Matters of the Heart: The Dyadic Effects of Psychological Resilience and Coping on Psychological Distress and Relationship Satisfaction Among Couples Undergoing Open Heart Surgery

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Abstract
Cardiac surgeries are among the most commonly performed surgical interventions worldwide. Despite goals of improved survival and enhanced quality of life, the process of undergoing cardiac surgery is physically and psychologically demanding. Elevated levels of psychological distress and relationship strain have been documented in both cardiac surgery patients and their spouses prior to undergoing cardiac surgery. Psychological resilience is a well-established protective factor for individuals facing adversity. Yet, research on resilience in the context of dyads, as well as research that investigates how and why psychological resilience helps individuals and couples adapt to stressful situations is scarce. The overarching goal of the current research was to investigate the extent to which psychological resilience is related to emotional and relationship outcomes in patients scheduled for open heart surgery and their spouses. A sample of 71 patient-spouse dyads were recruited and each participant completed a battery of standardized psychosocial questionnaires. Using actor-partner interdependence models, actor effects emerged, suggesting that resilience may serve as a protective factor against psychological distress and relationship strain among patients as well as their spouses. Partner effects were also identified, suggesting that patient resilience may have implications for spouse levels of relationship satisfaction. A secondary goal of the current research was to assess the extent to which resilience influences outcomes through ways of adaptive coping (i.e., collaboratively coping to manage stress) and maladaptive coping (i.e., catastrophizing pain). Using actor-partner interdependence mediation models it was found that the extent to which couples collaborated to manage stressors together mediated the relationship between their own resilience and their own sense of relationship satisfaction. As well, a partner effect emerged whereby greater psychological resilience in the patient was associated with greater relationship
satisfaction in the spouse via higher levels of the spouse’s common dyadic coping. Additionally, psychological resilience was related to lower psychological distress for both patients and their spouses, and this was explained in part by the fact that they engaged in lower levels of pain catastrophizing. The theoretical and clinical implications of this research are expanded upon, including the potential utility of individual and couples rehabilitation prior to cardiac surgery.
Lay Summary

Cardiac surgery is a commonly performed surgical intervention. Despite goals of improving quality of life, undergoing cardiac surgery is demanding. In some patients and their spouses, this leads to increased psychological distress and relationship strain. Psychological resilience is a protective factor for individuals facing difficult times. Yet, research on resilience in couples, as well as research that investigates how resilience helps individuals and couples adapt to stressful situations is limited. To help understand this, 71 patients scheduled for cardiac surgery and their spouses were asked to complete questionnaires. Results indicated that resilience may serve as a protective factor against psychological distress and relationship strain among patients and their spouses. Ways of coping, including the extent couples collaborated to manage stressors and lower levels of pain catastrophizing helped explain why resilience was associated with positive outcomes. The potential for interventions aimed at both individuals and couples prior to surgery is discussed.
Preface

This dissertation is original, unpublished, independent work by the author, Kara Turcotte. The UBC BREB certificate for this research titled Dyadic Predictors of Well-Being Among Individuals Undergoing Cardiac Surgery is H15-02555.
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Dedication

To my family.
Introduction

An estimated 36,000 Canadians and 400,000 Americans undergo cardiac surgery every year (McGillion et al., 2019). Despite goals of improved survival and enhanced quality of life, the process of undergoing cardiac surgery is physically and psychologically demanding. Elevated levels of psychological distress (Tully & Baker, 2012) and relationship strain (Tulloch & Greenman, 2018) have been documented in patients prior to undergoing cardiac surgery. This is important because it is established that emotional and relationship functioning prior to cardiac surgery are meaningful predictors of patients’ short- and long-term recovery (Cserép, Székely, & Merkely, 2013; Mavros et al., 2011). Family members of cardiac surgery patients are also impacted by the stressful period prior to cardiac surgery, with spouses being particularly at risk. Spouses of cardiac surgery patients report heightened levels of psychological distress leading up to the surgical procedure (Randall, Molloy, & Steptoe, 2009) and many report reduced marital quality (Tulloch & Greenman, 2018). It is therefore critical to better understand the psychosocial factors that can contribute to healthy emotional and relationship functioning among couples in the period leading up to cardiac surgery.

Numerous factors have been implicated in adaptive and maladaptive adjustment in the perioperative context of cardiac surgery. The variability in recovery from cardiac surgery suggests that individual differences, including psychological and social factors, may influence surgical outcomes (Rosenberger, Jokl, & Ickovics, 2006). In the context of major surgery, a greater focus on risk and resilience factors is needed to identify those who are at increased risk of adverse outcomes (Katz, 2012; Katz & Seltzer, 2009). Psychological resilience has been identified as a robust protective factor associated with successful adaptation to a vast array of stressful life events, but little attention has been given to resilience in a dyadic context (Windle,
Thus, the primary aim of the current research was to investigate the role of psychological resilience in the psychological distress and relationship satisfaction of cardiac surgery patients and their spouses, and the extent to which the resilience of one partner might also be associated with positive outcomes in the other partner. A secondary aim was to examine whether coping styles (i.e., common dyadic coping and pain catastrophizing) might help to explain the relationship between psychological resilience and psychological distress, as well as relationship satisfaction, in this population.

**Emotional and Relationship Distress in Couples Facing Cardiac Surgery**

The period leading up to open heart surgery is often wrought with stress and anxious anticipation (Fitzsimons et al., 2003). Prior to cardiac surgery, patients and their family members must endure uncertainty about the outcome of the procedure itself, including whether the patient will experience any serious adverse events, including death. Other stressors commonly encountered during the presurgical period include frequent medical appointments, adhering to an often complex medication regime, missed days at work, travel and accommodation (especially for those who do not live locally), and the associated financial burden of these activities (Gallagher & McKinley, 2007). In recent years, there has been an increased emphasis on streamlining hospital procedures to save costs and free up limited hospital resources. In the context of major surgical procedures, these measures have resulted in shortened hospital stays. The average length of hospital stay for a patient undergoing open heart surgery in Canada is 4 to 7 days (University of Ottawa Heart Institute, 2018). This relatively short period of hospitalization has left patients and their family members to prepare for and address recovery issues at home that would have previously been handled by professional health care providers. The anticipatory stress of having to provide at-home care for a loved one recovering from major
surgery is an additional and significant source of stress and strain among couples leading up to surgery as full recovery does not typically happen until 3 months after hospital discharge (Randall, Molloy, & Steptoe, 2009).

**Psychological Distress in Patients**

Not surprisingly, rates of anxiety and depression are elevated in cardiac populations. A review completed by Tully and Baker (2012) found that between 30% to 40% of all cardiac surgery patients experience depressive disorders (e.g., major depression or dysthymia) - rates that are significantly higher than community samples. The review by Tully and Baker (2012) also found levels of anxiety disorders (e.g., generalized anxiety disorder) to be high in cardiac surgery patients prior to surgery, ranging from 2% to 10.2%. A more recent systematic review of psychological status prior to cardiac surgery, which included 16 studies and 236,595 patients, found that depressive disorders were diagnosed in 14.1% of patients (ranging from 0.6% to 31.8%) and anxiety disorders were diagnosed in 21.9% of patients (ranging from 7.4% to 40.0%; Takagi et al., 2017).

Importantly, psychological distress among patients can impact their health and well-being over time. A systematic review of 29 studies found that psychosocial factors such as depressive and anxious symptoms were predictive of surgical outcomes, including pain and analgesic use, length of hospital stay, and functional recovery, even after controlling for relevant clinical variables such as gender, age, and medical comorbidities (Rosenberger, Jokl, & Ickovics, 2006). In a review assessing whether psychological factors influence recovery from surgery, Mavros and colleagues (2011) found that a range of pre-operative psychological variables in the patient were associated with post-operative surgical complications in early surgical recovery (assessed within a month of the surgical procedure). The review conducted by Mavros and colleagues
(2011), which included predominantly cardiac surgery patients, found a significant association between psychological factors (including anxious and depressive symptoms) and surgical recovery in 94% of the included research studies. Further highlighting the importance of understanding presurgical distress, research has also found that depression influences postsurgical cardiac events and has been linked to postsurgical mortality (Burg, Benedetto, & Soufer, 2003).

**Psychological Distress in Spouses of Cardiac Patients**

For many adults, the marital relationship constitutes their most central and enduring social relationship. Romantic partnerships are the most commonly researched dyads as spouses are among the most important interpersonal resources during times of stress (e.g., Ruiz et al., 2006; Trump & Mendenhall, 2017) and as such have the greatest opportunities to influence the well-being of the patient. Indeed, previous research has consistently demonstrated the physical and psychological health benefits of being married, and of being satisfied with the quality of that relationship (Holt-Lunstad, Birmingham, & Jones, 2008; Kiecolt-Glaser & Newton, 2001; Kiecolt-Glaser & Wilson, 2017).

Cardiovascular disease may have a substantial impact on the psychological and physical well-being of the ill individual’s spouse (Tulloch & Greenman, 2018). Spouses of cardiac surgery patients have reported high degrees of psychological distress particularly during the initial phase preceding surgery and up to one year following cardiac surgery (Rantanen et al., 2009). A review focusing on the psychosocial impact of cardiac events on spouses found that spouses are vulnerable to developing clinically significant levels anxious and depressive symptoms, which can even exceed the severity of the patients’ distress levels (Randall, Molloy, & Steptoe, 2009).
Distress in the spouse also has an impact on their health and well-being over time. A review conducted by Bjørnnes and colleagues (2019) focusing on the experiences of caregivers for cardiac surgery patients, where 84% of caregivers were spouses, found that caregivers have high rates of elevated blood pressure and psychological distress (i.e., anxious and depressive symptoms). Another review which included longitudinal research suggests that the distress can be long lasting and persist after the patient’s physical recovery following cardiac surgery (Randall, Molloy, & Steptoe, 2009). The review by Randall and colleagues (2009) found that spouses of patients experience significant disruption to their daily lives and often engage in caregiving responsibilities which may have negative implications for their physical health.

**Relationship Satisfaction in the Context of Cardiac Surgery**

A meta-analysis including 126 published articles with more than 72,000 individuals has found that greater marital quality is related to improved health with effect sizes ranging from $r = 0.07$ to $0.21$ (Robles et al., 2014). In a review on the impact of cardiovascular disease on the partners of patients, it was found that romantic relationships can be adversely impacted by cardiac surgery (Randall, Molloy, & Steptoe, 2009). This is significant in the context of the present research because presurgical relationship satisfaction has emerged as an important predictor of postsurgical well-being in couples (Ruiz et al., 2006). Longitudinal research conducted by King and Reis (2012) has found that men and women who report greater satisfaction in their romantic relationships are 3.2 times more likely to be alive 15 years after CABG surgery than those without a satisfying relationship. In this research, some gender effects emerged, suggesting that highly satisfied men were 2.7 times and highly satisfied women were 3.9 times more likely to be alive following the surgical procedure. Relationship quality prior to undergoing cardiac surgery can also have a long-term impact on the spouse. Longitudinal
research of partners of cardiac patients has found that the quality of the relationship at the time of the cardiac procedure was a unique predictor of partner’s psychological distress one year later (Saltmarsh et al., 2016).

**Psychological Resilience**

Taken together, the above findings highlight that both the patient as well as their spouse are at risk of high levels of distress prior to cardiac surgery, and that the quality of the relationship can be compromised. To date, cardiac research has largely focused on risk factors, rather than protective factors, associated with emotional and relational adjustment to cardiac surgery. There is an increasing emphasis on the need to identify protective factors for individuals coping with chronic illness, including those with cardiovascular disease. Research has found that positive psychological states can potentially play an important role in cardiac health and recovery from illness (DuBois et al., 2012). A systematic review including 14,000 cardiac patients found a prospective relationship between positive psychological constructs (e.g., optimism, positive affect) and better medical outcomes (e.g., reduced rehospitalization) in the majority of studies (DuBois et al., 2015). Importantly, in over 60% of the included studies, positive psychological constructs were significantly associated with health outcomes even when controlling for levels of psychological distress (e.g., depression or negative affect), highlighting that they make a unique contribution to health over and above negative risk factors (DuBois et al., 2015).

Over the past twenty years, psychological resilience has received growing attention in the research literature as a key protective factor in coping with chronic illness (Fletcher & Sarkar, 2013; Stewart & Yuen, 2011; Windle, 2011). The concept of resilience originated in research on adolescents (e.g., Olsson et al., 2003) and has evolved substantially in recent years. Yet, despite a
vast body of literature on the subject, there continues to be a lack of agreement regarding the essential components of the term ‘psychological resilience’ (Chmitorz et al., 2018). According to Fletcher and Sarkar (2013), current definitions of resilience typically fall under one of three categories: process, outcome, and stable personality trait. From the process perspective, resilience can be defined as an evolving process of adaptation to a threatening situation characterized by an interplay between risk and protective factors (e.g., Olsson et al., 2003). Based on the outcome perspective, resilience can be characterized as an outcome based on adaptive functioning despite risk from either acute or chronic stress (e.g., Masten, 2007). From the personality perspective, resilience can be defined as a personality trait that enables individuals to rebound from adversity and to adapt and thrive despite stressful events (e.g., Block & Kremen, 1996). Most recently, resilience has been conceptualized as a dynamic and variable process (Chmitorz et al., 2018). To that end, the American Psychological Association defines resilience as “the process of adapting well in the face of adversity, trauma, tragedy, threats, or even significant sources of stress” (APA, 2020). This process-based definition, “health-despite-adversity”, is considered both functional and dynamic and is used in the current research as it incorporates a complex interaction between risk and protective factors (Schetter & Dolbier, 2011). Further, this definition gives credence to the notion that resilience is modifiable and can be improved by interventions (Helmreich et al., 2017).

**Psychological Resilience, Distress, and Relationship Quality**

Past research has assessed the link between psychological resilience and positive adaptation, such as lower depressive and anxious symptoms and greater positive affect during stressors (e.g., Tugade & Fredrickson, 2004). In a comprehensive review of the relationship between psychological resilience and mental health, it was found that psychological resilience
was negatively correlated with adverse indicators of mental health (e.g., depression, anxiety, and negative affect) and positively correlated to positive indicators of mental health (e.g., positive affect) in 60 published studies (Hu, Zhang, & Wang, 2015). In this review the average effect sizes for resilience and adverse indictors of mental health was medium ($r = -0.36$), and the average effect for psychological resilience and positive indicators of mental health was large ($r = 0.50$). The results of this review indicate that psychological resilience can reduce or limit the negative impact of adversity on depressive and anxious symptoms and play a critical role in helping individuals achieve a state of positive mental health despite experiences of significant stress and adversity. Limited research has assessed the relationship between psychological resilience and relationship quality. Research that has been conducted in this area has found that higher levels of psychological resilience was strongly associated with relationship satisfaction in married dyads (Bradley & Hojjat, 2017).

**Psychological Resilience in Chronic Illness**

A review focusing on psychological resilience in the physically ill found that higher self-reported psychological resilience was consistently associated with improved mental health outcomes (Färber & Rosendahl, 2018). Across the research included in the review by Färber and Rosendahl (2018) a significant moderate correlation between resilience and improved mental health was found. Research on psychological resilience in caregivers is also emerging. A systematic review completed by Palacio and colleagues (2019) of psychological resilience in caregivers has found that resilience is associated with decreased emotional distress as well as an improved ability to cope adaptively (e.g., increased capacity to use proactive coping strategies). The role of psychological resilience in the specific context of cardiovascular disease has also received increasing attention. For example, low levels of psychological resilience have been
associated with increased levels of depression in cardiovascular disease patients (Carvalho et al., 2016) and in non-acute cardiac outpatient populations (Toukhsati et al., 2017). Consistent with these findings, greater psychological resilience has been associated with decreased anxious and depressive symptoms in cardiac surgery patients (Liu et al., 2018).

The Social Context of Resilience and Coping with Chronic Illness

Coping refers to a set of strategies, both cognitive and behavioural, used by an individual to manage the demands arising from stressful situations (Lazarus, 1993). Research has traditionally examined how patients cope with, and adjust to, the stress of chronic illness and related medical procedures from solely an individual-level stress and coping framework, in which the patient is conceptualized as the perceiver and receiver of support (Berg & Upchurch, 2007). While coping processes have been traditionally studied solely at an individual level, it is increasingly recognized that individuals cope in a social context (DeLongis & Holtzman, 2005; Helgeson et al., 2018). As detailed above, patients are not coping with cardiac disease or preparing to undergo major surgery in isolation. The presence and quality of close relationships are linked to health and well-being across the lifespan, and this applies to patients and caregivers alike (Pietromonaco & Collins, 2017). The spouse is often, but not always, the primary source of support for adults, and married couples influence each other’s well-being and health in important ways (Kiecolt-Glaser & Wilson, 2017). If the relationship is strong, people tend to be happier and healthier and conversely, low relationship satisfaction increases the risk of cardiovascular disease (Robles et al., 2014). Despite the link between close relationships and health, the vast majority of studies fail to take into account how the patient’s functioning might impact the spouse, and how the spouse’s functioning might impact the patient. Increasingly it has been
identified that a dyadic approach is needed to understand emotional and relationship outcomes in couples coping with chronic illness, including cardiovascular disease (Smith & Baucom, 2017).

A dyadic approach to studying coping with chronic illness considers the interdependence of couples, and may be particularly valuable in understanding the resilience process. Dyadic designs have increasingly been used in health research to investigate intrapersonal and interpersonal mechanisms of health and well-being (Reed, Butler, & Kenny, 2013). The most widely used dyadic model is the actor-partner interdependence model (APIM) which allows an estimation of both actor and partner effects (Kenny, Kashy, & Cook, 2006c). In the APIM, *actor effects* are defined as the impact of a person’s independent variable on his or her own outcome variable whereas *partner effects* refer to the impact of a person’s independent variable on the outcome variable of the partner. Research that has taken a dyadic approach to studying stress and coping has shown that characteristics of one partner can impact the well-being in the other partner. For example, research conducted by Ruiz and colleagues (2006) found that patients’ and spouses’ personality traits assessed prior to cardiac surgery influenced their partners’ psychological well-being following surgery. Specifically this research found that higher neuroticism in the partners of patients predicted the patients’ increased depressive symptoms 18 months following cardiac surgery, and likewise higher patient neuroticism later predicted their spouses’ depressive symptoms. Based on these findings, Ruiz and colleagues (2006) concluded that beyond the patients’ own risk factors, the spouses’ psychosocial characteristics can contribute a unique risk to the patients’ well-being. Broadly speaking, this research supports the notion that individual traits can be important risk and protective factors for adaption to stress for the individual themselves as well as their spouses.
The literature on resilience is also increasingly recognizing the broader social context in which it occurs, and as such models of resilience are expanding to incorporate interpersonal factors that play a role in resilience. The multi-system model of resilience (MSMR; Liu, Reed, & Girard, 2017) has been developed and it incorporates intra-individual (i.e., characteristics of the individual), interpersonal (i.e., developed over time through social interactions), and socio-ecological (i.e., larger formal and informal institutions in the community that facilitate adjustment) factors associated with resilience. A unique contribution of this model is that it incorporates interpersonal indicators of resilience highlighting the importance of social relationships. While the interpersonal nature of psychological resilience is a relatively new area of research, recent findings suggest that the psychological resilience of one individual might positively impact the well-being of others. Research conducted by Zhang and colleagues (2016) on the dyadic effects of resilience on well-being in older adults found that psychological resilience had both significant actor effects (i.e., one’s own resilience positively influencing their own quality of life outcomes) and partner effects (i.e., one’s partner’s resilience characteristics positively influencing their partner’s quality of life outcomes).

In sum, research on resilience in couples facing serious medical challenges is only just emerging, and a limited number of studies have taken a dyadic approach to understanding the social context of resilience. To date, the resilience framework has not been assessed at the dyadic level in cardiac surgery patient-spouse dyads. This is an important area of research, as it has been found that resilience has been shown to lead to more adaptive coping, and that this can foster better emotional well-being and stronger social relationships (Hou & Lam, 2014; Lim et al., 2014).
The Role of Resilience in Intrapersonal and Interpersonal Coping Processes

It is now well-established that psychological resilience is an adaptive characteristic (e.g., Windle, 2011). However, the research literature is still building on the understanding of why resilience is an adaptive trait and how it influences people as they manage major life stressors. One underexplored possibility is that people who have greater resilience tend to have better emotional health and better quality of relationships because they engage in collaborative approaches to coping, such as dyadic coping, and are less likely to engage in maladaptive strategies, like catastrophizing.

The Mediating Role of Dyadic Coping

Research has begun to assess the relationship between psychological resilience and coping in a social context. Broadly speaking, research suggests that highly resilient individuals are actively responsive to others’ needs and seek support from others to manage stressors (Zhang et al., 2017). Further, highly resilient individuals in romantic relationships are more likely to elicit more effective support from those around them (Fergus & Skerrett, 2015). In the context of coping with chronic illnesses, it has been found that highly resilient people are more responsive and active in their relationships with others and also elicit more positive responses when managing stressors (Hou & Lam, 2014; Lim et al., 2014). Therefore one way that resilience might promote positive adaptation is coping collaboratively to manage stressors.

The concept of dyadic coping emerged in the early 1990s in an attempt to expand individually oriented models of stress and coping (e.g., Lazarus, 1993) to encompass the social context of couples’ interactions. Dyadic coping, the different ways in which the patient and their partner interact when dealing with stressors (Berg & Upchurch, 2007), is likely to influence both individuals’ adjustment to stressful events. Dyadic coping is a multidimensional process that
includes partners’ stress communication to each other as well as their responses to deal with stress. Stressful events, such as cardiac surgery, are best understood as an interdependent process which is shared between partners (Falconier et al., 2015). The definition of dyadic coping is not consistent across research studies and methodological approaches (Falconier & Kuhn, 2019). However, some shared assumptions of existing research suggest that dyadic coping is a fundamentally social process that occurs between individuals in a close relationship that is dependent on both the coping of the other individual as well as the outcome of the stressful event (Bodenmann, Meuwly, & Kayser, 2011). Dyadic coping refers to the way couples deal with both individual and dyadic stressors and has two primary objectives: the reduction of distress for each partner and the enhancement of relationship quality (Bodenmann, 1997; Bodenmann, 2005). Dyadic coping is not considered solely altruistic behaviour. It represents a conscious effort to ensure the well-being of one’s partner, which in turn ensures one’s own well-being and overall satisfaction in the relationship (Bodenmann, 2005; Bodenmann, Pihet, & Kayser, 2006). There are many models of dyadic coping but one of the dominant dyadic coping models, the systemic-transactional coping model, has guided a large portion of research in the dyadic coping field (Bodenmann, Randall, & Fanconier, 2016).

The systemic-transactional model (STM; Bodenmann, 1995, 2005) views stressors as dyadic if they concern the couple directly, when both deal with the same stressor, or indirectly, when the stress of one member of the dyad spills over and thereby impacts both individuals. According to Bodenmann (2005), dyadic coping is distinguished as a unique form of coping, distinct from individual coping. It characterizes how partners cope with the stress associated with chronic illness together (Regan et al., 2015). The systemic-transactional model suggests that dyads’ coping involves the reciprocal interaction between the interpersonal communication of
stress and the subsequent coping responses, either positive or negative (Bodenmann, 2005). Bodenmann (2005) has defined both negative and positive dyadic coping. Negative dyadic coping refers to ambivalent support (e.g., equivocal support), hostility (e.g., support characterized by contempt), or superficial responses (e.g., cursory support which lacks empathy). Conversely, positive dyadic coping includes delegated dyadic coping (e.g., support designed to reduce the others’ burden), supportive dyadic coping (e.g., support characterized by empathic understanding), and common dyadic coping (e.g., support characterized by collaboration, in which dyads work together). The systemic-transactional model has a self-report measure, the Dyadic Coping Inventory, which taps the construct of interpersonal collaboration with the common dyadic subscale (Bodenmann, 2005). Common dyadic coping has been defined as occurring when “both partners participate in the coping process more or less symmetrically or complementary in order to handle a problem-focused or emotion-focused issue relevant to the dyad by using strategies such as joint problem solving, joint information seeking, sharing of feelings, mutual commitment, or relaxing together” (Bodenmann, 2005, pp. 38). Previous research has found that common dyadic coping is associated with better dyadic adjustment in couples managing chronic illness (Badr et al., 2010). The extent to which couples cope collaboratively, as assessed by the common dyadic coping subscale of the Dyadic Coping Inventory, is among the most commonly used measures of dyadic coping (Falconier & Khun, 2019). It is a robust predictor of enhanced psychological well-being and relationship satisfaction (Helgeson et al., 2018) and as such was incorporated into this research.

The Mediating Role of Pain Catastrophizing

Another reason why psychological resilience may be linked to better emotional health and increased relationship satisfaction could be that resilience is associated with decreased levels
of maladaptive coping including pain catastrophizing. The experience of chronic pain is common among individuals with cardiovascular disease (Fayaz et al., 2016). Pain catastrophizing, an emotionally focused and cognitively mediated response to pain, has been characterized as an exaggerated negative mental mindset in response to anticipated or experienced physical pain (Sullivan, Bishop, & Pivik, 1995). It is characterized by magnification of the negative components of pain, a feeling of helplessness in the ability to cope with pain, and an inability to disengage from thoughts regarding the pain, resulting in rumination (Sullivan, Bishop, & Pivik, 1995). In the research literature there is debate regarding whether catastrophizing can be considered a coping strategy used to elicit supportive or empathic responses from others (e.g., Sullivan, 2012). Pain catastrophizing has been identified as a robust predictor of pain severity, disability, as well as anxious and depressive symptoms (Quartana, Campbell, & Edwards, 2009; Sullivan, Rodgers, & Kirsh, 2001).

Increased research attention has focused on the concept of pain catastrophizing in the context of major surgery. A review conducted by Khan and colleagues (2011) found an association between pain catastrophizing and increased postsurgical pain severity. Further, this review found pain catastrophizing had a detrimental impact on postsurgical quality of life across a range of major surgeries. Within a cardiac surgery population, research by Khan and colleagues (2012) found that pain catastrophizing assessed prior to surgery was strongly associated with psychological distress (i.e., anxious and depressive symptoms). Further highlighting the importance of understanding psychological factors in the perioperative setting, this research also found that pain catastrophizing was uniquely predictive of the intensity of postoperative pain.

While pain is a subjective internal experience, pain is often expressed in a social context. To that end, some models of pain catastrophizing, such as the communal coping model of pain
catastrophizing, highlights the importance of the interpersonal processes and the social context in which pain and pain behaviours are embedded (Sullivan, Bishop, & Pivik, 1995). Individuals coping with pain do so in the context of long-standing interpersonal relationships that have a unique history of coping with stressful events (Holtzman & Delongis, 2007; Keefe & Porter, 2007). Pain catastrophizing has been linked to noticeable expressed signs of pain, and these expressions of pain and pain related distress have been linked to responses from others (Burns et al., 2015). That is to say, catastrophic thoughts in the person in pain can impact behavioural and emotional reactions by observers, and the observers responses can in turn also impact the experience of pain and levels of disability of the person in pain (Caes et al., 2013). It is possible that behavioural manifestations of pain catastrophizing could elicit critical or unsupportive responses from others, which could be detrimental to the quality of that relationship (Sullivan, 2012). Despite recent calls for research on social determinants and consequences of pain catastrophizing, little research has been conducted (Caes et al., 2013; Cano, Leonard, & Franz, 2005). Research by Cano, Leonard and Franz (2005) in married couples has found that partners do catastrophize about the pain experienced by their spouse. Indeed, this research found that the spouse’s catastrophizing was greater than the catastrophizing reported by the individual in pain. Recent research which assessed the extent to which spouses catastrophize their partners’ pain has found that pain catastrophizing in the dyad was linked to relationship satisfaction (Müller et al., 2019). Further, this research found that catastrophizing in both members of the dyad was significantly associated with increased psychological distress.

As described above, research has linked pain catastrophizing with negative psychological experiences such as depression and anxiety (Khan et al., 2012). Past research and theory has suggested that pain catastrophizing would be inversely linked with positive psychological
qualities such as psychological resilience (Pulvers & Hood, 2013). Indeed, in cross-sectional research of an national sample of individuals with chronic pain, it was found that resilient individuals were significantly less likely to catastrophize their pain (Karoly, & Ruehlman, 2006). Intensive longitudinal research in men and women with chronic pain has also found that high-resilience individuals report less day-to-day catastrophizing, compared to low-resilience individuals (Ong, Zautra, & Reid, 2010). However, research is scant and no prior studies have investigated whether psychological resilience in one partner may influence pain catastrophizing in the other person.

**Overview of Dissertation**

The overall aim of the current research was to examine how the social context influences emotional and relational well-being in patient-spouse dyads prior to undergoing cardiac surgery. Past research has found that relationship satisfaction and psychological distress have important contributions to adaptation following surgery in patient-spouse dyads (e.g., Tulloch & Greenman, 2018). Psychological resilience is a robust protective factor that may influence coping and successful adaptation to stressful events (Fletcher & Sarkar, 2013). However, no research to date has assessed to what extent psychological resilience impacts distress and relationship satisfaction in dyads preparing for surgery, and the pathways through which resilience may impact well-being in this population. Given the prevalence of cardiac surgery in North America, understanding individual and social factors in patient-spouse dyads that predict optimal postsurgical recovery is of the utmost importance, and has the potential to inform targeted psychosocial interventions for individuals and couples in the period leading up to surgery.
Specific Aims and Hypotheses

Operating within an APIM framework, the current study had six specific aims. The first two aims investigated whether resilience has direct effects on psychological distress (Specific Aim 1) and relationship satisfaction (Specific Aim 2) among couples undergoing cardiac surgery. The other four aims sought to examine whether common dyadic coping (Specific Aims 3 and 4) and pain catastrophizing (Specific Aims 5 and 6) might help to explain the link between resilience and the study outcomes.

Actor-Partner Interdependence Models

Specific Aim 1. To understand the extent to which psychological resilience is associated with patient and spouse levels of relationship satisfaction.

Hypothesis 1. Psychological resilience reported by one partner will be positively associated with their own report of relationship satisfaction (actor effects) and their partner’s report of relationship satisfaction (partner effects).

Specific Aim 2. To understand the extent to which psychological resilience is associated with patient and spouse levels of psychological distress.

Hypothesis 2. Psychological resilience reported by one partner will be negatively associated with their own report of psychological distress (actor effects) and their partner’s report of psychological distress (partner effects).

Actor-Partner Interdependence Dyadic Coping Mediation Models

Specific Aim 3. To understand the extent to which common dyadic coping mediates the relationship between psychological resilience and relationship satisfaction. As discussed by Ledermann, Macho and Kenny (2011), there are four different ways that these mediation effects
may occur in a dyadic context (summarized in Figure 1). For a full representation of an APIMeM model adapted from Ledermann, Macho, & Kenny (2011), see Appendix A.

Hypothesis 3A. *Patient-actor mediated effects.* Common dyadic coping reported by the patient will mediate the association between their own reports of psychological resilience and their own reports of relationship satisfaction (Figure 1, a effect).

Hypothesis 3B. *Spouse-actor mediated effects.* Common dyadic coping reported by the spouse will mediate the association between their own psychological resilience and their own report of relationship satisfaction (Figure 1, b effect).

Hypothesis 3C. *Patient-partner mediated effects.* Common dyadic coping reported by the spouse will mediate the association between the spouse’s report of psychological resilience and the patient’s report of relationship satisfaction (Figure 1, c effect).

Hypothesis 3D. *Spouse-partner mediated effects.* Common dyadic coping reported by the patient will mediate the association between their own reported psychological resilience and their spouse’s reports of relationship satisfaction (Figure 1, d effect).
Figure 1

Hypothesized dyadic mediation effects
Specific Aim 4. To understand the extent to which common dyadic coping mediates the relationship between psychological resilience and psychological distress. A parallel set of hypotheses were proposed as hypotheses 3A-3D, with psychological distress as the outcome.

**Actor-Partner Interdependence Catastrophizing Mediation Models**

Specific Aim 5. To understand the extent to which catastrophizing the patients’ pain mediates the relationship between psychological resilience and relationship satisfaction.

Hypothesis 5A. *Patient-actor mediated effects.* Total pain catastrophizing reported by the patient will mediate the association between their own reports of psychological resilience and their own reports of relationship satisfaction (Figure 1, a effect).

Hypothesis 5B. *Spouse-actor mediated effects.* Total pain catastrophizing reported by the spouse will mediate the association between their own psychological resilience and their own report of relationship satisfaction (Figure 1, b effect).

Hypothesis 5C. *Patient-partner mediated effects.* Total pain catastrophizing reported by the spouse will mediate the association between the own report of psychological resilience and the patient’s report of relationship satisfaction (Figure 1, c effect).

Hypothesis 5D. *Spouse-partner mediated effects.* Total pain catastrophizing reported by the patient will mediate the association between their own reported psychological resilience and their spouse’s reports of relationship satisfaction (Figure 1, d effect).

Specific Aim 6. To understand the extent to which pain catastrophizing mediates the relationship between psychological resilience and patient and spouse psychological distress. A parallel set of hypotheses were proposed as 5A-5D, with psychological distress as the outcome.
Method

Sample

Participants were recruited as part of a larger study examining risk and resiliency factors pre- and post-surgery in patient-spouse dyads undergoing open heart surgery. The current study focuses on data collected from 71 patients and their spouses who each completed a battery of standardized questionnaires approximately one-month prior to undergoing cardiac surgery. Individuals were recruited at the Interior Heart and Surgical Centre in Kelowna, British Columbia, Canada. The inclusion criteria for patients was: (1) 18 years or older, (2) scheduled for elective midsternal surgery (specifically, either coronary artery bypass graft surgery or aortic/mitral valve replacement), (3) ability to read, write, and speak fluent English, (4) daily access to a telephone, (5) ability to understand the instructions related to the study, and (6) ability to answer the questionnaire independently. Exclusion criteria for patients consisted of individuals undergoing coronary artery bypass graft surgery and simultaneous valve replacement surgery. The rationale for this exclusion criteria was based on the increased mortality and increased rates of post-operative complications in patients undergoing coronary artery bypass graft surgery and simultaneous valve replacement surgery. Urgent and emergency surgery patients were not eligible to participate. Patients’ spouses were also recruited. The inclusion criteria for spouses was: (1) 18 years or older, (2) a spouse undergoing scheduled elective midsternal surgery (either coronary artery bypass graft surgery or aortic/mitral valve replacement), (3) ability to read, write, and speak fluent English, (4) access to a telephone, (5) ability to understand the instructions related to the study, and (6) ability to answer the questionnaire independently.
Procedure

Recruitment began in April 2016 and ended June 2018. Potential participants, both patients and their spouses, were given a brochure detailing the research study by cardiac clinic staff during their presurgical orientation at the Interior Heart and Surgical Centre at the Kelowna General Hospital. After being told about the study during the presurgical orientation, 187 patients and 125 spouses consented to be contacted to learn more about the study and to be screened for eligibility. Potential participants were then contacted via telephone by a research assistant to determine their interest in participation. All potential participants were independently informed of the purpose of the study, the principles and requirements of voluntary participation, the informed consent process, and the study procedures. Interested individuals were screened for eligibility at that time.

Of the 187 patients and 125 spouses that consented to be contacted, 12 patients (6.4%) and six spouses (4.8%) could not be contacted via telephone for the enrollment screening. Two patients (1%) had their surgeries cancelled. Of the 173 patients who were contacted and screened for eligibility, 19 patients decided not to participate citing reasons such as experiencing too much stress ($n = 11; 6.3\%$) and not having enough time ($n = 8; 4.6\%$). Of the 117 spouses contacted and screened for eligibility, 17 spouses decided not to participate citing similar reasons such as too much stress ($n = 7; 5.9\%$), not enough time ($n = 8; 6.8\%$), or not interested in participating ($n = 2; 1.7\%$).

Cognitive capacity to participate was assessed by the Memory Impairment Screen by Telephone (MIS-T; Lipton et al., 2003), which is a telephone-based screening test for dementia which assesses orientation to date and short-term memory for non-contextual words. The MIS-T is scored from zero to eight, with higher scores indicating greater memory impairment. All of the
potential participants assessed for eligibility in the study screened negative for dementia, having scored less than 3 on the MIS-T.

All enrolled participants provided informed consent to participate. In total, 154 patients and 100 spouses were enrolled in the study. One telephone call was given to each person two weeks after enrollment to remind them to complete the study questionnaire. Of those enrolled, 106 patients (69%) and 77 spouses (77%) completed the questionnaire. The enrolled participants were given a choice on whether they preferred a mailed paper copy of the questionnaire or to complete an online questionnaire. The majority of participants opted to complete an online questionnaire. Specifically, of the 154 patients enrolled 66% completed the online survey and 34% completed the paper survey. For the 100 enrolled spouses 64% completed the online survey and 36% completed the paper survey.

To accurately reflect presurgical psychosocial vulnerability factors only participants who completed the survey prior to the surgical procedure were included in the final sample. In total 71 patient-spouse dyads completed the baseline measures prior to their surgery. The patients completed their survey on average 29 days prior to their surgery, while the spouses completed their survey on average 26 days prior to the surgery. Each participant was provided a unique ID number that allowed their data to remain confidential and to link their responses to their partner’s responses.

For their participation in the study, participants were compensated with a remuneration of a $15 gift card for volunteering their time to this research. Approval was obtained from the Research Ethics Boards at the participating institutions, the University of British Columbia and the Interior Health Authority. This research was conducted in accordance with institutional review boards in a manner consistent with the Canadian Psychological Association’s guidelines.
Measures

Prior to surgery, patients and their spouses were asked to independently answer a battery of standardized psychosocial and medical questionnaires. Demographic information (e.g., age, gender, relationship length) was also collected via self-report. Only the measures used in the current research will be discussed here.

**Psychological Resilience.** The Connor-Davidson Resilience scale (CD-RISC; Connor & Davidson, 2003) is a 25-item self-report measure developed to assess psychological resilience during the last month. The CD-RISC is comprised of a total score reflecting psychological resilience. Each item is rated on a 5-point Likert scale ranging from (0) not true at all to (4) true nearly all the time. The total score ranges from 0 to 100 with higher scores indicating greater psychological resilience. Example items include “able to adapt to change” and “think of self as a strong person”. Psychometric properties in the general population have shown good internal consistency, test-retest reliability, as well as convergent and divergent validity (Davidson & Connor, 2015). In the current research, the measure showed strong internal consistency. For the patient data, the Cronbach’s alpha was .91 and for the spouse data, the Cronbach’s alpha was .93.

**Psychological Distress.** The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) is a 14-item self-report measure of depressive and anxious symptoms. The HADS is comprised of a total score reflecting psychological distress and can be divided into two subscales, depression (7 items; e.g., “I feel as if I’m slowed down”) and anxiety (7 items; e.g., “I feel tense or wound up”). Each item is reported on a 4-point Likert scale ranging from (0) not at all to (3) most of the time. The total score ranges from 0 to 42 with higher scores indicating greater psychological distress. Psychometric properties of the HADS are adequate in primary care patients and in the general population (Bjelland et al., 2002). In the current research, the
patient HADS had a Cronbach’s alpha of .84 and the spouse HADS had a Cronbach’s alpha of .90.

**Couple Satisfaction Index.** The 4-item version of the Couples Satisfaction Index (CSI; Funk & Rogge, 2007) was used to assess self-reported relationship satisfaction. Developed based on item response theory and established measures of perceived relationship satisfaction, the CSI is a brief validated measure of relationship satisfaction. Each item is measured on a 6-point or 7-point Likert scale ranging from (0) not at all to (6) absolutely and completely. A sample item of this scale is “our relationship is strong”. The total score ranges from 0 to 21 with a higher score on this scale reflecting a greater sense of relationship satisfaction. Psychometric properties of the CSI are adequate (Funk & Rogge, 2007). In the current research the patient CSI had a Cronbach’s alpha of .86 and the spouse CSI had a Cronbach’s alpha of .95.

**Pain Catastrophizing.** Patients completed the Pain Catastrophizing Scale (PCS; Sullivan, Bishop, & Pivik, 1995), a 13-item self-report measure of catastrophic thinking associated with the experience of pain in oneself (PCS). Spouses completed the significant other version of this scale (PCS-S; Cano et al., 2005), which assesses catastrophic thoughts about pain in one’s significant other. Each item is reported on a 5-point Likert scale ranging from (0) not at all to (4) all the time, reflecting how often he or she experiences a particular thought or feeling when they or their significant other experiences pain. The PCS and PCS-S consist of a total score that ranges from 0 to 52, with higher scores indicating greater pain catastrophizing. The scale has three subscale scores assessing rumination (4 items; e.g., “I keep thinking about how badly I want the pain to stop”), magnification (3 items; e.g., “I become afraid that the pain will get worse”, and helplessness (6 items; e.g., “It’s terrible and I think it’s never going to get any better”). The PCS and PCS-S respectively have been shown to have adequate psychometric
properties (Cano, Leonard, & Franz, 2005; Osman et al., 2000; Sullivan, Bishop, & Pivik, 1995). In the current research, the PCS showed strong internal consistency, with Cronbach’s alpha of .95. The PCS-S had a Cronbach’s alpha of .89.

*Common Dyadic Coping.* The Dyadic Coping Inventory (DCI: Bodenmann, 2008) is a 37-item self-report measure developed based on Bodenmann’s theory of dyadic coping (Bodenmann, 1997). It measures the degree to which dyads support and help each other during stressful times, and assesses constructs such as supportive dyadic coping, negative dyadic coping, and common dyadic coping. Only the common dyadic coping subscale, which measures efforts that both partners make together, was used in this research. This subscale is comprised of 5 items (e.g., “We help one another to put the problem in perspective and see it in a new light”). Each item is rated on a 5-point likert scale ranging from (1) very rarely to (5) very often. The common dyadic coping subscale score ranges from 5 to 25 with higher ratings reflect greater perceptions of common dyadic coping. Previous studies have revealed adequate psychometric properties (Bodenmann, 2008; Levesque et al., 2014). In the current research, the common dyadic coping subscale had a Cronbach’s alpha of .85 in the patient data and .86 in the spouse data.

*Medical Comorbidity.* The Self-Administered Comorbidity Questionnaire (SCQ; Sangha et al., 2003) is a brief self-report measure that was completed by both the patient and the spouse which assesses the comorbidity of 12 defined and 3 optional medical conditions. Individuals can receive up to 3 points for each condition: 1 point for the presence of a problem, 1 point for receiving treatment for the problem, and 1 point if the condition limits the patient’s functioning. The maximum score is 36 points if the closed-ended questions are included. Previous research (e.g., Baumeister et al., 2010) has found high agreement between patient self-report and medical
report abstraction, suggesting that patient self-reports of medical comorbidities is a valid and effective approach to assessing comorbidity. The SCQ has been demonstrated to have adequate test-retest reliability, concurrent validity, and predictive validity (Sangha et al., 2003). In the current research the SCQ had a Cronbach’s alpha of .77 in the patient data and .92 in the spouse data.

**Pain and Health History.** A current pain and health history questionnaire was developed for this research based on previous longitudinal research assessing biopsychosocial factors associated with acute and chronic pain following surgery (Pagé et al., 2009). The questionnaire included questions about the patient and spouses current pain condition (e.g., “Are you currently feeling pain?”) and their previous pain experiences (e.g., “Have you ever had a pain problem that lasted for more than 1 month?”). A subset of patients also completed the Functional Status Classification Questionnaire (Schropfer et al., 2016), which was included approximately one year into data collection and included an assessment of functional limitations associated with their heart condition.

**Overview of Data Analytic Plan**

Data were organized using a dyadic structure design, in which each record includes the patient’s data as well as their spouse’s data. In this data structure, each row has a score for dyad level variables (e.g., dyad ID, relationship duration) and two scores for individual level variables (e.g., patient ID, patient psychological resilience, spouse ID, spouse psychological resilience). Several strategies were used to clean the data prior to conducting the study analyses. First, descriptive statistics were used to examine data points for accuracy (e.g., values within appropriate ranges), unusual patterns of responses (e.g., repeated values), and completeness. Next, following recommendations by Tabachnick and Fidell (2013), steps were taken to examine
patterns in the missing data, impute missing data, assess for univariate and multivariate outliers, assess distributions of study variables, and test for multicollinearity.

Preliminary data analyses included descriptive statistics and Pearson bivariate correlations of the study variables. Before proceeding with the APIM and APIMeM analyses, the main study variables including psychological resilience, common dyadic coping, pain catastrophizing, psychological distress, and relationship satisfaction were grand-mean centered (Kenny, Kashy, & Cook, 2006c). Potential covariates for inclusion in the APIM and APIMeM models were tested, including age, gender, relationship length, medical comorbidities, and current pain intensity. Actor-partner interdependence models were used to test study aims one and two (Fitzpatrick et al., 2016), while actor-partner interdependence mediation models were used to test study aims three, four, five, and six (Ledermann, Macho, & Kenny, 2011). Unless noted otherwise, all data screening and analyses was conducted using SPSS Version 26 (IBM Corp, 2019). APIM analyses were completed using Mplus (Muthén & Muthén, 2019), while the APIMeM mediation analyses were completed using an SPSS macro MEDYAD (Coutts, Hayes, & Jiang, 2019).
Results

Data Cleaning

**Missing Data.** In the current study, none of the scores on scale items were missing more than 5% of the data points (i.e., at most, 4.7% in the patient data and 3.8% in the spouse data were missing). Little’s Missing Completely at Random (MCAR) test was conducted to determine if there was a pattern to the missing data (Little, 1988). Results for both the patient data and spouse data were non-significant (all p’s > .129), indicating there was no pattern to the missing data. When minimal data points are missing (e.g., 5% or less) nearly any validated procedure (e.g., multiple imputation, expectation maximization) for handling missing data yields similar results (Tabachnick & Fidell, 2013). Expectation Maximization methodology was chosen to impute missing data.

**Outliers.** The presence of univariate and multivariate outliers was assessed for all included study variables. Standardized residuals (z scores) were screened and cases outside the absolute value of 3.29 were considered univariate outliers. No outliers were found for any of the full scale scores used in the analyses. Multivariate outliers indicate that an individual is responding differently compared to other participants across multiple dimensions. Multivariate outliers and influential observations were assessed using Mahalanobis’ distance scores and Cook’s values exceeding 1. One participant was identified as multivariate outlier, although this case was not deemed influential as Cook’s distance was less than 1. As this outlier was deemed statistically non-influential, all data points were retained to maximize the sample size.

**Normality.** The distribution of the study variables was assessed through histograms, probability plots (P-P plots), as well as skewness and kurtosis values. West, Finch, and Curran (1995) proposed a reference of non-normality as an absolute skew value greater than 2 and
absolute kurtosis as greater than 7. In the dataset, all study variables’ skewness and kurtosis values were less than the absolute values proposed by West, Finch, and Curran (1995).

**Multicollinearity.** Multicollinearity was assessed by examining the correlation matrix of predictor variables in each model, including patient and spouse variables. As displayed in Table 2, correlations between the predictor variables were well below an absolute value of .9, indicating no issues with multicollinearity (Tabachnick & Fidell, 2013). Examination of the collinearity statistics indicated that tolerance values were all greater than .10 and variance inflation factors (VIF) values did not exceed 10 (Field, 2013).

**Tests of Nonindependence.** An underlying assumption of dyadic data analysis is that two scores from two members of a dyad are more similar to each other than two scores from two people who are not members of the same dyad. Following conventions set by Kenny, Kashy and Cook (2006c) two-tailed Pearson product-moment correlation coefficients were used to test for nonindependence between the dyad members scores on the outcome variables. Interdyadic correlations of psychological distress, relationship satisfaction, pain catastrophizing, and common dyadic coping were statistically significant ($p$’s < .05), supporting that the dyad, rather than the individual, were appropriate as the unit of analysis in the statistical analyses procedures.

**Sample Characteristics**

The final study sample consisted of 71 patient-spouse dyads. Patients were scheduled to undergo CABG ($n = 32; 45.1\%$), mitral valve replacements ($n = 15; 21.1\%$), and aortic valve replacements ($n = 24; 33.8\%$). All couples were either married ($n = 65; 91.5\%$) or in a common-law relationship ($n = 6; 8.5\%$) and had been in a relationship for an average of 41.04 years ($SD = 14.04$). While not an eligibility requirement, all patient-spouse dyads were in heterosexual relationships. The patients were predominantly male ($n = 52; 73.2\%$) and spouses were
predominantly female ($n = 52; 73.2\%)$. The age of the patients ranged from 46 to 84 years with a mean age of 69.42 ($SD = 8.71$). The age of the spouses ranged from 41 to 85 years with a mean age of 67.97 ($SD = 9.54$). Patients and spouses were similar in their levels of education, where 74.6\% of patients and 76.8\% of spouses had attended either college or university. The sample was predominantly Caucasian (patients $n = 66; 93\%$; spouses $n = 65; 91.5\%$).

**Medical Comorbidities.** Medical comorbidity was assessed through self-report with the SCQ in both patients as well as the spouses. For patients, the most common comorbidities with their cardiovascular disease was osteoarthritis ($n = 17; 23.9\%$), back pain ($n = 16; 22.5\%$), and diabetes ($n = 13; 18.3\%$). Thirty patients completed the assessment of functional limitations associated with their heart condition. Of the patients that completed the assessment, 3 (10\%) indicated that they had no limitations of physical activity, 15 (50\%) reported that they had slight limitations of physical activity, 10 (33.3\%) indicated that they had marked limitations of physical activity, and 2 (6.6\%) revealed that they were unable to engage in any physical activity without discomfort. In spouses, the most common medical comorbidities were high blood pressure ($n = 28, 39.4\%$), back pain ($n = 28; 39.4\%$), and cardiovascular disease ($n = 10; 14.1\%$).

**Current Pain Intensity.** At the time of completing the study questionnaires, 33 patients (46.5\%) indicated they were currently experiencing pain. Using numerical rating score (NRS) cut-off points established by Boonstra and colleagues (2016), the majority of patients reported experiencing mild pain, with a NRS between 1 and 5 ($n = 29; 87.9\%$). Three patients (9.1\%) reporting moderate pain with a NRS between 6 and 7. One patient (3\%) reported experiencing severe pain with a NRS of 8. A total of 26 spouses (36.6\%) reported experiencing pain at the time of the assessment. Of these, 18 (69.2\%) reported experiencing mild pain, 7 (26.9\%) reported moderate pain, and 1 (3.9\%) spouse reported severe pain.
**Psychological Distress.** A total distress cut off score of ≥ 16, was used to assess the total level of psychological distress in the sample (Zigmond & Snaith, 1983). It was found that 16 patients (22.5%) and 16 spouses (22.5%) had elevated distress scores. While the current research used total HADS scores to assess for psychological distress, to further characterize the levels of distress in the sample, the patient and spouse HADS scores were assessed for clinically significant levels of anxiety and depression using a cut-off score of ≥ 8 (Bjelland, Dahl, Haug, & Neckelmann, 2002). It was found that 25 patients (35.2%) had clinically significant anxiety scores and 18 patients (25.3%) had clinically significant depression scores. In the spouses, it was found that 30 (42.2%) had clinically significant anxiety scores and 11 (15.5%) had clinically significant depression scores.

**Relationship Satisfaction.** The patient and spouse CSI scores were assessed for relationship dissatisfaction using a cut-off score of less than or equal to 13 (Funk & Rogge, 2007). It was found that 13 patients (18.3%) and 23 spouses (32.4%) had scores that suggest notable relationship dissatisfaction.

**Descriptive and Bivariate Analyses**

Means and standard deviations of study variables are presented in Table 1. Paired t-tests were used to assess for differences between patients and spouses on key study variables including psychological resilience, pain catastrophizing, common dyadic coping, psychological distress, and relationship satisfaction. No significant differences emerged. Pain catastrophizing and relationship satisfaction p’s were ≥ .08 whereas psychological resilience, psychological distress, and common dyadic coping p’s were ≥ .39.
Table 1

Mean, standard deviation, range, and paired sample t-tests of patient and spouse study variables

<table>
<thead>
<tr>
<th></th>
<th>Patient</th>
<th></th>
<th>Spouse</th>
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<td>(M)</td>
<td>(SD)</td>
<td>Range</td>
<td>(M)</td>
<td>(SD)</td>
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<td>12.62</td>
<td>37 - 98</td>
<td>75.85</td>
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<td>4.29</td>
<td>8 - 25</td>
<td>17.39</td>
<td>4.46</td>
</tr>
<tr>
<td>Pain Catastrophizing</td>
<td>13.35</td>
<td>10.65</td>
<td>0 - 50</td>
<td>15.89</td>
<td>8.59</td>
</tr>
<tr>
<td>Psychological Distress</td>
<td>11.44</td>
<td>6.21</td>
<td>0 - 29</td>
<td>11.06</td>
<td>7.10</td>
</tr>
<tr>
<td>Relationship Satisfaction</td>
<td>17.04</td>
<td>3.51</td>
<td>7 - 21</td>
<td>16.13</td>
<td>3.99</td>
</tr>
</tbody>
</table>

*Note. M mean; SD standard deviation; ** \(p < .01\); * \(p < .05\)*

Next, a series of bivariate correlations were conducted (Table 2). Three types of correlations are presented: (1) within-patient above the diagonal line, (2) within-spouse below the diagonal line, and (3) between dyad members bolded in the diagonal line. As expected, greater psychological resilience in the patient and the spouse was significantly correlated with higher levels of their own and their spouses relationship satisfaction and common dyadic coping, and lower levels of pain catastrophizing and psychological distress.
Table 2

Intercorrelations between patient and spouse study variables

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Psychological Resilience</td>
<td>.19</td>
<td>.43**</td>
<td>-.42**</td>
<td>-.41**</td>
<td>.37**</td>
</tr>
<tr>
<td>2. Common Dyadic Coping</td>
<td>.57**</td>
<td>.35**</td>
<td>-.19</td>
<td>-.22</td>
<td>.65**</td>
</tr>
<tr>
<td>3. Pain Catastrophizing</td>
<td>-.29*</td>
<td>-.14</td>
<td>.19</td>
<td>.44**</td>
<td>-.11</td>
</tr>
<tr>
<td>4. Psychological Distress</td>
<td>-.56**</td>
<td>-.45**</td>
<td>.45**</td>
<td>.20</td>
<td>-.08</td>
</tr>
<tr>
<td>5. Relationship Satisfaction</td>
<td>.40**</td>
<td>.68**</td>
<td>-.12</td>
<td>-.36**</td>
<td>.31**</td>
</tr>
</tbody>
</table>

Note. Patient correlations are above the diagonal; spouse correlations are below the diagonal; dyadic correlations are along the diagonal; ** p < .01; * p < .05

Preliminary Dyadic Analysis

Preliminary dyadic analyses included centering variables on grand means, assessing for potential covariates, and determining the distinguishing variable. Empirical distinguishability and degree of nonindependence were assessed using Mplus (Muthén & Muthén, 2019).

Centered Variables. Following guidelines developed by Kenny, Kashy, and Cook (2006c) all variables in the APIM and APIMeM analyses were centered on the grand mean and the centered variables were used in the following APIM and APIMeM analyses.

Covariates. Variables theoretically related to the outcomes variables were identified for the proposed APIM and APIMeM models. Potential covariates considered for inclusion were age, gender, relationship length, medical comorbidities, and current pain intensity. Functional limitations associated with cardiovascular disease were assessed for the subset of patients for which this data were available. Full correlation tables for both the patient and spouse are presented in Appendix B. A covariate is effective if it correlates highly only with the outcome variable. The inclusion of a covariate that is correlated with the predictor variable (i.e.,
psychological resilience) would reduce the statistical power and sensitivity of the analysis (Becker et al., 2016). As no potential covariates (i.e., age, gender, relationship length, medical comorbidities, and current pain intensity) emerged that were correlated with the outcome variables alone (i.e., relationship satisfaction and psychological distress), no covariates were included in the APIM and APIMeM models. The decision to not include control variables is consistent with recent statistical recommendations (e.g., Becker et al., 2016) as the exclusion of control variables improves the interpretability of statistical results.

**Distinguishability.** Distinguishable dyads have inherent characteristics that differentiates the members within a dyad. Examples of indistinguishable dyads include identical twins whereas examples of distinguishable dyads might include a parent and child relationship. In statistical analyses, the decision to treat dyad members as distinguishable or indistinguishable can be made conceptually or empirically (Kenny, Kashy, & Cook, 2006b). In the current sample, conceptually, there are differences in the physical rigour and distress related to undergoing cardiac surgery as opposed to being in a romantic relationship with someone undergoing cardiac surgery. As such, the statistical analyses were tested for distinguishable dyads. Following guidelines by Ackerman and colleagues (2011), an omnibus test of distinguishability was conducted on the two APIM models. The omnibus test of distinguishability involves constraining patient and spouse’s means, variances, intrapersonal covariances, and interpersonal covariances to equality within the model. After the equality constraints are imposed, the model fit was assessed for its chi-square value. For the APIM with psychological resilience predicting relationship satisfaction the model fit was $\chi^2 (4) = 4.70, p = .319$. For the APIM model with psychological resilience predicting psychological distress the model fit was $\chi^2 (4) = 3.66, p = 0.454$. These results suggest that the patient and spouse were not empirically distinguishable in
either APIM model. However, given the role differences between the spouse and the patient undergoing surgery, the decision was made to conduct analyses for distinguishable data.

**Distinguishing Variables.** In the current research there are two factors that could be used to distinguish dyad members: role (patient undergoing the surgical procedure or spouse of patient undergoing surgery) and gender (men or women). The analyses were re-run with gender as the distinguishing variable, and no differences in patterns of significant APIM and APIMeM effects were found. This is likely related to the fact that patients were significantly more likely to be male \(t(70) = 5.06, p < .001\), and, since all couples were heterosexual, spouses were also significant more likely to be female \(t(70) = 5.06, p < .001\).

**Effect Sizes.** An estimate of the standardized effect sizes was calculated for all APIM and APIMeM models. This effect size estimate, following guidelines developed by Kenny, Kashy, and Cook (2006c), was calculated to be appropriate for the nonindependence in dyadic data. Effect sizes were interpreted as small Cohen’s \(d \geq 0.20\), medium Cohen’s \(d \geq 0.50\), and large Cohen’s \(d \geq 0.80\) (Cohen, 2013).

**Power.** To determine statistical power prior to collecting dyadic data, the degree of non-independence between the predictor variables in distinguishable dyads needs to be known (Kenny, Kashy, & Cook, 2006b). At the time this research was conceptualized, limited research had assessed the association between psychological resilience in married dyads, and no research has assessed the association in dyads preparing to undergo major surgery. As information regarding the association between psychological resilience in married or common-law dyads was not available, sample size conventions in published literature were followed (Kenny, Kashy, & Cook, 2006b). A goal of recruiting 70 complete dyads was set. This was deemed an appropriate sample size goal given the limited number of elective coronary artery bypass graft or
aortic/mitral valve replacement surgeries conducted annually at the Interior Heart and Surgical Centre.

**Actor-Partner Interdependence Models**

In the first part of the analyses the actor and partner effects of psychological resilience on relationship satisfaction and psychological distress were examined. The analysis was based on the actor-partner interdependence model (Kenny & Cook, 1999). The basic APIM model is a saturated model (i.e., df = 0) so no model fit indices can be assessed. The basic APIM models include two predictor variables (psychological resilience of the patient and spouse) and the outcome variables (in the first model, relationship satisfaction of the patient and their spouse and in the second model, psychological distress of the patient and their spouse). The relationships between the variables are specified as actor effects, partner effects, and covariances. The actor effects represent the impact of each individual’s predictor variable on their own outcome (e.g., patient resilience predicting patient relationship satisfaction). The partner effects reflect the impact of each person’s predictor variable on his or her partner’s outcome variable (e.g., patient resilience predicting spouse relationship satisfaction). In order to distinguish partner effects, the effects are labelled by referring to the dyad member of the outcome variables (Ledermann, Macho, & Kenny, 2011). For example, the effect from patient predictor (e.g., psychological resilience) to spouse outcome (e.g., relationship satisfaction) is the spouse partner effect and the effect from spouse predictor (e.g., psychological resilience) to patient outcome (e.g., psychological distress) is the patient partner effect.

**Psychological Resilience and Relationship Satisfaction.**

Regarding actor effects greater psychological resilience was linked to greater relationship satisfaction for patients and spouses, respectively $\beta = .10, p < .05$, ES = .33; $\beta = .10, p < .05$, ES
=.36. With regards to partner effects, patients who reported greater psychological resilience had spouses who were significantly more satisfied in their relationships $\beta = .08, p < .05, ES = .26$. However, there was no significant relationship between spouse resilience and patient relationship satisfaction $\beta = .03, p = .462, ES = .10$.

**Psychological Resilience and Psychological Distress.**

With regards to actor effects, patients and spouses who reported higher levels of psychological resilience also reported significantly less psychological distress $\beta = -.19, p < .001, ES = .37; \beta = -.30, p < .001, ES = .57$ respectively. No significant partner effects emerged for the impact of patient’s psychological resilience on their spouse’s psychological distress $\beta = .01, p = .847, ES = .01$, or for the spouse’s psychological resilience on the patients’ distress $\beta = -.06, p = .247, ES = .10$.

**Actor-Partner Interdependence Mediation Models**

To test the mediation hypotheses, the actor-partner interdependence mediation model (APIMeM; Ledermann, Macho, & Kenny, 2011) was used. Specifically, APIMeM was used to evaluate whether coping styles (common dyadic coping and pain catastrophizing) mediated the association between psychological resilience and the outcome variables (relationship satisfaction and psychological distress). In a mediation model, partial mediation occurs when the direct effect (i.e., $c$) is different from 0 in the mediation model whereas full mediation occurs when the direct effect $c$ is not substantial in size and the indirect effect of the predictor on the outcome through the mediator equals the total effect of the predictor on the outcome variable (Ledermann & Macho, & Kenny, 2011). In a standard APIMeM for distinguishable dyads a saturated model has 27 parameters. These parameters include six actor effects, six partner effects, one variance and one mean for each initial variable, one intercept for each mediator and outcome, one variance for
each error term, one covariance between the initial variable, one covariance between the mediators’ error terms, and one between the outcomes’ error terms. In an APIMeM analysis there are four effects between predictor (X) and outcome (Y) variables that could potentially be mediated. In the APIMeM the sum of the two simple indirect effects for a given X Y effect represents the total indirect effect. Further, the sum of the total indirect effect and the corresponding direct c’ provides the total effect. For a representation of an APIMeM model adapted from Ledermann, Macho, & Kenny (2011), see Appendix A.

Mediation analyses were completed using MEDYAD (Coutts, Hayes, & Jiang, 2019), a macro program in SPSS which uses an ordinary least squares regression-based approach to mediation for distinguishable dyadic data. Parametric bootstrapping with 5,000 trials was used to test for the confidence intervals for indirect effects. A total of four APIMeMs were completed where separate analyses examined whether coping style (i.e., common dyadic coping and pain catastrophizing) significantly mediated the association between psychological resilience and the outcome variables (i.e., relationship satisfaction and psychological distress).

**Actor-Partner Interdependence Dyadic Coping Mediation Models**

The following results examine two separate mediation models assessing whether common dyadic coping mediated the relationship between psychological resilience and the outcome variables relationship satisfaction and psychological distress.

*Psychological Resilience and Relationship Satisfaction.* The first APIMeM examined the direct and indirect effects of each individual’s psychological resilience on their own and their spouse’s relationship satisfaction with the indirect effects operating through their own and their spouse’s common dyadic coping (table 3; figure 2). Actor effects were found where greater psychological resilience was linked to greater common dyadic coping in the patient $\beta = .13$, $p <$
001, ES = 0.37 and spouse $\beta = 0.17, p < .001, ES = 0.45$. A partner effect emerged, where the patient’s psychological resilience was significantly associated with their spouse’s common dyadic coping $\beta = 0.10, p = .007, ES = 0.33$. In terms of actor effects, higher levels of common dyadic coping was associated with greater relationship satisfaction in the patient $\beta = 0.47, p < .001, ES = 0.45$ and the spouse $\beta = 0.59, p < .001, ES = 0.46$. No partner effects emerged between common dyadic coping and relationship satisfaction. Further, no significant direct effects were found between psychological resilience and relationship satisfaction.

Three indirect effects were found (Table 4). The first indirect effect occurred when the patient’s common dyadic coping mediated the relationship between patient psychological resilience and their own relationship satisfaction. As well, the spouse’s common dyadic coping mediated the relationship between their own psychological resilience and their own relationship satisfaction. Finally, the spouse’s common dyadic coping mediated the relationship between the patient’s psychological resilience and the spouse’s relationship satisfaction. When a model contains more than one indirect effect, two indirect effects can be statistically compared to each other. A pairwise contrast of indirect effects was completed. The indirect effect of patient psychological resilience on patient relationship satisfaction mediated by patient dyadic coping was contrasted with patient psychological resilience on spouse relationship satisfaction mediated by spouse common dyadic coping. The contrasted indirect effect was .01 with a bootstrapped 95% confidence interval of -.05 to .08. As the confidence interval includes zero, there is no statistical difference between these indirect effects.

Two residuals, which are partial correlations, are provided in this model. The first residual ($r = .16$) represents the association between the mediators (patient and spouse common dyadic coping) controlling for psychological resilience. The residual representing the association
between measures of relationship satisfaction controlling for psychological resilience and
common dyadic coping \( r = .14 \). The correlation between the residuals \( r = .20 \).

**Table 3**

*Effect of psychological resilience on relationship satisfaction via common dyadic coping*

<table>
<thead>
<tr>
<th>Effect</th>
<th>( \beta ) Estimate</th>
<th>SE</th>
<th>( p )</th>
<th>95% CI</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>( a ) effects (Resilience ( \rightarrow ) Dyadic Coping)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Actor Effect</td>
<td>0.13</td>
<td>0.04</td>
<td>.001</td>
<td>.06, .21</td>
<td>.37</td>
</tr>
<tr>
<td>Spouse Actor Effect</td>
<td>0.17</td>
<td>0.03</td>
<td>.000</td>
<td>.11, .24</td>
<td>.45</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
<td>0.05</td>
<td>0.04</td>
<td>.137</td>
<td>-.02, .12</td>
<td>.24</td>
</tr>
<tr>
<td>Spouse Partner Effect</td>
<td>0.10</td>
<td>0.03</td>
<td>.007</td>
<td>.03, .16</td>
<td>.33</td>
</tr>
<tr>
<td>( b ) effects (Dyadic Coping ( \rightarrow ) Relationship Satisfaction)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Actor Effect</td>
<td>0.47</td>
<td>0.09</td>
<td>.000</td>
<td>.30, .64</td>
<td>.45</td>
</tr>
<tr>
<td>Spouse Actor Effect</td>
<td>0.59</td>
<td>0.10</td>
<td>.000</td>
<td>.38, .80</td>
<td>.46</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
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<td>0.09</td>
<td>.215</td>
<td>-.07, .31</td>
<td>.21</td>
</tr>
<tr>
<td>Spouse Partner Effect</td>
<td>-0.02</td>
<td>0.09</td>
<td>.822</td>
<td>-.21, .17</td>
<td>.09</td>
</tr>
<tr>
<td>( c' ) effects (Resilience ( \rightarrow ) Relationship Satisfaction)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Actor Effect</td>
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<td>0.03</td>
<td>.473</td>
<td>-.04, .08</td>
<td>.16</td>
</tr>
<tr>
<td>Spouse Actor Effect</td>
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<td>0.03</td>
<td>.914</td>
<td>-.06, .07</td>
<td>.06</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
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<td>0.03</td>
<td>.581</td>
<td>-.08, .04</td>
<td>.14</td>
</tr>
<tr>
<td>Spouse Partner Effect</td>
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<td>0.03</td>
<td>.514</td>
<td>-.04, .09</td>
<td>.16</td>
</tr>
</tbody>
</table>

*Note.* \( SE \) standard error; ES Cohen’s d.
Figure 2

Effect of psychological resilience on relationship satisfaction via common dyadic coping
Table 4

<table>
<thead>
<tr>
<th>Indirect Effects</th>
<th>Effect</th>
<th>Boot SE</th>
<th>Boot 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient resilience on patient relationship satisfaction via patient common dyadic coping</td>
<td>.06</td>
<td>.02</td>
<td>.02, .12</td>
</tr>
<tr>
<td>Patient resilience on patient relationship satisfaction via spouse common dyadic coping</td>
<td>.01</td>
<td>.01</td>
<td>-.01, .03</td>
</tr>
<tr>
<td>Patient psychological resilience on spouse relationship satisfaction via patient common dyadic coping</td>
<td>-.00</td>
<td>.02</td>
<td>-.04, .03</td>
</tr>
<tr>
<td><strong>Patient resilience on spouse relationship satisfaction via spouse common dyadic coping</strong></td>
<td>.06</td>
<td>.02</td>
<td>.02, .10</td>
</tr>
<tr>
<td><strong>Spouse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spouse resilience on patient relationship satisfaction via patient common dyadic coping</td>
<td>.03</td>
<td>.02</td>
<td>-.01, .07</td>
</tr>
<tr>
<td>Spouse resilience on patient relationship satisfaction via spouse common dyadic coping</td>
<td>.02</td>
<td>.02</td>
<td>-.01, .06</td>
</tr>
<tr>
<td>Spouse psychological resilience on spouse relationship satisfaction via patient common dyadic coping</td>
<td>-.00</td>
<td>.01</td>
<td>-.02, .01</td>
</tr>
<tr>
<td><strong>Spouse resilience on spouse relationship satisfaction via spouse common dyadic coping</strong></td>
<td>.10</td>
<td>.03</td>
<td>.05, .16</td>
</tr>
</tbody>
</table>

*Note.* SE standard error.

**Psychological Resilience and Psychological Distress.**

The second model examined the direct and indirect effects of each individual’s psychological resilience on their own and their spouses’ psychological distress with the indirect effects operating through their own and their spouses common dyadic coping (Table 5; Figure 3). As described above, in terms of actor effects, greater psychological resilience was linked to greater common dyadic coping in the patient and spouse. The patient’s psychological resilience was also significantly associated with their spouse’s common dyadic coping. No statistically
significant actor or partner effects emerged between common dyadic coping and psychological distress (all \( p' \)'s > .113), and Cohen’s \( d \) effect sizes were small or negligible for both patient and partner effects ranging from .10 to .23. Direct actor effects of psychological resilience on psychological distress were found for patients \( \beta = -0.19, p = 0.003, ES = 0.32 \) and their spouses \( \beta = -0.22, p = 0.001, ES = 0.34 \). As described above in the APIM analyses, no significant partner direct effects were found for psychological resilience and distress. No significant indirect effects were found (Table 6).

Two residuals, which are partial correlations, are provided in this model. As described above, the first residual \( (r = 0.16) \) represents the association between the mediators (patient and spouse common dyadic coping) controlling for psychological resilience. The second residual \( (r = 0.13) \) represents the association between measures of patient and spouse psychological distress controlling for psychological resilience and common dyadic coping. The correlation between the two residuals in this model is .12.
Table 5

Effects of psychological resilience on psychological distress via common dyadic coping

<table>
<thead>
<tr>
<th>Effect</th>
<th>β Estimate</th>
<th>SE</th>
<th>p</th>
<th>95% CI</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a effects (Resilience → Dyadic Coping)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Actor Effect</td>
<td>0.13</td>
<td>0.04</td>
<td>.001</td>
<td>.06, .21</td>
<td>.37</td>
</tr>
<tr>
<td>Spouse Actor Effect</td>
<td>0.17</td>
<td>0.03</td>
<td>.000</td>
<td>.11, .24</td>
<td>.45</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
<td>0.05</td>
<td>0.04</td>
<td>.137</td>
<td>-.02, .12</td>
<td>.24</td>
</tr>
<tr>
<td>Spouse Partner Effect</td>
<td>0.10</td>
<td>0.03</td>
<td>.007</td>
<td>.03, .16</td>
<td>.33</td>
</tr>
<tr>
<td><strong>b effects (Dyadic Coping → Distress)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Actor Effect</td>
<td>-0.06</td>
<td>0.18</td>
<td>.764</td>
<td>-.42, .31</td>
<td>.10</td>
</tr>
<tr>
<td>Spouse Actor Effect</td>
<td>-0.32</td>
<td>0.20</td>
<td>.125</td>
<td>-.72, .09</td>
<td>.23</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
<td>0.10</td>
<td>0.20</td>
<td>.633</td>
<td>-.31, .50</td>
<td>.13</td>
</tr>
<tr>
<td>Spouse Partner Effect</td>
<td>-0.30</td>
<td>0.18</td>
<td>.113</td>
<td>-.67, .07</td>
<td>.23</td>
</tr>
<tr>
<td><strong>c′ effects (Resilience → Distress)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Actor Effect</td>
<td>-0.19</td>
<td>0.06</td>
<td>.003</td>
<td>-.32, -.07</td>
<td>.32</td>
</tr>
<tr>
<td>Spouse Actor Effect</td>
<td>-0.22</td>
<td>0.06</td>
<td>.001</td>
<td>-.35, -.10</td>
<td>.34</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
<td>-0.07</td>
<td>0.06</td>
<td>.253</td>
<td>-.20, .05</td>
<td>.20</td>
</tr>
<tr>
<td>Spouse Partner Effect</td>
<td>0.08</td>
<td>0.06</td>
<td>.213</td>
<td>-.05, .21</td>
<td>.21</td>
</tr>
</tbody>
</table>

Note. SE standard error; ES Cohen’s d.
Figure 3

Effects of psychological resilience on psychological distress via common dyadic coping
Table 6

*Indirect effects of psychological resilience on psychological distress via common dyadic coping*

<table>
<thead>
<tr>
<th>Indirect Effects</th>
<th>Effect</th>
<th>Boot SE</th>
<th>Boot 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient resilience on patient distress via patient dyadic coping</td>
<td>-.01</td>
<td>.03</td>
<td>-.06, .05</td>
</tr>
<tr>
<td>Patient resilience on patient distress via spouse common dyadic coping</td>
<td>.01</td>
<td>.02</td>
<td>-.03, .05</td>
</tr>
<tr>
<td>Patient resilience on spouse distress via patient common dyadic coping</td>
<td>-.04</td>
<td>.03</td>
<td>-.11, .01</td>
</tr>
<tr>
<td>Patient resilience on spouse distress via spouse common dyadic coping</td>
<td>-.03</td>
<td>.02</td>
<td>-.08, .01</td>
</tr>
<tr>
<td><strong>Spouse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spouse resilience on patient distress via patient dyadic coping</td>
<td>-.00</td>
<td>.01</td>
<td>-.03, .02</td>
</tr>
<tr>
<td>Spouse resilience on patient distress via spouse common dyadic coping</td>
<td>.02</td>
<td>.03</td>
<td>-.05, .09</td>
</tr>
<tr>
<td>Spouse resilience on spouse distress via patient dyadic coping</td>
<td>-.02</td>
<td>.02</td>
<td>-.06, .01</td>
</tr>
<tr>
<td>Spouse resilience on spouse distress via spouse common dyadic coping</td>
<td>-.06</td>
<td>.04</td>
<td>-.13, .02</td>
</tr>
</tbody>
</table>

*Note.* SE standard error.

**Actor-Partner Interdependence Pain Catastrophizing Mediation Models**

The following results examine mediation models assessing whether pain catastrophizing mediated the relationship between psychological resilience and the outcome variables relationship satisfaction and psychological distress.

*Psychological Resilience and Relationship Satisfaction.* The third model assessed whether pain catastrophizing mediated the association between psychological resilience and relationship satisfaction. This model examined the direct and indirect effects of each individual’s psychological resilience on their own and their spouses’ relationship satisfaction with the indirect effects operating through their own and their spouses pain catastrophizing (table 7; figure 4).
With respect to actor effects, greater psychological resilience was linked to lower pain catastrophizing in the patient $\beta = -0.36, p = < .001$, ES = 0.36 and in the spouse $\beta = -0.17, p = .024$, ES = 0.28. No significant relationships emerged between pain catastrophizing and relationship satisfaction. As described in the APIM model above, direct effects were found for patient psychological resilience on both patient and spouse relationship satisfaction. For the spouse’s psychological resilience, a direct effect was found for their own relationship satisfaction. No indirect effects emerged (table 8).

The first residual ($r = .16$) represents the association between the mediators (patient and spouse pain catastrophizing) controlling for psychological resilience. The residuals representing the association between measures of relationship satisfaction controlling for psychological resilience and pain catastrophizing, $r = .20$. The correlation between the residuals is .20.
Table 7

Effects of psychological resilience on relationship satisfaction via pain catastrophizing

<table>
<thead>
<tr>
<th>Effect</th>
<th>$\beta$ Estimate</th>
<th>SE</th>
<th>$p$</th>
<th>95% CI</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a$ effects (Resilience $\rightarrow$ Catastrophizing)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Actor Effect</td>
<td>-0.36</td>
<td>0.09</td>
<td>.000</td>
<td>-.55, -.17</td>
<td>.36</td>
</tr>
<tr>
<td>Spouse Actor Effect</td>
<td>-0.17</td>
<td>0.08</td>
<td>.024</td>
<td>-.33, -.02</td>
<td>.28</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
<td>0.03</td>
<td>0.09</td>
<td>.744</td>
<td>-.15, .21</td>
<td>.11</td>
</tr>
<tr>
<td>Spouse Partner Effect</td>
<td>-0.06</td>
<td>0.08</td>
<td>.458</td>
<td>-.22, .10</td>
<td>.16</td>
</tr>
<tr>
<td>$b$ effects (Catastrophizing $\rightarrow$ Relationship Satisfaction)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Actor Effect</td>
<td>0.03</td>
<td>0.04</td>
<td>.504</td>
<td>-.05, .11</td>
<td>.16</td>
</tr>
<tr>
<td>Spouse Actor Effect</td>
<td>0.00</td>
<td>0.05</td>
<td>.998</td>
<td>-.11, .11</td>
<td>.01</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
<td>-0.07</td>
<td>0.05</td>
<td>.127</td>
<td>-.17, .02</td>
<td>.24</td>
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<tr>
<td>Spouse Partner Effect</td>
<td>0.06</td>
<td>0.05</td>
<td>.225</td>
<td>-.03, .15</td>
<td>.21</td>
</tr>
<tr>
<td>$c'$ effects (Resilience $\rightarrow$ Relationship Satisfaction)</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Patient Actor Effect</td>
<td>0.10</td>
<td>0.03</td>
<td>.005</td>
<td>.03, .17</td>
<td>.33</td>
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<tr>
<td>Spouse Actor Effect</td>
<td>0.10</td>
<td>0.03</td>
<td>.004</td>
<td>.04, .17</td>
<td>.33</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
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<td>0.03</td>
<td>.621</td>
<td>-.05, .08</td>
<td>.14</td>
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<tr>
<td>Spouse Partner Effect</td>
<td>0.09</td>
<td>0.04</td>
<td>.016</td>
<td>.02, .17</td>
<td>.30</td>
</tr>
</tbody>
</table>

Note. SE standard error; ES Cohen’s d.
Figure 4

Effects of psychological resilience on relationship satisfaction via pain catastrophizing
Table 8

Indirect effects of psychological resilience on relationship satisfaction via pain catastrophizing

<table>
<thead>
<tr>
<th>Indirect Effect</th>
<th>Effect</th>
<th>Boot SE</th>
<th>Boot 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient resilience on patient relationship satisfaction via patient pain catastrophizing</td>
<td>-.01</td>
<td>.01</td>
<td>-.04, .02</td>
</tr>
<tr>
<td>Patient resilience on patient relationship satisfaction via spouse catastrophizing</td>
<td>.00</td>
<td>.01</td>
<td>-.01, .02</td>
</tr>
<tr>
<td>Patient resilience on spouse relationship satisfaction via patient catastrophizing</td>
<td>-.02</td>
<td>.02</td>
<td>-.05, .01</td>
</tr>
<tr>
<td>Patient resilience on spouse relationship satisfaction via spouse catastrophizing</td>
<td>.00</td>
<td>.00</td>
<td>-.01, .01</td>
</tr>
<tr>
<td><strong>Spouse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spouse resilience on patient relationship satisfaction via patient catastrophizing</td>
<td>.00</td>
<td>.00</td>
<td>-.01, .01</td>
</tr>
<tr>
<td>Spouse resilience on patient relationship satisfaction via spouse catastrophizing</td>
<td>.01</td>
<td>.01</td>
<td>-.00, .04</td>
</tr>
<tr>
<td>Spouse resilience on spouse relationship satisfaction via patient catastrophizing</td>
<td>.00</td>
<td>.00</td>
<td>-.01, .01</td>
</tr>
<tr>
<td>Spouse resilience on spouse relationship satisfaction via spouse pain catastrophizing</td>
<td>.00</td>
<td>.01</td>
<td>-.02, .02</td>
</tr>
</tbody>
</table>

*Note. SE standard error.*

**Psychological Resilience and Psychological Distress.** The fourth APIMeM examined the direct and indirect effects of each individual’s psychological resilience on their own and their spouses’ psychological distress with the indirect effects operating through their own and their spouse’s pain catastrophizing (Table 9; Figure 5). A significant negative relationship emerged between psychological resilience and pain catastrophizing in the patient $\beta = -.36, p = < .001$, ES $= 0.36$ and spouse $\beta = -.17, p = .024$, ES $= 0.28$. Further, significant actor effects were found between higher pain catastrophizing and higher psychological distress in the patient $\beta = .19, p =$
.008, ES = 0.31 and spouse $\beta = .25$, $p = .004$, ES = 0.32. As described above in the APIM model, significant negative direct effects were found for psychological resilience on psychological distress in the patient and the spouse. In terms of indirect effects, it was found that pain catastrophizing partially mediated the relationship between psychological resilience and psychological distress in the patient as well as the spouse (table 10).

Two residuals, representing partial correlations, are available in this model. As described above, the first residual, representing the association between pain catastrophizing controlling for psychological resilience is $r = .16$. The second residual, representing the association between measures of psychological distress controlling for psychological resilience and pain catastrophizing is $r = .09$. The correlation between the residuals is $r = .12$. 
Table 9

Effects of psychological resilience on psychological distress via pain catastrophizing

<table>
<thead>
<tr>
<th>Effect</th>
<th>( \beta ) Estimate</th>
<th>SE</th>
<th>( p )</th>
<th>95% CI</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td>( a ) effects (Resilience ( \rightarrow ) Catastrophizing)</td>
<td></td>
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</tr>
<tr>
<td>Patient Actor Effect</td>
<td>-0.36</td>
<td>0.09</td>
<td>.000</td>
<td>-.55, -.17</td>
<td>.36</td>
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<tr>
<td>Spouse Actor Effect</td>
<td>-0.17</td>
<td>0.08</td>
<td>.024</td>
<td>-.33, -.02</td>
<td>.28</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
<td>0.03</td>
<td>0.09</td>
<td>.744</td>
<td>-.15, .21</td>
<td>.11</td>
</tr>
<tr>
<td>Spouse Partner Effect</td>
<td>-0.06</td>
<td>0.08</td>
<td>.458</td>
<td>-.22, .10</td>
<td>.16</td>
</tr>
<tr>
<td>( b ) effects (Catastrophizing ( \rightarrow ) Distress)</td>
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<td></td>
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<tr>
<td>Patient Actor Effect</td>
<td>0.19</td>
<td>0.07</td>
<td>.008</td>
<td>.05, .33</td>
<td>.31</td>
</tr>
<tr>
<td>Spouse Actor Effect</td>
<td>0.25</td>
<td>0.08</td>
<td>.004</td>
<td>.08, .42</td>
<td>.32</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
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<td>0.08</td>
<td>.872</td>
<td>-.15, .17</td>
<td>.07</td>
</tr>
<tr>
<td>Spouse Partner Effect</td>
<td>0.04</td>
<td>0.07</td>
<td>.596</td>
<td>-.10, .18</td>
<td>.14</td>
</tr>
<tr>
<td>( c' ) effects (Resilience ( \rightarrow ) Distress)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient Actor Effect</td>
<td>-0.12</td>
<td>0.06</td>
<td>.041</td>
<td>-.24, -.01</td>
<td>.27</td>
</tr>
<tr>
<td>Spouse Actor Effect</td>
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<td>0.05</td>
<td>.000</td>
<td>-.36, -.15</td>
<td>.40</td>
</tr>
<tr>
<td>Patient Partner Effect</td>
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<td>0.05</td>
<td>.235</td>
<td>-.17, .04</td>
<td>.20</td>
</tr>
<tr>
<td>Spouse Partner Effect</td>
<td>0.04</td>
<td>0.06</td>
<td>.526</td>
<td>-.08, .16</td>
<td>.15</td>
</tr>
</tbody>
</table>

*Note. SE standard error; ES Cohen’s d.*
Figure 5

Effects of psychological resilience on psychological distress via pain catastrophizing
Table 10

*Indirect effects of psychological resilience on psychological distress via pain catastrophizing*

<table>
<thead>
<tr>
<th>Indirect Effects</th>
<th>Effect</th>
<th>Boot SE</th>
<th>Boot 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient resilience on patient distress via patient</td>
<td>-.07</td>
<td>.04</td>
<td>-.15, -.01</td>
</tr>
<tr>
<td>catastrophizing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient resilience on patient distress via spouse</td>
<td>-.00</td>
<td>.01</td>
<td>-.02, .02</td>
</tr>
<tr>
<td>catastrophizing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient resilience on spouse distress via patient</td>
<td>-.01</td>
<td>.02</td>
<td>-.07, .03</td>
</tr>
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<td>catastrophizing</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Patient resilience on spouse distress via spouse</td>
<td>-.02</td>
<td>.02</td>
<td>-.06, .02</td>
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</tr>
<tr>
<td><strong>Spouse</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Spouse resilience on patient distress via patient</td>
<td>.01</td>
<td>.02</td>
<td>-.02, .05</td>
</tr>
<tr>
<td>catastrophizing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spouse resilience on patient distress via spouse</td>
<td>-.00</td>
<td>.02</td>
<td>-.04, .03</td>
</tr>
<tr>
<td>catastrophizing</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Spouse resilience on spouse distress via patient</td>
<td>.00</td>
<td>.01</td>
<td>-.01, .02</td>
</tr>
<tr>
<td>catastrophizing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spouse resilience on spouse distress via spouse</td>
<td>-.04</td>
<td>.02</td>
<td>-.10, -.004</td>
</tr>
<tr>
<td>catastrophizing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. SE standard error.*

**Summary of Results**

A brief summary of the results of the six research aims is presented below:

The first aim was to understand the extent to which psychological resilience is associated with patient and spouse levels of relationship satisfaction. As hypothesized, one’s own psychological resilience was linked to greater relationship satisfaction in both patients and spouses. Patients who scored higher on psychological resilience also had spouses who were significantly more satisfied in their romantic relationship.

The second aim was to understand the extent to which psychological resilience is associated with patient and spouse psychological distress. Similar to aim one, actor effects...
emerged whereby greater psychological resilience was associated with lower levels of psychological distress in both the patient as well as their spouse. Contrary to hypotheses, resilience was not significantly related to partner levels of distress.

The aims of research question three and four were to investigate the indirect associations between psychological resilience and study outcomes via common dyadic coping. Results indicated that the patient’s common dyadic coping mediated the relationship between their own psychological resilience and their own relationship satisfaction. As well, the spouse’s common dyadic coping mediated the relationship between their own psychological resilience and their own relationship satisfaction. Finally, the spouse’s common dyadic coping mediated the relationship between the patient’s psychological resilience and the spouse’s relationship satisfaction. Contrary to study hypotheses, dyadic coping did not significantly mediate the relationship between resilience and psychological distress.

The aims of research question five and six were to investigate the indirect association of between psychological resilience and study outcomes via catastrophizing. There was no evidence for a mediating role of catastrophizing in the association between resilience and relationship satisfaction. However, patient pain catastrophizing significantly mediated the relationship between their own psychological resilience and their psychological distress. Further, it was found that spouse catastrophizing (about the patient’s pain) mediated the relationship between their own psychological resilience and their own psychological distress.
Discussion

Cardiac surgeries are among the most commonly performed surgical interventions worldwide. The current study adds to a growing body of literature that examines the impact of psychological and social factors on the well-being of patients and their spouses during the perioperative period. Psychological resilience is a well-established protective factor for individuals facing adversity. Yet, research on resilience in the context of dyads, as well as research that investigates how and why psychological resilience helps individuals and couples manage and adapt to stressful situations is surprisingly scarce. As there is a dearth of research in this area, the overarching goal of the current research was to investigate the extent to which psychological resilience is related to emotional and social outcomes in patients undergoing cardiac surgery and their spouses, and the extent to which resilience influences outcomes via ways of coping with stress. Within an actor-partner interdependence model, significant actor effects emerged, suggesting that psychological resilience may serve as a protective factor against psychological and relationship distress among patients as well as their spouses. Partner effects were also identified, suggesting that patient resilience may have implications for spouse levels of relationship satisfaction in the context of an impending cardiac surgery. The findings of this research also point to the role of common dyadic coping and pain catastrophizing in helping to explain the benefits of psychological resilience in dyads. What follows is a detailed discussion of the study’s findings, as well as the methodological, theoretical, and clinical implications of this research.

Psychological Resilience and Relationship Satisfaction. The first aim of this work was to assess the association between psychological resilience and relationship satisfaction in patient-spouse dyads. As hypothesized, psychological resilience was linked to greater relationship
satisfaction in both patients as well as their spouses with small effect sizes found. These findings are consistent with the limited previous research that has been conducted in this area which has identified greater psychological resilience as an important catalyst for relationship satisfaction in romantic couples (e.g., Bradley & Hojjat, 2017; Chochovski, Moss, & Charman, 2013). In the current research, a small sized partner effect emerged in which patients who indicated greater psychological resilience had spouses who were more satisfied in their romantic relationship. The small but significant association between patient and spouse psychological resilience and the spouse’s relationship satisfaction is particularly noteworthy given that almost a third of the spouses reported significant levels of dissatisfaction in their relationships, suggesting that interventions targeting resilience could be beneficial for this population at risk for poorer relationship quality. Meanwhile, the relationship satisfaction of the patient was not influenced by the psychological resilience of their spouse. One possible explanation of these results could be that the patient may be more focused on and overwhelmed by their imminent surgical procedure, and thus may not be as attentive or impacted by their spouse’s characteristics, including psychological resilience. Patient relationship satisfaction was also more positive than spouses’ (81.7% of patients reported scores reflecting relationship satisfaction compared to 67.6% of spouses), leading to a possible ceiling effect when attempting to predict relationship outcomes for the patient. Lastly, the discrepancy in partner effects may also be related to the greater prevalence of male patients (and their female spouses) who participated in this research. In other words, it may be the case that wives’ relationship satisfaction is more impacted by their husbands’ resilience than vice versa. Given these findings, future research could benefit from focusing on protective factors that are perhaps unique to patients and spouses, as well as the moderating role of gender in these relationships.
This is the first study, to the author’s knowledge, to document the interdependence of resilience in patient-spouse dyads in a perioperative context. The current findings build on previous dyadic research assessing individual traits associated with well-being within couples undergoing cardiac surgery (Ruiz et al., 2006). Specifically, Ruiz and colleagues (2006) found that higher spouse neuroticism prior to the surgery predicted higher patient depressive symptoms following the surgery, and similarly, higher patient neuroticism predicted greater depressive symptoms in the patients’ spouse after the surgical procedure. The partner effects which were found in the current research, along with previous research conducted by Ruiz and colleagues (2006) highlight the importance of studying predictors of relationship quality and emotional well-being from a dyadic perspective, and specifically that partners can influence one another in meaningful ways when preparing to undergo a stressful process such as cardiac surgery.

**Psychological Resilience and Psychological Distress.** The second aim was to assess the relationship between psychological resilience and psychological distress in patient-spouse dyads. In the current research, 22.5% of both patients and spouses reported elevated levels of psychological distress, highlighting the need to identify risk and protective factors for distress in this population. It is also worth noting that anxiety featured prominently in this sample, highlighting the anxious anticipation of imminent cardiac surgery. Specifically, 42.2% of the spouses reported clinically significant levels of anxiety as did 35.2% of patients.

In the current research, significant actor effects emerged in the patient as well as the spouse, such that psychological resilience was inversely associated with participants’ own levels of psychological distress. The effect size was small for patients and medium for spouses. These findings are consistent with research showing the protective benefits of psychological resilience for individuals with cardiovascular disease (e.g., Liu et al., 2018; Toukhsati et al., 2017). Further,
the findings are in line with a recent review of the protective benefits of psychological resilience against psychological distress among caregivers for a range of chronic diseases (Palacio et al., 2019). In terms of previous research in dyads, the findings are also consistent with the protective benefits of resilience against one’s own levels of psychological distress among hematopoietic stem cell transplant patient and family caregiver dyads (Cuhadar et al., 2016) and cancer survivor patient-spouse dyads (Lim, Shon, Paek, & Daly, 2014).

Contrary to hypotheses, no partner effects of resilience on distress emerged. In other words, psychological resilience in one member of the dyad did not influence the psychological distress in the other member. It is becoming increasingly clear that the factors that influence psychological distress in the perioperative period are nuanced and complicated (Levett & Grimmett, 2019). Research on the transitive influence of patients’ and spouses’ presurgical characteristics on their partners adaptation to surgery (i.e., the influence one person has on a second person) is sparse in the health research literature. In the limited research that has been conducted in dyads undergoing cardiac surgery, partner effects have emerged for neuroticism, but not optimism (Ruiz et al., 2006). Consistent with this, the current research failed to identify partner effects for psychological resilience on psychological distress. It is possible that the impact of these traits is not evident until the post-operative period, or perhaps that maladaptive traits may be more powerful predictors of well-being than adaptive traits. It is also possible that protective factors such as psychological resilience influence close others more indirectly through coping mechanisms. To that end, a review of surgical resilience found that resilient surgical patients tend to have better coping skills, which in turn facilitates improved post-operative recovery (Graham & Becerril-Martinzez, 2014).
**Psychological Resilience and the Mediating Role of Common Dyadic Coping.** The third and fourth research aims were to investigate whether greater levels of dyadic coping could help explain the link between psychological resilience and emotional and relational outcomes in couples. The antecedents of dyadic coping, specifically the concepts that precede dyadic coping in intimate relationships, is gaining increased attention in the research literature (Staff, Didymus, & Backhouse, 2017). Highly resilient individuals may be more active in their interpersonal relationships and thereby elicit more positive responses from their spouses (e.g., Lim et al., 2014). In the current research small effect sizes emerged for patients as well as spouses suggesting those who reported greater psychological resilience were more likely to collaborate together to manage stressful experiences. As well, a small-sized partner effect emerged in which greater psychological resilience in the patient was associated with greater common dyadic coping in the spouse. These findings support the notion that resilient individuals are more engaged in their intimate relationships and elicit more positive responses from their spouse (Lim et al., 2014).

**Common Dyadic Coping and Relationship Satisfaction.** In line with study hypotheses, patients and spouses who reported greater common dyadic coping also reported stronger relationship satisfaction, with small to medium effect sizes emerging. These findings are consistent with a recent meta-analysis including 72 studies and 17,856 participants which found that dyadic coping is strongly correlated with relationship satisfaction (Falconier, et al., 2015). In this review, the strongest predictor of relationship satisfaction in both men and women was the extent to which partners’ collaborated to manage stress (i.e., common dyadic coping processes). Research suggests that this holds true for couples facing serious medical conditions. For example, in patient-spouse dyads managing a cancer diagnosis it was found that engaging in
common dyadic coping is associated with improved functioning of the relationship (Badr et al., 2010). The association between common dyadic coping and relationship satisfaction found in the current research is in line with emerging research on couples’ resilience which found that when couples experience stressful life events, social factors such as greater likelihood to collaborate to manage stress (i.e., common dyadic coping) are associated with greater relationship satisfaction (Sanford et al., 2016). Although most research has been cross-sectional, a recent dyadic longitudinal study of 240 couples over five years has also demonstrated that both men and women were more satisfied with their romantic relationships when they and their partners reported higher levels of dyadic coping (Rusu et al., 2020).

The current research also adds to our current understanding of why psychological resilience impacts relationships. Specifically, the extent to which couples collaborated to manage stressors together mediated the relationship between their own resilience and their own sense of relationship satisfaction. As well, a partner effect emerged where greater psychological resilience in the patient was associated with greater relationship satisfaction in the spouse via higher levels of common dyadic coping in the spouse. This partner effect suggests that the degree of psychological resilience in the cardiac surgery patient may facilitate or encourage the extent to which the spouse responds to them in a collaborative manner, and that collaboration to manage stressors in the perioperative period was associated with the spouses’ stronger relationship satisfaction.

**Common Dyadic Coping and Psychological Distress.** The fourth aim of the current research was to assess the extent to which common dyadic coping mediates the relationship between psychological resilience and psychological distress. Contrary to study hypotheses and contrary to the positive association between dyadic coping and relationship satisfaction, no
significant effects were found between common dyadic coping and psychological distress, and common dyadic coping did not help to explain the relationship between psychological resilience and psychological distress. The lack of association between common dyadic coping and psychological distress could be partially explained by previous findings that increased common dyadic coping can sometimes be associated with decreased expression of negative feelings in individuals as well as their spouses (Bodenmann et al., 2004). The lack of significant findings could also be related to the relatively low levels of distress in the current sample. There have been mixed findings about the association between common dyadic coping and psychological distress, and the mixed results seem to be related to the varying levels of distress in the populations assessed. The previous research which has found an association between common dyadic coping and psychological distress was conducted in more highly distressed dyads. In 191 couples facing incurable metastatic breast cancer, common dyadic coping was associated with higher levels of distress in patients whereas partners who reported more dyadic coping reported slightly lower levels of distress (Badr et al., 2010). In a longitudinal study assessing the relationship between dyadic coping and adjustment to cancer, increased common dyadic coping has been associated with lower depression in 538 patient-spouse dyads in individuals coping with nonmetastatic breast cancer following surgery (Rottman et al., 2015). The inconsistency in these findings between Badr and colleagues (2010) and Rottman and colleagues (2015) may be related to the level of distress and prognosis of the individuals in their sample. In sum, the association between common dyadic coping and psychological distress appears to be complex. It is possible that within the current research some individuals may be reporting more dyadic coping because they are more stressed and subsequently are engaging in more coping efforts. Further, it is possible that some other factors such as demographics, individual differences, and
contextual factors might be influencing the relationship between dyadic coping and psychological distress.

**Psychological Resilience and the Mediating Role of Pain Catastrophizing.** The fourth and fifth research aims were to investigate whether pain catastrophizing could help explain the link between resilience and emotional and relational outcomes in couples. In a comprehensive model of pain adaptation which integrates psychological vulnerability and resilience to pain, greater psychological resilience has been associated with lower pain catastrophizing (Sturgeon & Zautra, 2013). Consistent with the comprehensive model of pain adaptation, in the current research, small effect sizes were found, suggesting patients and spouses who were higher in psychological resilience reported lower levels of pain catastrophizing. The association between greater resilience and less catastrophizing is consistent with an emerging body of research that suggests that positive psychological qualities, including resiliency, would be negatively associated with pain catastrophizing among patients (Pulvers & Hood, 2013). While the current research was cross-sectional, previous longitudinal research in chronic pain patients has found that, independent of relevant factors such as pain intensity, individuals with high levels of resilience exhibited lower day-to-day levels of pain catastrophizing compared to individuals with lower levels of resilience (Ong, Zautra, & Reid, 2010).

An interesting trend in the data also emerged, showing that spouses of patients were reporting higher levels of catastrophizing about their spouse’s pain than patients’ own pain catastrophizing. The findings of the current research are in line with the limited research that has been conducted showing that spouses do catastrophize about the pain experienced by their partner (Cano, Leonard, & Franz, 2005). To date, limited research has assessed the dyadic context of pain catastrophizing in romantic couples and no research has assessed dyadic pain
catastrophizing in romantic couples in a perioperative setting. However, a similar line of research has been conducted within parent-child dyads (Noel et al., 2015) which found that parent catastrophizing exerted a direct influence on both the parent’s and their children’s memories of the child’s postsurgical pain. In the adult literature, only one published article could be identified that used dyadic methods to examine spouse catastrophizing about their partner’s pain. The results of this study, which included 101 patient-spouse dyads, found that spouses do catastrophize about their partners’ pain (Müller et al., 2019) and that the maladaptive effect of their catastrophizing appears to be an interpersonal and dyadic process. Specifically, the researchers found that spouse catastrophizing contributed to the patient’s fatigue severity through the couple’s ruminative communication patterns. Research on spousal catastrophizing of their partner’s pain is clearly an underdeveloped and important area for future research.

**Pain Catastrophizing and Relationship Satisfaction.** The fifth aim of the current research was to assess the extent to which pain catastrophizing mediates the relationship between psychological resilience and relationship satisfaction. Pain catastrophizing was not associated with relationship satisfaction and no significant indirect effects emerged, suggesting that pain catastrophizing did not mediate the relationship between psychological resilience and relationship satisfaction in this sample. It is possible that rather than having an indirect impact on relationship satisfaction, pain catastrophizing could be related to more overt pain behaviours (e.g., grimacing, vocalizations), which could in turn influence the relationship quality in married couples. In the research literature there is an increasing trend to investigate pain catastrophizing in daily life to assess the extent to which pain catastrophizing is used as an interpersonal coping strategy in romantic couples. For example, using daily diary methodology in 105 married couples where one member of the dyad has chronic low back pain, Burns and colleagues (2015)
found that patients demonstrated greater pain catastrophizing in the presence of their romantic partner, and that the pain catastrophizing was associated with increased pain intensity and pain interference. Notably in this research greater pain catastrophizing in the patient at an early time in the day predicted an increase in their perception of spousal support at a later time in the day. It is possible that there are individual differences in the extent to which individuals overtly catastrophize their pain in the presence of their spouse. Further, there is likely a bidirectional relationship such that levels of catastrophizing are also influenced by characteristics of the spouse and the relationship.

**Pain Catastrophizing and Psychological Distress.** The sixth and final aim of the current research was to assess the extent to which pain catastrophizing mediates the relationship between psychological resilience and psychological distress. Previous research has linked pain catastrophizing with psychological distress in cardiac surgery patients (Khan et al., 2012). In the current research two significant indirect effects emerged. Among both patients and spouses, higher psychological resilience was related to lower distress, and this was explained in part by the fact that they engaged in lower levels of pain catastrophizing.

These findings add to a growing literature examining the relationship between positive psychological states and psychological distress, and whether pain catastrophizing mediates that relationship. For example, research conducted by Tran and colleagues (2017) in 70 individuals with chronic pain found that those higher in trait happiness tended to report lower levels of depressive symptomatology and that this effect was mediated by lower levels of pain catastrophizing. Taken together, these results support emerging research on the inverse relationship between positive traits (including psychological resiliency) and pain catastrophizing.
(Pulvers & Hood, 2013) and help us understand why resilience is so important when faced with distressing situations.

**Theoretical Implications of Psychological Resilience in a Dyadic Context.** In the current research psychological resilience appears to be a protective factor against psychological distress and relationship strain in the patient-spouse dyad. Interestingly, a significant correlation between levels of psychological resilience in the patient and the spouse did not emerge, with a correlation of only \( r = .19 \). The limited dyadic psychological resilience research that has been conducted has been inconsistent about the degree to which resilience is correlated in couples. For example, research in 91 cancer survivor patient-spouse dyads found that resilience was not correlated \( (r = .03; \text{Lim et al., 2014}) \). Conversely, in 158 healthy couples facing day-to-day stressors, psychological resilience was significantly correlated between husband and wife dyads \( (r = .45; \text{Zhang, Yu, & Zhang, 2017}) \). One possible explanation for these inconsistent findings could stem from the populations assessed. Specifically, to date, the research that has found no correlation between psychological resilience has been conducted in patient-spouse couples dealing with chronic health conditions, potentially highlighting the dynamic nature of psychological resilience and its effects on romantic couples managing chronic health issues. It is possible that levels of psychological resilience might fluctuate in response to challenging situations. Specifically, certain stressful situations could challenge and test some people’s resilience, and for some, resilience might falter. To that end, while there is a significant amount of heterogeneity in the definitions of psychological resilience, leading definitions highlight the notion that resilience is not a static concept, and in fact is a dynamic construct which can vary over time (Windle, 2011). To further understand the relationship between psychological resilience in dyads, one can turn to the literature on optimism (the cognitive disposition to expect
favourable outcomes; Scheier & Carver, 1985). Optimism is another robust protective factor and has been found to reduce risk of cardiovascular events (Boehm & Kubzansky, 2012). Longitudinal dyadic research in 2,758 couples from the Health and Retirement study found that the level of optimism in patient-spouse dyads were significantly correlated but fluctuated over time (Chopik, Kim, & Smith, 2018). In discussing these findings, it was suggested by Chopik and colleagues (2018) that optimism in dyads were coordinated over time and also changed in concert with each other. In sum, it is possible that in couples in which one individual is facing a very serious medical issues such as cardiac surgery, the dynamic changes in psychological resilience over time may become less coordinated and potentially even asynchronous. The associations between psychological resilience and dyadic coping processes in the current study also speak to the importance of developing a more in depth understanding of the dyadic context of resilience.

**Theoretical Implications of Psychological Resilience and Common Dyadic Coping.**

The antecedents of dyadic coping are gaining increased attention in the research literature (Staff, Didymus, & Backhouse, 2017). Consistent with study hypotheses, in the current research psychological resilience was strongly associated with common dyadic coping. Further, as detailed above, common dyadic coping mediated the relationship between psychological resilience and relationship satisfaction in the patient and spouse, and a partner effect emerged highlighting the interpersonal context of managing stressors in the perioperative period. These findings emphasize the importance of understanding the protective factors that influence the extent to which stressors are managed collaboratively. Taken together, the findings of the current research support the communicative theory of resilience (CTR; Buzzanell, 2010). In this theory, it is emphasized that resilience is sustained through interpersonal interactions and discourse.
Several processes which facilitate resilience are identified in the communicative theory of resilience including crafting normalcy (e.g., efforts to maintain old normalcies from before the stressor or create a new normal), maintaining and using communication networks (e.g., build and effectively use social relationships), affirming identity anchors (e.g., efforts to enhance or reinforce particular personal identities), putting alternative logics to work (e.g., efforts to reframe stressful situations), and validating negative emotion while emphasizing productive actions (e.g., efforts to focus on positive feelings or implications of the stressor and minimize the negative aspects). The current findings support the communicative theory of resilience as individuals with greater levels of psychological resilience in the study collaborated with their spouse to cope more effectively with stressors in the perioperative period.

**Theoretical Implications of Psychological Resilience and Pain Catastrophizing.** Pain catastrophizing has been conceptualized as an interpersonal coping strategy that is aimed at soliciting supportive responses from others (Sullivan, Bishop, & Pivik, 2001). Despite the emphasis on catastrophizing as an interpersonal coping mechanism very limited research has assessed dyadic pain catastrophizing in romantic couples (Cano et al., 2005). As well, the majority of research has assessed risk factors as predictors of pain catastrophizing, although protective factors that influence pain catastrophizing is emerging (Pulvers & Hood, 2013). In the current research, it was found that both the patient as well as their spouse catastrophize about the patient’s pain leading up to surgery. Indeed, spouses of patients reported higher levels of catastrophizing than the patients themselves, and this had implications for well-being. Specifically, as discussed above, pain catastrophizing mediated the relationship between psychological resilience and psychological distress in both the patient and the spouse. These findings support prior research demonstrating that positive psychological resources can influence
perioperative pain adaptation, and that this occurs in a social context (Sturgeon & Zautra, 2013). Overall this research highlights the interpersonal context of pain catastrophizing in romantic couples and the need to address perioperative pain catastrophizing in the patient as well as their spouse.

**Clinical Implications**

Psychological resilience in the current study was linked with lower psychological distress and higher relationship satisfaction in both the patient as well as their spouse. Additionally, psychological resilience was linked with more adaptive coping mechanisms, including greater collaborative coping and lower pain catastrophizing with small effect sizes emerging. In research assessing psychosocial presurgical factors which influence postsurgical well-being in cardiac surgery patients, Contrada and colleagues (2008) highlighted that even modest psychosocial effect sizes are clinically significant given the annual volume of cardiac surgeries and their associated economic and psychological costs. Taken together, these results highlight the importance of comprehensively understanding the psychosocial risk and protective factors prior to surgery and developing interventions to address them. To that end, the first meta-analysis that linked the benefits of psychological preparation for surgery was published 27 years ago (Johnston & Voegele, 1993). Since then, it has become increasingly accepted that psychological factors influence well-being in the perioperative period. For example, a meta-analysis of 105 research studies with 10,302 participants found a relationship between preoperative psychological factors on postoperative outcomes including postoperative pain, behavioural recovery, negative affect, and length of hospital stay (Powell et al., 2016).

Combined, the research findings linking preoperative psychological factors to postoperative outcomes highlights the need for prehabilitation prior to major surgery.
Prehabilitation, defined as improving a patient’s pre-operative fitness, including optimizing psychological well-being, is a well-established preventative measure prior to elective surgery (Levett & Grimmett, 2019). The goal of cardiac prehabilitation is to reduce the incidence or severity of postoperative complications in patients as they await cardiac surgery and includes a range of preventative interventions depending on the needs of the individual patient (McCann et al., 2019). Candidate psychosocial factors that could be modified with prehabilitation include ways of coping with stress, marital quality, and anxious and depressive symptoms (McCann et al., 2019). The protective role of psychological resilience that emerged in the current study bolsters an emerging body of research that highlights the importance of positive psychological traits in the context of cardiovascular disease (Boehm & Kubzansky, 2012; Boehm et al., 2017; Kubzansky et al., 2018). To this end, there have been recent calls to adopt presurgical interventions that target resiliency as a way to enhance patient-centered surgical care (Shen et al., 2020).

Psychological resilience training programs have been developed for a variety of clinical and non-clinical populations. To date, several systematic reviews and meta-analyses have been completed to assess the efficacy of resilience training programs (e.g., Kim et al., 2019; Leppin et al., 2014). One of the first meta-analyses that assessed the efficacy of resiliency training programs included 25 randomized clinical trials and found small to moderate improvements in mental health in diverse adult populations (Leppin et al., 2014). A review of randomized controlled trials of resilience interventions for patients with chronic diseases also found improvements in psychological resilience and decreases in anxious and depressive symptoms (Kim et al., 2019). Two trials have specifically targeted resilience in patients with cardiovascular disease: the adult congenital heart disease coping and resilience trial (ACHD-CARE; Kovacs et
al., 2015) and the resilience and activity every day program (READY; Burton et al., 2009). Broadly speaking, both trials have shown promising results. For example, the feasibility trial for the ACHD-CARE project suggested that the intervention was highly valued by participants and demonstrated a medium effect size for improvements in depression symptoms (Kovacs et al., 2018).

In the current research, it was not possible to establish causality in the relationship between psychological resilience and the outcomes assessed including psychological distress and relationship strain. However, the results of these recent studies suggest that resilience is modifiable and that bolstering resilience can lead to meaningful improvements in psychosocial functioning. However, born out of the heterogeneity of definitions of resilience, and despite the increased interest in developing and evaluating resilience interventions, there is limited consensus as to what components are needed for effective and efficacious programs (Leppin et al., 2014).

The current study revealed emotional and marital distress in a notable subset of spousal caregivers, a significant association between resilience and patient and spouse well-being, as well as significant partner effects. These findings highlight the need to include family members in perioperative interventions. Indeed, empirical support for couples-based interventions for cardiac patient-spouse dyads is emerging (Matire & Helgeson, 2017; Reid, Ski, & Thompson, 2013; Smith & Baucom, 2017; Tulloch & Greenman, 2018) which emphasize that interventions may be the most beneficial if they consider and incorporate intimate relationships.

In the current research a significant partner effect emerged in which the relationship between psychological resilience and relationship satisfaction was mediated by the extent to which the spouse collaborated with the patient to manage stressors. This finding supports
preventative training programs that target couples’ dyadic communication and coping skills. In a review of dyadic coping and relationship satisfaction, it was suggested that couples treatment could incorporate a focus on dyadic coping that includes psychoeducation and training (Falconier, et al., 2015). Psychoeducation may help partners learn the value of communicating with each other in order to engage in conjoint efforts to cope when both are experiencing stress. Further, some couples may benefit from skills training such as Couples’ Coping Enhancement Training (CCET; Bodenmann & Shantinath, 2004), a program which includes communication, problem solving, and dyadic coping skills which focuses on improving relationship satisfaction and reducing marital distress.

In the current research pain catastrophizing mediated the relationship between psychological resilience and psychological distress. Indeed, levels of pain catastrophizing were elevated in both the patient and the spouse, with the spouse showing slightly higher levels of catastrophizing. Interventions for pain catastrophizing have been developed including a program called Empowered Relief™ by Beth Darnall (© 2013-2020 Stanford University), which consists of a single 2-hour class. With large effect sizes emerging, the pilot program found the intervention led to significantly reduced pain catastrophizing in individuals with chronic pain with gains maintained for four weeks after treatment (Darnall et al., 2014). The promising results of this trial suggest that this type of brief intervention warrants investigation in the context of perioperative settings (Darnall, 2016). The Empowered Relief intervention has been embedded in a digital behavioural medicine intervention called My Surgical Success and pilot tested in individuals preparing to undergo breast cancer surgery (Darnall et al., 2019). Results indicate that those who engaged with My Surgical Success were highly satisfied and the program was associated with significantly accelerated opioid cessation after surgery. As identified by the
developer of this intervention, a further extension could be to modify this program for spouses to address their catastrophizing and distress around their partners’ pain (Martire et al., 2019).

Methodological Contributions

The current research makes a number of methodological contributions to the literature. A primary strength was the recruitment of both patients as well as their spouses, and the use of APIM and APIMeM statistical approaches to examine the dyadic data. The vast majority of research on couples coping with major health stressors has relied on the reports from one member of the dyad, most often the patient (e.g., Kenny, Kashy, & Cook, 2006a). Yet, as this research has demonstrated, adaptation to a stressful event is a dynamic process, and one person can influence the functioning of another, especially in close relationships. The recruitment of dyads, while methodologically challenging, provides a more thorough and comprehensive understanding of risk and resiliency factors that impact a couple’s adjustment in the perioperative context. Further, this research included both male and female cardiac surgery patients, with 26.8% of patients being women. This is important because it accurately reflects the prevalence of women undergoing cardiac surgery in Canada (Johnston et al., 2019).

Limitations

Despite this study’s contributions, there are limitations that should be acknowledged. One limitation is the reliance on self-report measures. While the self-report measures provided important information about the patients’ and spouses’ perceptions of their own personal characteristics and coping processes, it would have been valuable to have obtained spouse reports of patient coping and well-being, and vice versa. Additionally, investigating the impact of psychological resilience and coping processes on other outcomes including behavioural measures (e.g., physical activity) and physiological measures (e.g., cortisol and oxytocin levels) would
provide valuable information on the mechanisms underlying stress responses in the perioperative period.

The sample size was an additional limiting factor. The total of 71 dyads included in the current study was lower than the median of 101 dyads found in the published literature (Kenny, Kashy, & Cook, 2006b). However, even with this relatively modest sample size, small, statistically significant effect sizes were detected. Nonetheless, in a review of couples coping with cardiovascular disease, women (whether they were patients or spouses) were found to be at an elevated risk for negative outcomes including psychological distress (Trump & Mendenhall, 2017). Thus, the absence of gender differences in the current study could have been related to the small number of female patients in the sample. A larger sample size could also have allowed for testing more complex statistical models, such as moderated mediation. Specifically, a larger sample could have provided the opportunity to test contextual factors that may moderate the association between psychological resilience, coping processes, and adjustment in the perioperative period. Based on previous research, candidate moderators include gender, positive affect, and type of surgery (Jackson et al., 2016).

An additional limitation of the current research was its cross-sectional design. Specifically, due to cross-sectional methodology, causal inferences cannot be made. For example, it is not possible to conclude that psychological resilience actually leads to better outcomes, such as improved relationship satisfaction or decreased distress, or vice versa. For example, previous research assessing psychological resilience in older adults has found that the quality of an individual’s relationship with their spouse serves as a protective factor and bolsters resilience despite experiencing multiple adversities, including health challenges (Fuller-Iglesias,
Sellars, & Antonucci, 2008). It is perhaps most likely that resilience, mental health, and relationship functioning interact in complex ways over time.

The current research did not obtain cardiac disease classification levels in all patients. The assessment of functional limitations associated with cardiovascular disease and inclusion of other established cardiac disease classification systems (e.g., the New York Heart Association Classification guidelines) could have provided relevant information regarding functional capacity, clinical severity, and prognosis. It is possible that more immediate factors related to the patient’s heart condition and physical functioning limitations could have been more salient drivers of individual well-being.

The sample was fairly homogenous, consisting of mainly Caucasian, heterosexual and well-educated dyads who have been married or common-law partners for a lengthy period of time. Although the sample was highly homogeneous in terms of ethnicity, this is reflective of Statistics Canada (2016) data which found that over 80% of individuals residing in the geographical region where participants were recruited reported Western European ethnic origins. As such, it is difficult to generalize the results of the study to same sex couples, couples who have been together for less time, individuals with lower socioeconomic status, and visible minorities. Of course, not everyone undergoing cardiac surgery is in a long-term romantic relationship, and research is also needed to explore other types of patient-caregiver dyads that include other family members, friends, and formal care aids.

Finally, the couples who opted to participate in this research may have been experiencing less stress or anxiety prior to undergoing the cardiac surgery. In total 11% of the patients and 15% of the spouses approached to participate declined because they were either too busy or too stressed to participate. Due to self-selection, the sample of participants may have
disproportionately included more well-functioning dyads, with greater levels of psychological resilience, higher levels of relationship satisfaction, lower levels of psychological distress, and with more adaptive coping mechanisms. As such, the generalizability of the findings may again be limited.

**Future Research Directions**

To strengthen our ability to make causal inferences about the protective role of resilience in the perioperative period, lab-based experimental research that aims to manipulate levels of psychological resilience (e.g., Hanssen et al., 2013) as well as clinical trials to increase resilience (e.g., Kovacs et al., 2018) are needed. In addition, and as described above, cross-sectional analyses cannot reveal important changes in mental health and well-being over time. It is unclear to what extent psychological resilience is a trait which remains relatively stable over time or it is a dynamic process which is malleable and can be improved with psychological interventions. Longitudinal methodology enables the analysis of dynamic individual and group level changes as well as an understanding of the factors that influence changes in resilience. Indeed, longitudinal designs to assess the dynamic impact of preoperative psychological factors and coping processes on short- and long-term postoperative outcomes would provide interesting information regarding causality. As such, longitudinal research is needed to understand the dynamic nature of psychological resilience over time. Research in this area would help clarify definitions of psychological resilience by building a better understanding of how resilience and resilience processes may change over time and impact mental health and well-being throughout a range of daily stressors to more severe adverse experiences.

Future research may also benefit from a more comprehensive assessment using daily diary methodology including both state and trait resilience (e.g., Lock, Rees, & Heritage, 2020).
Additionally, future research may benefit from a comprehensive assessment of daily pain catastrophizing (e.g., Darnall et al., 2017). This is significant as research has found that pain catastrophizing demonstrates significant variations over time, and that this catastrophizing impacts affective responses and supportive responses with spouses (Martire et al., 2019). To that end, discerning how pain catastrophizing influences affective reactions to experienced or anticipated pain may further the research on the protective benefits of psychological resilience on pain catastrophizing. Further research in this area may help explain how and why psychologically resilient individuals rebound from daily pain catastrophizing and clarify the role of affect in this relationship.

Further, new conceptualizations of resilience are considering it in a dyadic context. The Couple Resilience Inventory (CRI; Sanford et al., 2016) has been developed to assess a romantic couple’s resilience and incorporates two distinct dimensions of relationship behaviour including positive dimensions such as responsiveness to each other’s needs and encouraging each other to be optimistic and negative dimensions such as partners criticizing each other, or failing to engage in positive behaviours of dyadic coping. Particularly given the amount of individuals reporting notable relationship dissatisfaction in the current research a more nuanced understanding of the full gamut of relationship behaviours, including negative relationship behaviours, would be appropriate.

In the current research a strong association emerged between psychological resilience and the extent to which dyads collaborated together to manage stress. More research is needed to more fully understand antecedents of dyadic coping including stress communication and shared illness appraisals. In the systemic-transactional model, each partner communicates their experience of stress to the other, and the other partner perceives, interprets, and decodes these
signals and responds to the stressed partner with some form of coping (Bodenmann, 2005). This communication of stress has been identified as an additional important antecedent of dyadic coping. Future research should incorporate more nuanced understanding of dyadic communication processes, including the extent to which resilience influences stress communication. Further, shared illness appraisals refer to the extent to which a person perceives illness as a joint problem rather than an individual problem (Helgeson et al., 2018). Despite the fact that shared illness appraisal is a cornerstone of major communal coping theories, including the systematic-transactional model of dyadic coping (Bodenmann, 2005), there is a dearth of research on the appraisal aspect of dyadic coping, and how that appraisal impacts illness-related support. It is possible that the difference between the successful provision of support and the unsuccessful provision of support may be due to the extent to which an individual perceives their illness as a joint or shared problem, and perceives the partner’s assistance as working together and collaborating to resolve the issue. Further the extent to which psychological resilience impacts the shared illness appraisal process is unknown. Whether an illness is appraised as “our” illness or “my” illness has the potential to influence interpersonal coping processes and adjustment.

Summary

Preparing to undergo cardiac surgery is a stressful experience for both the patient as well as their immediate family members. Indeed, the current research revealed emotional and marital distress in a notable subset of both patients and their spouses. Positive psychology constructs including psychological resilience are increasingly being considered important for cardiovascular health. Psychological resilience has emerged as a robust protective factor during times of stress, although limited attention has been given to resilience in dyadic and surgical contexts. Using
dyadic statistical methodology, psychological resilience emerged as a fairly robust factor that may protect against established presurgical vulnerabilities among both patients and their spouses. It was also found that patient resilience has implications for spouse perceptions of relationship quality. Thus, intervening to enhance patient resilience may not only impact patient well-being, but it may also have a beneficial spill-over effect on the spouse. Adaptive coping processes, including the extent to which couples collaborate to manage stress was also explored. Broadly speaking, common dyadic coping was associated with greater relationship satisfaction. These findings highlight that it is important to understand the social context of resilience given that resilience was closely linked to the extent to which couples collaborated to manage stress. Maladaptive coping processes including the extent to which patients and spouses catastrophize the patient’s pain was also assessed. Notably, spouses reported higher levels of pain catastrophizing than patients. The results suggest that increased pain catastrophizing was associated with greater psychological distress. Given the number of cardiac surgeries performed annually in North America, prehabilitation interventions that foster psychological resilience, improve adaptive coping mechanisms and mitigate maladaptive coping mechanisms in both the patient as well as their spouse may have significant health and quality of life benefits.
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Appendix A

Actor Partner Interdependence Mediation Model retrieved from Ledermann, Macho, and Kenny (2011, pp. 597)

The total effects, total indirect effects, simple indirect effects, and direct effects $c'$ in the APIMeM for distinguishable dyad members retrieved from Ledermann, Macho, and Kenny (2011, pp. 599)

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Patient Partner Effect

![Diagram of the Actor Partner Interdependence Mediation Model](image-url)
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</tbody>
</table>

*Note.* \(A\) = actor effect, \(P\) = partner effect; IE = indirect effect; 1 = patient, 2 = spouse.
Appendix B

Full potential covariate correlation tables for patients and spouses

### Full covariate correlation table for patients

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
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<tbody>
<tr>
<td>1. Psychological resilience</td>
<td>1</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2. Pain catastrophizing</td>
<td>-.42**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>3. Common dyadic coping</td>
<td>.43**</td>
<td>-.19</td>
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<td></td>
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<td></td>
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<tr>
<td>4. Relationship satisfaction</td>
<td>.37**</td>
<td>-.11</td>
<td>.65**</td>
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<td></td>
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<td>-.22</td>
<td>-.08</td>
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<td></td>
</tr>
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<td>6. Age</td>
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<td>-.15</td>
<td>-.06</td>
<td>-.03</td>
<td>-.21</td>
<td>1</td>
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<tr>
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<td>-.07</td>
<td>-.16</td>
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<td>-.00</td>
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<td>8. Length of relationship</td>
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<td>-.02</td>
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<td>.04</td>
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<tr>
<td>9. Medical comorbidity</td>
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<td>.59**</td>
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</tbody>
</table>

**Note.** * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed). Please note data for cardiac symptoms is available for 30 patients. Please note pain catastrophizing is about their own pain.

### Full covariate correlation table for spouses

<table>
<thead>
<tr>
<th></th>
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<tr>
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<td>-.45**</td>
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</table>

**Note.** * Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed). Please note pain catastrophizing reflects catastrophizing about their spouse’s pain.