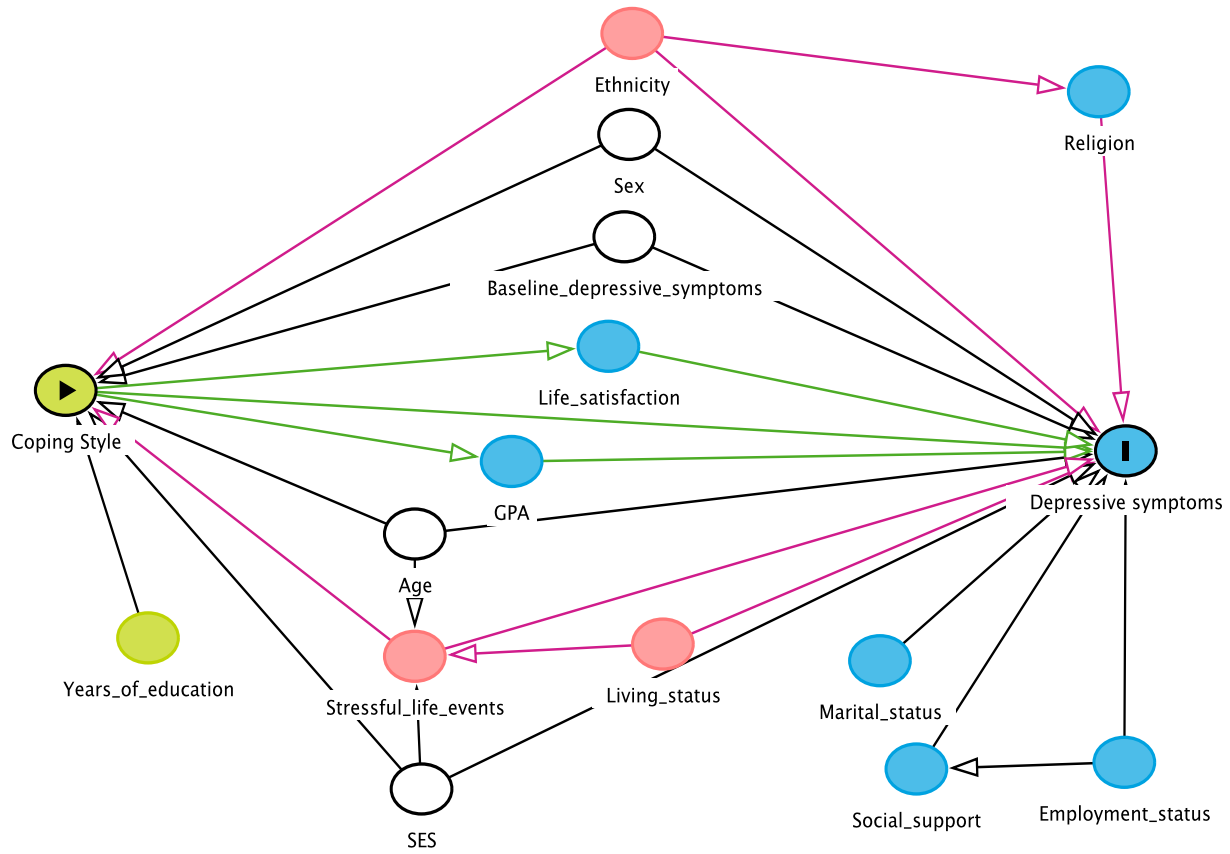


Figure 8. Directed Acyclic Graph (DAG) of the association between coping style and depressive symptoms

Green: exposure or ancestor of exposure; Blue: outcome or ancestor of outcome; Pink: ancestors of both exposure and outcome (confounder); white: adjusted variable

Note: A directed acyclic graph (DAG) was modeled to analyse causal assumptions between coping style and depressive symptoms using the online software DAGitty (Textor et al., 2011). This causal diagram helped identify confounding variables to control for the association between coping style and depressive symptoms. Variables included in the diagram were identified by searching the literature for articles studying the association between coping style and depressive symptoms/depression. Thus, variables associated with coping style and/or with depressive symptoms and variables controlled for in those studies were included in the DAG. The direction of arrows were also based on the literature.

## Appendix E: R Code for Analyses

Linear regression models

Regression model 1 : Stressful life events → MDI22

```
# regression model (adjusted for covariates)
lm(MDI22~SLE_score_22+AGE_FINAL_22+sex.factor+education.factor2+MDI21, data =
Drop_missing.data) %>% summary()

lm(MDI22~SLE_score_22+AGE_FINAL_22+sex.factor+education.factor2+MDI21, data =
Drop_missing.data) %>% confint()
```

Regression model 2: Stressful life events → Problem-focused coping

```
# regression model (adjusted for covariates)
lm(Problem_focused_mean_score~SLE_score_22+AGE_FINAL_22+Sex+education+MDI21,
data = Drop_missing.data) %>% summary()

lm(Problem_focused_mean_score~SLE_score_22+AGE_FINAL_22+Sex+education+MDI21,
data = Drop_missing.data) %>% confint()
```

Regression model 3: Stressful life events → Emotion-focused coping

```
# regression model (adjusted for covariates)
lm(Emotion_focused_mean_score~SLE_score_22+AGE_FINAL_22+Sex+education+MDI21,
data = Drop_missing.data) %>% summary()

lm(Emotion_focused_mean_score~SLE_score_22+AGE_FINAL_22+Sex+education+MDI21,
data = Drop_missing.data) %>% confint()
```

Regression model 4: Stressful life events → Avoidant coping

```
# regression model (adjusted for covariates)
lm(Avoidant_mean_score~SLE_score_22+AGE_FINAL_22+Sex+education+MDI21, data =
Drop_missing.data) %>% summary()

lm(Avoidant_mean_score~SLE_score_22+AGE_FINAL_22+Sex+education+MDI21, data =
Drop_missing.data) %>% confint()
```

Regression model 5: Coping styles → MDI22

```
# regression model (adjusted for covariates)
lm(MDI22~Problem_focused_mean_score+Emotion_focused_mean_score+Avoidant_mean_
score+AGE_FINAL_22+sex.factor+education.factor2+MDI21, data = Drop_missing.da
ta) %>% summary()

lm(MDI22~Problem_focused_mean_score+Emotion_focused_mean_score+Avoidant_mean_
score+AGE_FINAL_22+sex.factor+education.factor2+MDI21, data = Drop_missing.da
ta) %>% confint()
```

## Mediation analyses

### Mediation model 1 - mediator: Problem-focused coping

```
# adjusted for covariates
expData10 <- neImpute(MDI22 ~ SLE_score_22 * Problem_focused_mean_score + AGE_FINAL_22 + Sex + education + MDI21, data = Drop_missing.data)

neMod10 <- neModel(MDI22 ~ SLE_score_220 * SLE_score_221 + AGE_FINAL_22 + Sex + education + MDI21, expData = expData10, se = "robust")

summary(neMod10)
confint(neMod10)

neEffdecomp(neMod10) %>% summary()
neEffdecomp(neMod10) %>% confint()

# adjusted including other coping styles - sensitivity analysis
expData7 <- neImpute(MDI22 ~ SLE_score_22 * Problem_focused_mean_score + Emotion_focused_mean_score + Avoidant_mean_score + AGE_FINAL_22 + Sex + education + MDI21, data = Drop_missing.data)

neMod7 <- neModel(MDI22 ~ SLE_score_220 * SLE_score_221 + Emotion_focused_mean_score + Avoidant_mean_score + AGE_FINAL_22 + Sex + education + MDI21, expData = expData7, se = "robust")

summary(neMod7)
confint(neMod7)

neEffdecomp(neMod7) %>% summary()
neEffdecomp(neMod7) %>% confint()
```

### Mediation model 2 - mediator: Emotion-focused coping

```
# adjusted for covariates
expData11 <- neImpute(MDI22 ~ SLE_score_22 * Emotion_focused_mean_score + AGE_FINAL_22 + Sex + education + MDI21, data = Drop_missing.data)

neMod11 <- neModel(MDI22 ~ SLE_score_220 * SLE_score_221 + AGE_FINAL_22 + Sex + education + MDI21, expData = expData11, se = "robust")

summary(neMod11)
confint(neMod11)

neEffdecomp(neMod11) %>% summary()
neEffdecomp(neMod11) %>% confint()

# adjusted including other coping styles - sensitivity analysis
expData8 <- neImpute(MDI22 ~ SLE_score_22 * Emotion_focused_mean_score + Problem_focused_mean_score + Avoidant_mean_score + AGE_FINAL_22 + Sex + education + MDI21, data = Drop_missing.data)
```

```

neMod8 <- neModel(MDI22 ~ SLE_score_220 * SLE_score_221 + Problem_focused_mean_score + Avoidant_mean_score + AGE_FINAL_22 + Sex + education + MDI21, expData = expData8, se = "robust")

summary(neMod8)
confint(neMod8)

neEffdecomp(neMod8) %>% summary()
neEffdecomp(neMod8) %>% confint()

```

Mediation model 3 - mediator: Avoidant coping

```

# adjusted for covariates
expData12 <- neImpute(MDI22 ~ SLE_score_22 * Avoidant_mean_score + AGE_FINAL_22 + Sex + education + MDI21, data = Drop_missing.data)

neMod12 <- neModel(MDI22 ~ SLE_score_220 * SLE_score_221 + AGE_FINAL_22 + Sex + education + MDI21, expData = expData12, se = "robust")

summary(neMod12)
confint(neMod12)

neEffdecomp(neMod12) %>% summary()
neEffdecomp(neMod12) %>% confint()

# adjusted including other coping styles - sensitivity analysis
expData9 <- neImpute(MDI22 ~ SLE_score_22 * Avoidant_mean_score + Problem_focused_mean_score + Emotion_focused_mean_score + AGE_FINAL_22 + Sex + education + MDI21, data = Drop_missing.data)

neMod9 <- neModel(MDI22 ~ SLE_score_220 * SLE_score_221 + Problem_focused_mean_score + Emotion_focused_mean_score + AGE_FINAL_22 + Sex + education + MDI21, expData = expData9, se = "robust")

summary(neMod9)
confint(neMod9)

neEffdecomp(neMod9) %>% summary()
neEffdecomp(neMod9) %>% confint()

```

Four-way decomposition

```

load("~/Documents/1.Thesis/2.Methods/3.NDIT database/R studio_database_Annie/.RData")

Drop_missing_numerique<-Drop_missing.data
save(Drop_missing_numerique, file="~/Documents/1.Thesis/2.Methods/3.NDIT database/R studio_database_Annie/Drop_missing_numerique.rda")

```

```

# Change factors into numeric variables
Drop_missing.data$Sex<-as.numeric(Drop_missing.data$Sex)
Drop_missing.data$education<-as.numeric(Drop_missing.data$education)

# Load Libraries
library(boot)
library(survival)
library(data.table)
library(foreign)
library(dummies)
library(GenABEL)
library(dummies)

# Sources import here - this script should be run from the same folder where
src.R is
source('src.R')

# Data pathway
load("~/Documents/1.Thesis/2.Methods/3.NDIT database/R studio_database_Annie/
Drop_missing_numerique.rda")
Drop_missing.data<-Drop_missing_numerique

```

Mediator: Problem-focused coping

```

# Path to save results
output<- '~/Documents/1.Thesis/2.Methods/3.NDIT database/R studio_database_Annie/Results_Problem_focused_coping.csv'

# Vanderweele decomposition code
#Define variables
A<<- 'SLE_score_22'
M<<- 'Problem_focused_mean_score'
Y<<- 'MDI22'
COVAR<<-c('AGE_FINAL_22', 'Sex', 'education', 'MDI21')

#1=binary 0=continuous
outcome=0
mediator=0

# Reading data file
data <- Drop_missing.data[,c(A,M, Y, COVAR)]

table(data$education); data$education <- as.numeric(data$education )-1; table
(data$education);

#Assign levels for the exposure that are being compared;
#for mstar it is the level at which to compute the CDE and the remainder of t
he decomposition
a<<-1
astar<<-0

```

```

mstar<<-0

#Bootstrap number of iterations
N_r=5

if (! prod(c(A,Y,M,COVAR) %in% names(data) ) ) {stop('Some of defined variable names are not in data file!')}

if ( mediator==1 & outcome==1 ) { save_results(output=output, boot_function=boot.bMbO, N=N_r) }
if ( mediator==0 & outcome==1 ) { save_results(output=output, boot_function=boot.cMbO, N=N_r) }
if ( mediator==1 & outcome==0 ) { save_results(output=output, boot_function=boot.bMcO, N=N_r) }
if ( mediator==0 & outcome==0 ) { save_results(output=output, boot_function=boot.cMcO, N=N_r) }

```

Mediator: Emotion-focused coping

```

# Path to save results
output<-'~/Documents/1.Thesis/2.Methods/3.NDIT database/R studio_database_Annie/Results_Emotion_focused_coping.csv'

```

```

# Vanderweele decomposition code
A<<-'SLE_score_22'
M<<-'Emotion_focused_mean_score'
Y<<-'MDI22'
COVAR<<-c('AGE_FINAL_22','Sex','education','MDI21')

outcome=0
mediator=0

a<<-1
astar<<-0
mstar<<-0

N_r=5

data <- Drop_missing.data[,c(A,M, Y, COVAR)]

table(data$education); data$education <- as.numeric(data$education )-1; table(data$education);

if (! prod(c(A,Y,M,COVAR) %in% names(data) ) ) {stop('Some of defined variable names are not in data file!')}

if ( mediator==1 & outcome==1 ) { save_results(output=output, boot_function=boot.bMbO, N=N_r) }
if ( mediator==0 & outcome==1 ) { save_results(output=output, boot_function=boot.cMbO, N=N_r) }

```

```

if ( mediator==1 & outcome==0 ) { save_results(output=output, boot_function=
boot.bMcO, N=N_r) }
if ( mediator==0 & outcome==0 ) { save_results(output=output, boot_function=
boot.cMcO, N=N_r) }

```

Mediator: Avoidant coping

*# Path to save results*

```

output<- '~/Documents/1.Thesis/2.Methods/3.NDIT database/R
studio_database_Annie/Results_Avoidant_coping.csv'

```

*# Vanderweele decomposition code*

```

A<<- 'SLE_score_22'
M<<- 'Avoidant_mean_score'
Y<<- 'MDI22'
COVAR<<-c('AGE_FINAL_22', 'Sex', 'education', 'MDI21')

```

```

outcome=0
mediator=0

```

```

a<<-1
astar<<-0
mstar<<-0

```

```

N_r=5

```

```

data <- Drop_missing.data[,c(A,M, Y, COVAR)]
table(data$education); data$education <- as.numeric(data$education )-1; table
(data$education);

```

```

if (! prod(c(A,Y,M,COVAR) %in% names(data) ) ) {stop('Some of defined variab
le names are not in data file!')}

```

```

if ( mediator==1 & outcome==1 ) { save_results(output=output, boot_function=
boot.bMbO, N=N_r) }
if ( mediator==0 & outcome==1 ) { save_results(output=output, boot_function=
boot.cMbO, N=N_r) }
if ( mediator==1 & outcome==0 ) { save_results(output=output, boot_function=
boot.bMcO, N=N_r) }
if ( mediator==0 & outcome==0 ) { save_results(output=output, boot_function=
boot.cMcO, N=N_r) }

```

## Appendix F: Sensitivity Analyses Results

Table A2. Comparing beta coefficients adjusted or not for coping styles and 95% confidence intervals for the natural direct, natural indirect and total effects of each potential mediator of the stressful life events – depressive symptoms association, NDIT Study 2011–2012.

	Potential mediator					
	Problem-focused coping		Emotion-focused coping		Avoidant coping	
	Unadjusted for coping $\beta$ (95% CI)*	Adjusted for coping $\beta$ (95% CI)* <sup>a</sup>	Unadjusted for coping $\beta$ (95% CI)*	Adjusted for coping $\beta$ (95% CI)* <sup>b</sup>	Unadjusted for coping $\beta$ (95% CI)*	Adjusted for coping $\beta$ (95% CI)* <sup>c</sup>
NDE	<b>0.74</b> <b>(0.50, 0.97)</b>	<b>0.49</b> <b>(0.28, 0.70)</b>	<b>0.26</b> <b>(0.06, 0.46)</b>	<b>0.27</b> <b>(0.07, 0.47)</b>	<b>0.63</b> <b>(0.34, 0.92)</b>	<b>0.45</b> <b>(0.20, 0.70)</b>
NIE	0.00 (-0.02, 0.02)	0.01 (-0.02, 0.03)	<b>0.14</b> <b>(0.03, 0.25)</b>	0.05 (-0.05, 0.14)	0.05 (-0.01, 0.11)	-0.03 (-0.08, 0.02)
TE	<b>0.74</b> <b>(0.50, 0.97)</b>	<b>0.50</b> <b>(0.29, 0.71)</b>	<b>0.40</b> <b>(0.18, 0.62)</b>	<b>0.32</b> <b>(0.09, 0.54)</b>	<b>0.68</b> <b>(0.38, 0.98)</b>	<b>0.42</b> <b>(0.16, 0.69)</b>

\*Adjusted for age, sex, participant education, depressive symptoms (cycle 21).

<sup>a</sup> Adjusted for emotion-focused and avoidant coping styles

<sup>b</sup> Adjusted for problem-focused and avoidant coping styles

<sup>c</sup> Adjusted for problem-focused and emotion-focused coping styles

NDE: Natural Direct Effect, NIE: Natural Indirect Effect, TE: Total Effect, CI: Confidence Interval

Bold indicates confidence intervals that do not include the null

Table A3. Comparing beta coefficients adjusted or not for coping styles and 95% confidence intervals for the four-way decomposition of each potential mediator of the stressful life events – depressive symptoms association, NDI Study 2011–2012.

	Potential mediator					
	Problem-focused coping		Emotion-focused coping		Avoidant coping	
	Unadjusted for coping $\beta$ (95% CI)	Adjusted for coping $\beta$ (95% CI) <sup>*a</sup>	Unadjusted for coping $\beta$ (95% CI)	Adjusted for coping $\beta$ (95% CI) <sup>*b</sup>	Unadjusted for coping $\beta$ (95% CI)	Adjusted for coping $\beta$ (95% CI) <sup>*c</sup>
CDE	<b>2.26</b> <b>(1.78, 3.02)</b>	<b>1.62</b> <b>(1.39, 2.16)</b>	<b>-0.83</b> <b>(-1.27, -0.74)</b>	<b>-0.74</b> <b>(-1.24, -0.64)</b>	<b>0.40</b> <b>(0.01, 0.89)</b>	0.27 (-0.24, 0.44)
INT <sub>ref</sub>	<b>-1.51</b> <b>(-2.22, -1.06)</b>	<b>-1.13</b> <b>(-1.65, -0.85)</b>	<b>1.16</b> <b>(1.05, 1.68)</b>	<b>1.12</b> <b>(0.99, 1.69)</b>	0.23 (-0.12, 0.53)	<b>0.19</b> <b>(0.12, 0.64)</b>
INT <sub>med</sub>	0.00 (0.00, 0.01)	0.01 (0.00, 0.01)	<b>0.03</b> <b>(0.03, 0.04)</b>	<b>0.02</b> <b>(0.02, 0.03)</b>	0.01 (0.00, 0.02)	0.00 (0.00, 0.02)
PIE	0.00 (-0.01, 0.01)	0.00 (-0.01, 0.01)	<b>0.15</b> <b>(0.05, 0.17)</b>	<b>0.10</b> <b>(0.03, 0.12)</b>	0.05 (-0.03, 0.07)	<b>-0.03</b> <b>(-0.09, -0.02)</b>
TE	<b>0.75</b> <b>(0.72, 0.80)</b>	<b>0.51</b> <b>(0.50, 0.60)</b>	<b>0.52</b> <b>(0.42, 0.52)</b>	<b>0.51</b> <b>(0.45, 0.51)</b>	<b>0.69</b> <b>(0.53, 0.83)</b>	<b>0.44</b> <b>(0.33, 0.56)</b>

\*Adjusted for age, sex, participant education, depressive symptoms (cycle 21).

<sup>a</sup> Adjusted for emotion-focused and avoidant coping styles

<sup>b</sup> Adjusted for problem-focused and avoidant coping styles

<sup>c</sup> Adjusted for problem-focused and emotion-focused coping styles

CDE: Controlled direct effect, INT<sub>ref</sub>: Reference interaction, INT<sub>med</sub>: Mediated interaction, PIE: pure indirect effect, TE: Total Effect, CI: Confidence Interval

Bold indicates confidence intervals that do not include the null

## Appendix G: NDIT Ethics Approval



### CENTRE DE RECHERCHE

Comités d'évaluation scientifique et d'éthique de la recherche  
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Téléphone : 514 - 890-8000 - Poste 14485  
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Le 21 février 2007

Dr Jennifer O'Loughlin  
Épidémiologie  
A/S Mme Erika Dugas  
Édifice St-Urbain  
3875, rue Saint-Urbain - 1<sup>e</sup> étage  
Montréal (Québec) H2W 1T9

**Objet : ND06.o87 - Approbation finale CÉR**

L'étude de la dépendance à la nicotine

Docteur,

J'accuse réception, en date du 21 février 2007, de votre lettre ainsi que des documents suivants en vue de l'approbation finale de l'étude décrite en rubrique :

- Formulaire de consentement - Questionnaire - Version française - 8 février 2007
- Formulaire de consentement - Questionnaire - Version anglaise - 8 février 2007
- Formulaire de consentement - Échantillon d'ADN - Version française - 8 février 2007
- Formulaire de consentement - Échantillon d'ADN - Version anglaise - 8 février 2007

Le tout est jugé satisfaisant. Je vous retourne sous pli une copie de chacun des formulaires portant l'estampille d'approbation du comité. Seuls ces formulaires devront être utilisés pour signature par les sujets.

La présente constitue l'approbation finale, **valide pour un an à compter du 27 novembre 2006**, date de l'approbation initiale. Je vous rappelle que toute modification au protocole et/ou au formulaire de consentement en cours d'étude, doit être soumise pour approbation du comité d'éthique.

Le comité suit les règles de constitution et de fonctionnement de l'Énoncé de Politique des trois Conseils et des Bonnes pratiques cliniques de la CIH.

Vous souhaitant la meilleure des chances dans la poursuite de vos travaux, je vous prie d'accepter, Docteur, mes salutations distinguées.

Brigitte St-Pierre, conseillère en éthique  
Vice-présidente  
Comité d'éthique de la recherche  
Équipe Hôpital Notre-Dame du CHUM

BSTP/go

P. j. : Formulaires de consentement approuvés et estampillés

#### CENTRE HOSPITALIER DE L'UNIVERSITÉ DE MONTRÉAL

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McGill

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Fax/Télécopieur: (514) 398-3595

28 August 2006.

Dr. Jennifer O'Loughlin  
Department of Epidemiology & Biostatistics  
Purvis Hall  
1020 Pine Avenue West  
Montreal Quebec H3A 1A2

**RE: IRB Study Number A05-B21-06B**

Dear Dr. O'Loughlin,

Thank you for responding to the Initial Review Board's correspondence dated 31 May 2006 in reference to the study entitled, *Long-term follow-up of the Nicotine Dependence in Teens (NDIT) Cohort*. This study received full Board review on May 29, 2006.

The submitted revisions are acceptable and final ethics approval is provided on August 28, 2006 for the following:

- Study Protocol (IRB dated May 2006);
- Appendix 8: Consent form for Self-Administered Questionnaire dated May 2006;
- Revised Appendix 9: Consent form for DNA Sample Collection dated June 2006;
- Appendix 10: Data/DNA User's Manual;
- Appendix 12: Self-Administered Questionnaire (May 2006).

*Please ensure that an IRB acceptable French translation of the approved consent forms are available to subjects during the consent process.*

The ethics approval for this study is valid until **May 2007**. The Certificate of Ethical Acceptability is enclosed.

All research involving human subjects is required to undergo an annual review in accordance with the date of initial approval. It is the responsibility of the investigator to submit a completed application form for Continuing Review to the IRB prior to the date of expiration of ethics approval. A copy of the Continuing Review Form is available on the IRB website at: <http://www.medicine.mcgill.ca/research/irb/>.

Any modifications or unanticipated developments that may occur to the study prior to the annual review must be reported to the IRB promptly. Regulation does not permit the initiation of a study modification prior to IRB review and approval of the change.

Sincerely,

Serge Gauthier, MD  
Chair  
Institutional Review Board

Cc: A05-B21-06B

## Appendix H: Supplementary Material

The following tables are included as supplementary material in the manuscript.

Table A4. Description of variables included in analysis

Variable	Data collected in cycle(s)	Item(s)	Response choices	Recoded for analysis	Psychometric properties
Stressful life events	22	Did you experience any of the following in the past 12 months? (i) break-up of relationship or marriage, (ii) kicked out of school, (iii) serious car accident, (iv) pregnancy, (v) lost a job, (vi) major health problem, (vii) major and/or chronic financial problems, (viii) began college or university, (ix) sought psychological or psychiatric care, (x) established a new steady relationship with a partner, (xi) got married, (xii) problems at work (with boss or co-workers), (xiii) changed job, (xiv) problems with the law, (xv) death of a parent or other family member, (xvi) major argument with parents, (xvii) birth of a child, (xviii) a close relative or friend had a serious illness or injury, (xix) your spouse, parent, sibling or child died, (xx) another close relative died, (xxi) you had serious problems with a close friend, neighbor or relative, (xxii) you became much better off financially, (xxiii) other stressful event (specify)	no, yes	Each item was summed to form a cumulative life event score (range: 0-23)	Adapted from the List of Threatening Experiences (LTE) and from the Long-term Difficulties Inventory (LDI)  LTE: High test-retest reliability and satisfactory specificity (0.74) and sensitivity (0.89) for concurrent validity <sup>1</sup>  Reasonable stability of retrospective reporting based on a two-year interval of test-retest correlations for the LDI score ( $r = 0.7$ ) and for the LTE score ( $r = 0.6$ ) <sup>2</sup>  Construct validity for LTE and LDI based on positive associations with psychological distress and depression/anxiety <sup>2</sup>
Coping style	22	People react to difficult, stressful, or upsetting situations in different ways. How often do you do each of the following when you experience such a situation? (i) focus on the problem and see how I can solve it, (ii) blame myself for having gotten into this situation, (iii) treat myself to a favorite food or snack, (iv) think about how I have solved similar problems, (v) feel anxious about not being able to	never, rarely, sometimes, often, very often	Problem-focused coping included the following items: (i), (iv), (vii), (x), (xiii), (xvi), (xix)  Emotion-focused coping included the following items: (ii), (v), (viii), (xi), (xiv), (xvii), (xx)	Internal consistency – $\alpha = 0.90-0.92$ for problem-focused coping; $\alpha = 0.88-0.90$ for emotion-focused coping; $\alpha = 0.83-0.84$ for avoidant coping <sup>3,4</sup>

		cope, (vi) go out for a snack or meal, (vii) determine a course of action and follow it, (viii) blame myself for being too emotional about the situation, (ix) buy myself something, (x) work to understand the situation, (xi) become very upset, (xii) visit a friend, (xiii) take corrective action immediately, (xiv) blame myself for not knowing what to do, (xv) spend time with a special person, (xvi) think about the event and learn from my mistakes, (xvii) wish that I could change what has happened or how I felt, (xviii) phone a friend, (xix) analyze the problem before reacting, (xx) focus on my general inadequacies, (xxi) take time off and get away from the situation		Avoidant coping included the following items: (iii), (vi), (ix), (xii), (xv), (xviii), (xxi)  Responses to each item were summed and divided by the number of items responded to for each coping style subscale (range: 1.00-7.00)	
Depressive symptoms	21-22	In the past two weeks, how much of the time have you...? (i) felt low in spirits or sad, (ii) lost interest in, or could no longer enjoy your daily activities, (iii) felt lacking in energy and strength, (iv) felt less self-confident, (v) had a bad conscience or feelings of guilt, (vi) felt that life wasn't worth living, (vii) had difficulty concentrating (when reading the newspaper or watching TV), (viii) (a) felt very restless, (viii) (b) felt subdued or slowed down, (ix) had trouble sleeping at night or waking up too early, (x) (a) suffered from reduced appetite, (x) (b) suffered from increased appetite	at no time, some of the time, slightly less than half of the time, slightly more than half of the time, most of the time, all the time	Responses to each item were summed to create a continuous score (range: 0-50)	Sensitivity: 0.86-0.92. Specificity: 0.82-0.86 <sup>5</sup>
Age	1-23	Date of birth, Date of survey	-	-	-
Sex	1-20	Are you a boy or a girl?	Male, female	-	-
Participant education	21	How far have you gone in school?	attended high school, but did not graduate; graduated high school; attended CEGEP, community/technical college, but did not graduate; graduated CEGEP, community/technical college; attended university (or teacher's college), but did not graduate; graduated university with a Bachelor's degree;	Attended/graduated high school (attended high school, but did not graduate; graduated high school) and attended/graduated CEGEP/university (attended CEGEP, community/technical college, but did not graduate; graduated CEGEP, community/technical college; attended university or teacher's college, but did not graduate; graduated university with a Bachelor's	-

			graduated university with a Master's degree; graduated university with a PhD/professional degree; Other (specify)	degree; graduated university with a Master's degree; graduated university with a PhD/professional degree). "Other" was reassigned into one of the two categories	
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## References

1. Brugha TS, Cragg D. The List of Threatening Experiences: the reliability and validity of a brief life events questionnaire. *Acta Psychiatr Scand* 1990;82:77-81.
2. Rosmalen JG, Bos EH, de Jonge P. Validation of the Long-term Difficulties Inventory (LDI) and the List of Threatening Experiences (LTE) as measures of stress in epidemiological population-based cohort studies. *Psychol Med* 2012;42:2599-608.
3. Endler NS, Parker JDA. *Coping Inventory for Stressful Situations (CISS): Manual*. 2nd ed. Multi-Health Systems; 1994
4. Endler, N.S., & Parker, J.D.A. (1994). Assessment of multidimensional coping: Task, emotion, and avoidance strategies. *Psychological Assessment*, 6, 50– 60.
5. Bech P, Rasmussen NA, Olsen LR, Noerholm V, Abildgaard W. The sensitivity and specificity of the Major Depression Inventory, using the Present State Examination as the index of diagnostic validity. *J Affect Disord* 2001;66:159-64.

Table A5. Number of missing values of selected characteristics, NDIT Study 1999–2012

	n	%
Age at baseline	0	0
Sex	0	0
Mother's education	316	24.4
Participant's education	64	4.9
Country of birth	1	0.1
French-speaking	1	0.1
Stressful life events	437	33.8
Coping style	440	34.0
Depressive symptoms at age 20	416	32.1
Depressive symptoms at age 24	445	34.4

\*Note analysis were done on complete data only

## Appendix I: Additional Results – Regression Analysis

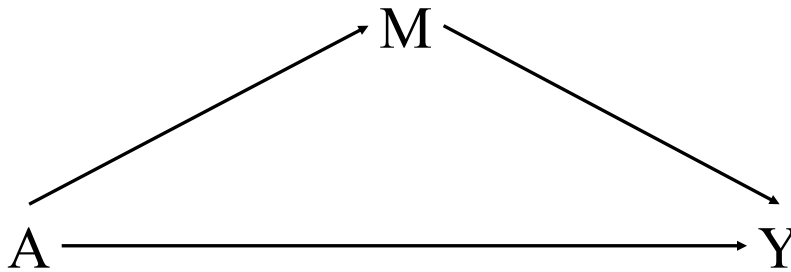


Table A6. Adjusted beta coefficients and 95% confidence intervals for the associations among stressful life events, coping styles and depressive symptoms, NDIT Study 2011–2012.

	$\beta^*$ (95% CI)
<b>A → Y</b>	
Model: SLE → Depressive symptoms	
Stressful life events	<b>0.75 (0.54, 0.97)</b>
<b>A → M</b>	
Model: SLE → Problem-focused coping	
Stressful life events	-0.01 (-0.04, 0.02)
Model: SLE → Emotion-focused coping	
Stressful life events	<b>0.06 (0.04, 0.09)</b>
Model: SLE → Avoidant coping	
Stressful life events	<b>0.08 (0.06, 0.10)</b>
<b>M → Y</b>	
Model: Problem-focused coping → Depressive symptoms	
Problem-focused coping	<b>-1.24 (-1.77, -0.70)</b>
Model: Emotion-focused coping → Depressive symptoms	
Emotion-focused coping	<b>4.26 (3.67, 4.84)</b>
Model: Avoidant coping → Depressive symptoms	
Avoidant coping	0.09 (-0.51, 0.69)

\*Adjusted for age, sex, participant education, depressive symptoms (cycle 21)

CI: Confidence Interval

Bold indicates confidence intervals that do not include the null