



Childhood Trauma and Relationship Satisfaction Among Parents: A Dyadic Perspective on the Role of Mindfulness and Experiential Avoidance

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Abstract

Objectives Childhood cumulative trauma (CCT) has consistently been associated with relationship dissatisfaction in adulthood. Early parenthood is a challenging context where partners' vulnerabilities, such as CCT history, tend to be exacerbated and further decrease relationship satisfaction. However, dyadic studies are lacking and the mechanisms that underlie this association in coparents remain unclear. An increasing body of literature supports dispositional mindfulness as an explanatory mechanism of this relationship, as it was negatively linked to CCT and associated with higher relationship satisfaction. Experiential avoidance, a maladaptive self-regulatory strategy commonly used by CCT survivors, looks promising in explaining how coparents' lower mindfulness brings about relational dissatisfaction. Empirical literature highlights mindfulness as a predictor of experiential avoidance, which in turn is associated with relationship dissatisfaction. Using a dyadic perspective, this longitudinal study aimed to assess whether associations between CCT and relationship satisfaction were serially mediated by mindfulness and experiential avoidance in couples following the birth of a child.

Method A randomly selected sample of 529 parental couples completed self-report questionnaires at two time points, 6 months apart. Path analyses based on the Actor-Partner Interdependence Model were performed.

Results Path analyses showed a significant serial mediation from CCT to relationship satisfaction, sequentially through lower mindfulness and higher experiential avoidance, while accounting for relationship satisfaction at Time 1. Significant structural paths and indirect effects confirmed partners' interinfluences.

Conclusions Findings suggest that mindfulness and experiential avoidance are key factors to explore in parental couples facing relationship issues associated with childhood trauma.

Preregistration This study was not preregistered.

Keywords Child maltreatment · Parenting · Relationship satisfaction · Mindfulness · Avoidance

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According to research on couple psychology, a satisfying romantic relationship is among the most important factors for physical and psychological health in adult life. Indeed, studies have indicated that relationship dissatisfaction is associated with lower intrapersonal well-being and poorer professional functioning, physical health, and longevity (Holt-Lunstad et al., 2010; Mirsu-Paun & Oliver, 2017; Vaillant, 2008). Parenthood being a complex and challenging stage of life, a vast majority (up to 90%) of parental couples report a steady decrease in relationship satisfaction following the birth of a child (Doss et al., 2009; Kamp Dush, 2011). Early parenthood often comes with major changes in daily life, such as increased responsibilities, lessened sleep quality, higher fatigue, and financial insecurity, which put pressure on parents' vulnerabilities and can affect their

relational functioning (Keizer & Schenk, 2012). Relationship dissatisfaction can be an especially taxing issue in this context, since it is intimately related to the partner's coparental relationship and parenting practices as well as the socio-affective development of their child (Bernet et al., 2016). Moreover, studies have identified childhood interpersonal trauma as a major risk factor for relationship dissatisfaction in parental couples, but empirical knowledge on the matter remains limited (MacIntosh & Ménard, 2021).

Childhood interpersonal trauma (e.g., sexual abuse, being exposed to violence between caretakers) is increasingly recognized as a public health issue, with vast epidemiological studies reporting that most individuals from the community have endured at least one type of trauma before age 18 (Finkelhor et al., 2007, 2009; Turner et al., 2016). A host of studies have also established that long-term consequences, reaching well beyond post-traumatic stress disorder (PTSD), often stem from these traumatic experiences, such as depression, substance abuse, and higher suicidal risks as well as behavioral and self-regulatory difficulties (Dugal et al., 2016; Hébert et al., 2018; Norman et al., 2012). Furthermore, childhood interpersonal trauma is worryingly prevalent; studies with community samples generally report mean numbers ranging between one and three types of trauma endured per individual (e.g., Bigras et al., 2017; Godbout et al., 2020; Thibodeau et al., 2017). Importantly, enduring several different types of interpersonal traumas before adulthood, described as cumulative childhood trauma (CCT; Herman, 1992), has been consistently associated with more complex and severe outcomes than exposure to a sole interpersonal trauma (Hodges et al., 2013; Putnam et al., 2013).

Because of the interpersonal nature of CCT, and the fact that attachment figures are typically the instigators, survivors are at higher risk of developing difficulties in the relational realm (Nguyen et al., 2017; Rumstein-McKean & Hunsley, 2001). Couple relationships tend to be even more impacted by these issues since they are generally the most intimate and attachment-driven human bond experienced in adulthood. Thus, romantic relationships are a context where triggering CCT-related post-traumatic reactions is more likely to happen (Bigras et al., 2017; Briere, 2002). The empirical literature shows that trauma survivors report significantly lower general relationship satisfaction, suffer more from relationship distress, and report more intimate partner violence than non-survivors (Dugal et al., 2016; Peterson et al., 2018; Widom et al., 2014). Studies considering the cumulative effect of several traumas also revealed that a greater number of trauma types predict lower relationship satisfaction (Bigras et al., 2015; Godbout et al., 2020; Liu et al., 2019), supporting the consideration of CCT in further studies. However, most studies used convenience samples of undergraduate students, which does not represent the complex reality of most adult survivors and fail to document

the influence of contextual stressors, such as parenthood, on relational issues (Bradbury et al., 1998, 2000). Studies conducted on samples of new parents are therefore sparse in regard to past traumatic experiences and how they affect the intimate relationship they share. A study by Fredman et al. (2017) revealed that parental couples in which at least one parent was exposed to CCT presented steeper post-partum decreases in relationship satisfaction and highlighted fathers as more vulnerable to the effects of their partners' post-traumatic distress than mothers. Furthermore, prior studies highlighted that parents who sustained CCT reported re-experiencing post-traumatic symptoms through their parental role, which suggests possible reactivations of latent traumatic schemes (Christie et al., 2017).

In order to better understand the repercussions of CCT on relationship quality among parental couples, studies that take into account the reciprocal influence of both parents are needed. Indeed, most current studies are based on an intra-individual perspective that evacuates the interdependency inherently shared by intimate partners in regard to their respective relationship satisfaction. Yet, the scientific community is increasingly emphasizing the relevance of developing more systemic literature on couples by examining data from both partners to reveal *actor effects*, where a person's characteristic predicts his own outcomes, as well as *partner effects*, where a person's characteristic predicts their partner's outcomes (Kenny et al., 2020; Oka & Whiting, 2013). A limited number of dyadic studies reported significant actor and partner effects between childhood maltreatment history and couple satisfaction (Maneta et al., 2015; Vaillancourt-Morel et al., 2019; Whisman, 2014). Most notably, one study by Liu et al. (2019) revealed, in a sample of new parents, indirect effects of childhood emotional maltreatment on relationship satisfaction through each parent's post-partum depression. Gender differences were found, such as significantly stronger associations between childhood trauma and relationship satisfaction with fathers than mothers, and stronger associations between paternal depression and maternal relationship satisfaction than vice versa. These findings further highlight the need to study explanatory mechanisms and how they are linked to each parent's couple functioning.

Theoretical works from Briere (2002; 2010) introduced a framework named the Pain Paradox that may shed light on how CCT associates with lower relationship satisfaction later in life (Godbout et al., 2020; Im et al., 2020). This model highlights mindfulness, defined as the disposition to purposefully and non-judgmentally pay attention to the experience that emerges in the present moment (Kabat-Zinn, 2003), as an important capacity that is found to be lacking in CCT survivors and that might explain their couple issues. Although it has been increasingly conceptualized as a multidimensional construct (e.g., nonjudgmental, non-reactive

attitude with inner experience) on which there is yet to be scientific consensus (Bergomi et al., 2013; Van Dam et al., 2018), mindful attentiveness and awareness of present experiences appear to be specifically relevant to examine the link between CCT and relationship satisfaction (Karremans et al., 2017).

The Pain Paradox model suggests that the distress caused by CCT exposure might paradoxically lead survivors to engage in distress-sustaining behaviors to suppress or avoid their painful experiences. Experiential avoidance, a maladaptive self-regulatory strategy more present among those with lower mindfulness disposition, may aim at disconnecting from the present emerging experience instead of intentionally focusing on it with an accepting stance (Karekla & Panayiotou, 2011; Thompson & Waltz, 2010). In this regard, underdeveloped mindfulness throughout early life might bring about a heavier reliance on avoidance strategies when overwhelmed with trauma-related thoughts and feelings. Indeed, because of lower mindfulness capacities, survivors are known to deploy experiential avoidance strategies such as dissociation, thought suppression, and tension-reducing distractions to regulate their contact with painful inner states as well as external stimuli that triggers their suffering (Roche et al., 2018; Thompson et al., 2011). Since most CCT survivors were victimized by caretakers or loved ones, their avoidance strategies tend to be predominantly triggered when in interpersonal contexts, as they anticipate being hurt or betrayed again by people they are close to. When survivors purposefully distance themselves from their own present experience, they may succeed in finding short-term relief, but maintain or aggravate their difficulties over time. In the long run, these tendencies might negatively impact their socio-affective development, and thus lead to problematic, unfulfilling romantic relationships as adults, especially in the context of early parenthood, where contextual and relational stressors are especially salient. In sum, CCT exposure might be related to lower mindfulness disposition, and then to higher experiential avoidance in survivors, which might lead to lower relationship satisfaction among parents.

Empirical evidence supports these theoretical contentions. As suggested by the Pain Paradox, mindfulness has been widely studied and documented in recent decades as an important resilience factor to counter PTSD and avoidance symptoms (Ortiz & Sibinga, 2017; Shapiro et al., 2008; Vujanovic et al., 2009). A study by Godbout et al. (2020) conducted with individuals from the general population was the first to document the indirect negative effect of CCT on relationship satisfaction through lower mindfulness levels. More recently, a study by Fitzgerald (2022) revealed that relational mindfulness mediated the associations between CCT and both positive and negative aspects of relationship quality in 106 adults. Mindfulness has also been highlighted as an explanatory mechanism of the associations

between CCT and other outcomes relevant to relationship satisfaction such as sexual concerns, aggression, and positive relations with others (Daigneault et al., 2016; Huang et al., 2021; Roche et al., 2019). As for experiential avoidance, it is known for maintaining and exacerbating post-traumatic distress (Bishop et al., 2018; Hayes & Gifford, 1997; Thompson & Waltz, 2010), and avoidance strategies appear in the DSM-5 as a diagnostic criterion for PTSD (American Psychiatric Association, 2013). Moreover, exposure to childhood interpersonal trauma is documented as a predictor of experiential avoidance (Fiorillo et al., 2013; Gratz et al., 2007; Roche et al., 2019). Despite conceptual overlaps, past research established distinct factorial structures and theoretical differences regarding mindfulness and experiential avoidance central processes: mindfulness is rooted in attentional regulation and metacognition, which enable better behavioral regulation among other capacities, whereas experiential avoidance is rooted in impulsive behavioral tendencies and psychological inflexibility (Brown et al., 2007; Monestès et al., 2018). Moreover, dispositional mindfulness is established as a trait that is either nurtured or hampered by early life experiences and remains stable over time in the absence of a mindfulness practice (King et al., 2019). Meanwhile, experiential avoidance is known as a maladaptive self-regulatory mechanism that fluctuates according to one's present context (Karekla & Panayiotou, 2011). Past studies have found that dispositional mindfulness predicts lower experiential avoidance (Brem et al., 2017; Thompson & Waltz, 2010), and a study by Antoine et al. (2018) reported that mindfulness training (compared to a control group on a waiting list) reduces experiential avoidance levels over 6 weeks. Authors of these articles suggested that acting on "mindless autopilot" leads to avoidance when coping with negative feelings, whereas being mindfully aware, non-reactive, and nonjudgmental to one's present experience may lower the tendency to use avoidant coping mechanisms. Based on previous studies, lower mindfulness and higher experiential avoidance might sequentially explain the impacts of CCT on relationship satisfaction, but such pathways have never been tested.

Mindfulness has received increasing interest given its recognized positive influence on numerous factors related to couple relationship functioning, including relationship satisfaction. A systematic review from Kozlowski (2013) highlighted positive associations with relationship satisfaction, empathy, intimacy, and partner acceptance (Barnes et al., 2007; Birnie et al., 2010; Jones & Hansen, 2015; Kappen et al., 2018), as well as better conflict management and reduced risks of intimate partner violence (Horst, 2013; Shorey et al., 2014). A first integrative theoretical model was proposed by Karremans et al. (2017) to shed light on the interpersonal processes at play. Authors concluded that mindful attentiveness and awareness of present experiences

and events could play a crucial role in understanding couple relationship functioning. This specific aspect of mindfulness might indeed facilitate the awareness of one's internal states and processes during challenging interactions with their partners and help regulate impulsive, self-centered behaviors in favor of thoughtful, deliberate, and pro-relationship behaviors. Although this theoretical study offers speculations on why partners with lower mindfulness are less satisfied with their relationship, empirical data are needed to support it. Moreover, the key maladaptive responses or behaviors that are responsible for relationship dissatisfaction with mindless partners remain to be confirmed. Experiential avoidance appears as a promising missing link since it is known to lead to poorer relationship quality and shares strong negative associations with mindful awareness and attention to present (Reddy et al., 2011; Shear, 2010; Zamir et al., 2018). However, this has yet to be empirically supported.

Studies using dyadic designs found mutual influences between both partners' mindfulness disposition and their relationship satisfaction (Adair et al., 2018; Pakenham & Samios, 2013). Most notably, a study by Parent et al. (2014) found mutual influences of partners' mindfulness on each other's relationship satisfaction in a sample of parental couples. Their findings indicated that mothers' mindfulness was more highly related to both partners' relationship satisfaction compared to fathers' mindfulness. However, these studies used cross-sectional designs, and none examined the role of mindfulness in the link uniting CCT to relationship satisfaction. Parental couples also remain understudied, yet this population experiences an ideal situation to study how each partner's vulnerabilities might interplay in a context of parental and relational stressors (Bradbury et al., 1998; Fredman et al., 2017). In that regard, examining a sample of couples with a young infant could provide valuable insight into partners' interinfluence that ultimately results in greater or weaker relationship satisfaction when faced with challenging circumstances. The present study thus proposes to use a dyadic and longitudinal design with a representative sample of parents to examine the predictive value of CCT, mindfulness, and experiential avoidance on relationship satisfaction. To the best of the authors' knowledge, no previous study has investigated these associations, despite their relevance and possible implications. Findings on the matter would indeed help answer many interrogations that persist in the scientific literature and could be used as empirical support for future trauma-sensitive, mindfulness-based clinical trials.

This study aimed to examine (1) the sequential mediation role of mindfulness and experiential avoidance in the link between CCT and relationship satisfaction (i.e., actor effects), and (2) the links between one parent's CCT, mindfulness, and experiential avoidance and the other parent's relationship satisfaction (i.e., partner effects). We

hypothesized that (1) a parent's CCT would predict its own lower mindfulness, which in turn would be negatively associated to its own experiential avoidance and, subsequently, its own lower couple satisfaction, and that (2) parents would mutually negatively influence each other's relationship satisfaction through their CCT history, mindfulness, and experiential avoidance.

Method

Participants

A sample of 529 heterosexual couples who are parents to an infant was recruited in the context of a longitudinal, multiwave research project aiming to study the effects of CCT on parental couples' well-being. Recruitment of the sample was made possible through a partnership with the Quebec Parental Insurance Plan (QPIP), which has access to the entire population of parents of a new baby in the Quebec province, hence enabling a probabilistic sampling. The QPIP provided randomized coordinates of couples fitting the following inclusion criteria: being 18 years or older, being in a couple relationship with the other parent, being fluent in English or French, and having given birth to an infant within the past 6 months. Provincial and nationwide demographic reports were used to assess if the sample was adequately representative of the population of parental couples welcoming a new child in the targeted area (Institut de la statistique du Québec, 2016; Statistique Canada, 2023). Although differences were found on yearly income and education level, the final sample appeared to be representative of the sociodemographic profile of the targeted population regarding age, birth country, and first language, as well as the distribution of the population density by region throughout the province of Quebec. Results of an a priori Monte Carlo analysis performed using Mplus (Muthén & Muthén, 2012) indicated that 500 participants were sufficient to detect weak-to-moderate associations in the hypothesized integrative model, with a standard type I error rate ($\alpha = 0.05$), and a power of 0.80. A total of 545 eligible couples were successfully recruited and completed both Time 1 (T1) and Time 2 (T2) questionnaires. Six couples were excluded because of missing data on all variables of this study, which therefore established a sample size of 539 couples for the analyses.

Procedure

Eligible couples were contacted by a research assistant who invited them to participate in the study, first via email followed by phone calls, with a response rate of 46.60%. Interested parents used the provided hyperlink leading to a consent form and a series of self-reported measures hosted

on the Qualtrics online platform. Six months later, participants were invited again to complete the survey using the same protocol. During the first wave of data collection (T1), couples completed the questionnaire between January 2019 and September 2020 while the questionnaire from the second wave (T2) was completed between July 2019 and February 2021 with a retention rate of 87%. Reasons for not completing T2 included not being able to recontact or loss of interest in participating. The mean age of participants' infant was 2.50 months old at T1 and 8.40 months old at T2. At both waves, each participant received a CA\$20 compensation or gift card once both parents of a couple completed the questionnaire (CA\$40/couple). This study's procedure was approved by our university's Institutional Review Board for research involving human subjects.

Measures

Covariates Demographic variables were assessed to document the sociodemographic characteristics of the sample and to be potentially included as covariates in the model if they were statistically related to the outcomes. Potential covariates were selected based on previously documented predictors of relationship satisfaction among parental couples. In that respect, relationship length and infant's age were included in the questionnaire in order to control for the decline of relationship satisfaction that is often observed over time as well as in the first year post-partum (Bogdan et al., 2022; Dew & Wilcox, 2011; Rosen et al., 2017). Further, because the impacts of COVID-19 on couple functioning are increasingly documented (e.g., Wisyaningrum et al., 2021), a dichotomous score indicating if the questionnaires were completed before or after the official implementation of confinement and sanitary measures in the region on March 13, 2020 (0 = *no* vs 1 = *yes*) was computed and introduced as a covariate. A full list of demographic variables and covariates is presented in Table 1.

Cumulative Childhood Trauma CCT was assessed at T1 using the Cumulative Childhood Trauma Questionnaire (CCTQ; Godbout et al., 2017), which measures exposure to eight types of childhood interpersonal trauma before the age of 18 years. This instrument measures childhood sexual abuse based on Canada legal definitions (Government of Canada, 2017). Participants reporting unwanted sexual experiences prior to age 18 or any sexual experiences with a person 5 years older or in a position of authority before age 16 were identified as victims. The seven additional types of trauma (i.e., physical and psychological abuse, physical and psychological neglect, witnessing physical and psychological interparental violence, and bullying by peers) are measured based on "a typical year before the age of 18." For each type of trauma, participants who indicated "never

happened" were identified as "0 = non-victim" while participants indicating at least one occurrence in a typical year were identified as having endured this type of trauma "1 = victim." A CCT score was created by summing the participants' dichotomous scores for each type of trauma, which ranged from 0 to 8, with a higher score indicating higher CCT exposure. This questionnaire has shown satisfactory psychometric properties in previous studies (Bolduc et al., 2018; Godbout et al., 2020). The reliability coefficients were excellent ($\alpha = 0.90$; $\omega = 0.90$) in this sample.

Mindfulness Mindfulness was assessed at T1 using the Mindfulness Attention Awareness Scale (MAAS; Brown & Ryan, 2003; French translation by Jermann et al., 2009), the most widely used, validated, and translated dispositional mindfulness measure. Authors of the questionnaire define the concept as attentiveness and awareness of present events and experiences. The MAAS was chosen for this study because it specifically focuses on the awareness and attentional aspects of mindfulness, which were highlighted as especially relevant factors for relational outcomes (Karemans et al., 2017). The questionnaire contains five items rated on a 6-point Likert scale ranging from 1 = *almost always* to 6 = *almost never*. Participants must rate the degree to which they relate to statements regarding their daily experience, such as "doing tasks without being aware of doing it" or "running on automatic, without much awareness." All items were reversed and total scores range from 6 to 30, with higher scores representing better mindfulness dispositions. In the present sample, the reliability coefficients were good ($\alpha = 0.89$; $\omega = 0.90$).

Experiential Avoidance The Acceptance and Action Questionnaire-II (AAQ-II; (Bond et al., 2011; French translation by Monestès et al., 2018) was used to measure experiential avoidance at T2. This measure focuses on the negative attitude toward internal experiences (e.g., emotions, thoughts, memories) and the unwillingness to stay connected to them. Example items include the following: "I worry about not being able to control my worries and feelings" and "I'm afraid of my feelings." The AAQ-II consists of seven items rated on a 7-point Likert scale (from 1 = *never true* to 7 = *always true*) yielding scores from 7 to 49, where higher scores indicate greater experiential avoidance. The AAQ-II is a revised version of the original AAQ, and is documented as being successfully superior and more stable in its psychometric properties (see Monestès et al., 2018). In the present sample, the reliability coefficients were good ($\alpha = 0.89$; $\omega = 0.90$).

Relationship Satisfaction Relationship satisfaction was measured at both baseline and follow-up using the four-item version of the Dyadic Adjustment Scale (DAS-4; Sabourin

Table 1 Sample sociodemographic characteristics

	Mothers <i>n</i> (%)		Fathers <i>n</i> (%)	
	T1	T2	T1	T2
Age, <i>M</i> (<i>SD</i>)	31.10 (4.60)	31.50 (4.60)	33.70 (5.50)	34.10 (5.60)
Infant's age in months, <i>M</i> (<i>SD</i>)	2.40 (1.50)	8.30 (2)	2.60 (1.60)	8.50 (2.10)
Birth country				
Canada	441 (83.70)		431 (81.80)	
Europe/USA	33 (6.30)		27 (5.10)	
Other	53 (10)		69 (13.10)	
Educational level				
High-school or lower	66 (12.50)		103 (19.40)	
College	186 (35.50)		215 (40.90)	
University	274 (52)		209 (39.70)	
Main occupation				
Full-time worker	385 (73.10)	367 (69.60)	492 (93.50)	479 (90.60)
Part-time worker	54 (10.20)	55 (10.40)	18 (3.40)	29 (5.50)
Student	16 (3)	14 (2.70)	5 (1)	6 (1.10)
Unemployed/other	72 (13.60)	91 (17.30)	11 (2.10)	15 (2.80)
Yearly income (CA\$)				
0–19,999	57 (10.90)	58 (11)	12 (2.30)	8 (1.50)
20,000–39,999	137 (26.10)	141 (26.80)	65 (12.40)	68 (13)
40,000–79,999	267 (50.90)	258 (49.10)	312 (59.30)	304 (57.90)
80,000 and more	64 (12.20)	69 (13.10)	137 (26.10)	145 (27.60)
Number of children at T2				
First child	259 (49.50)		255 (48.70)	
2 children	169 (32.30)		165 (31.50)	
3 and more	95 (18.20)		103 (19.80)	
Relationship status at T2				
Married		159 (30.10)		
Common-law/cohabitation relationship		367 (69.50)		
Other		2 (0.40)		
Pregnancy at T2				
Yes	26 (4.90)			
No	503 (95.10)			
Relationship length in years at T2, <i>M</i> (<i>SD</i>)	7.10 (4.10)		7.20 (4.20)	

Notes: Exclusively includes the final sample of 529 heterosexual couples. Percentages exclude missing values (varies between variables; ranges from 0 to 6 missing values)

et al., 2005). The DAS-4 is among the most widely used couple relationship satisfaction questionnaires and shows satisfactory psychometric qualities (Graham et al., 2006; Whisman et al., 2018). Participants were asked to rate the degree to which each item describes their couple relationship during the past month. The first three items employ a 6-point Likert scales ranging from 0 = *Never* to 5 = *All the time*. These items assess the frequency to which they experience positive affects and confidence, as well as doubts or desire of separation within the relationship with their partner. The fourth item measures the degree of happiness felt within their relationship on a 7-point Likert scale, with response ranging from 0 = *Extremely unhappy* to 6 = *Perfectly happy*.

Total scores range between 0 and 21, with higher scores indicating higher relationship satisfaction. In the present sample, the reliability coefficients were satisfactory at T1 ($\alpha=0.74$; $\omega=0.74$) and T2 ($\alpha=0.77$; $\omega=0.78$).

Data Analyses

Descriptive analyses were computed using SPSS version 22 on a pairwise dataset to examine sample characteristics and draw mean comparisons across genders. Correlational analyses were also performed to assess predicted relationships between main variables and identify potential covariates.

The hypothesized model was tested on Mplus version 6.0 (Muthén & Muthén, 2012) using path analyses guided by the Actor-Partner Interdependence Model (APIM), as specified in seminal works on dyadic data analyses by Cook & Kenny, 2005; Kenny et al., 2020). This analytic methodology enables an examination of outcomes related to dyadic processes, where data from both partners of a couple are used to reveal actor and partner effects. All performed path analyses used maximum likelihood estimation (MLR) with standard errors and chi-square statistics that are robust to non-normality and account for missing data. A preliminary APIM was conducted to test direct actor and partner links between CCT (T1) and relationship satisfaction (T2) while controlling for T1 relationship satisfaction.

An integrative mediational APIM (Fig. 1) was then computed, in which we tested actor and partner associations between CCT (T1) and relationship satisfaction (T2) through mindfulness (T1) and experiential avoidance (T2) as sequential mediators, while accounting for relationship satisfaction at T1. As per current statistical paradigms on mediation (Fairchild & McDaniel, 2017), hypothesized associations were examined using a longitudinal methodology allowing us to adequately assess mediational effects. Hence, we applied temporal precedence of the exogenous variables and the first mediators (CCT and mindfulness; T1) on the second mediators and the outcomes (experiential avoidance and relationship satisfaction; T2), and also controlled prior assessment of relationship satisfaction to better estimate change in terms of explained variance.

A total of 32 possible indirect effects between both parents' CCT and relationship satisfaction were assessed in the model. These were examined with 95% bias-corrected bootstrap (10,000 resampling) confidence intervals using the Maximum Likelihood (ML) estimator, where statistical significance is confirmed when generated intervals do not include zero (Preacher & Hayes, 2008).

As this study uses a dyadic design, it was important to test for empirical distinguishability between parents prior to using gender as a distinguishing variable in the model. Since parents were theoretically expected to be distinguishable by their gender, an omnibus within-dyad distinguishability test was performed to verify whether mothers' and fathers' responses were empirically distinguishable (Kenny et al., 2020). The omnibus test for distinguishability is conducted by constraining means and variances as well as intrapersonal and interpersonal variances to be equal across genders, and then comparing the fit of the constrained model with the fit of a model with unconstrained estimates. Model comparison was conducted using the rescaled $-2 \log$ likelihood difference test, which is distributed as chi-squared with degrees of freedom equal to the rescaled difference in the number of parameters between the constrained and unconstrained models (Satorra & Bentler, 2010), yielding a significant chi-square test ($\Delta\chi^2$) if these parameters differed significantly between mothers and fathers. Using a similar model comparison strategy, further analyses applied constraints on actor and partner paths to be equal in the mediational model to compare within-partner associations with cross-partner

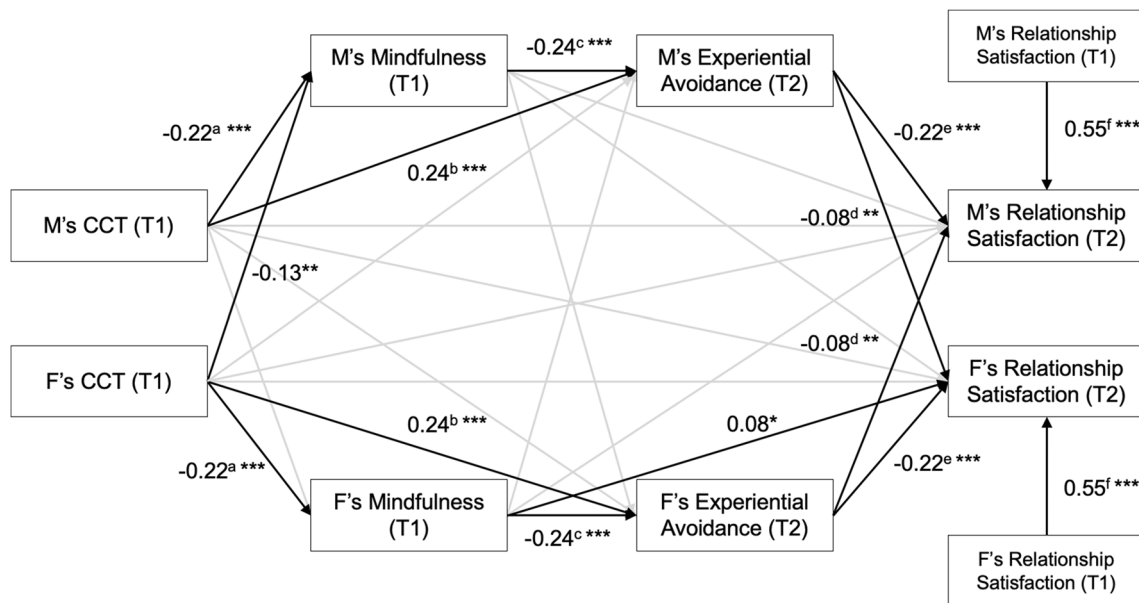


Fig. 1 Results of the mediational Actor-Partner Interdependence Model. *Notes:* All links were estimated; nonsignificant links are shown in gray. Identical subscripts (a, b, c, d, e, f) have been con-

strained to be equal. Ms', mothers' scores; Fs', fathers' scores; CCT, childhood cumulative trauma. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

associations and identify potential differences or similarities between actor and partner effects.

Finally, overall goodness of fit between observed data and the estimated conceptual model was tested by considering dominant scientific guidelines on several indicators. Fit indices can be interpreted using cutoff values developed in statistical methods literature to determine whether fit is satisfactory and draw comparisons between different variations of a model (Hooper et al., 2008; Kline, 2005; Schumacker & Lomax, 2016). In that respect, a root mean square error of approximation (RMSEA) inferior to 0.08, a comparative fit index (CFI) and Tucker-Lewis index superior to 0.95, a non-statistically significant χ^2 , and, finally, a χ^2/df ratio inferior to 3 indicated good fit.

Results

Descriptive Data

Results of the omnibus test confirmed distinguishability between mothers and fathers by their gender, which specifically resided in their mean scores of CCT ($\Delta\chi^2=4.14$, $\Delta df=1$, $p<0.05$), experiential avoidance ($\Delta\chi^2=5.93$, $\Delta df=1$, $p<0.05$), and relationship satisfaction at T1 ($\Delta\chi^2=7.47$, $\Delta df=1$, $p<0.01$). As members of dyads were found to be distinguishable by gender, they could not be randomly assigned as “partner 1” and “partner 2” in the APIM, hence the removal of same-sex couples ($n=10$) from the sample for the next steps. Sociodemographic characteristics of the final sample of 529 heterosexual couples are shown in Table 1.

Frequencies of the different interpersonal trauma types across genders are presented in Table 2. Chi-square tests indicated that mothers reported significantly more sexual abuse, psychological violence, and witnessing of interparental psychological violence, as compared to fathers who reported more physical neglect than mothers. Means and

standard deviations of all study variables are presented in Table 3. Paired-sample *t*-tests were used to examine differences between mothers and fathers regarding the continuous variables. Findings revealed that mothers reported significantly more CCT exposure ($t(525)=1.98$, $p<0.05$), experiential avoidance ($t(528)=5.13$, $p<0.001$), and relationship satisfaction at T1 ($t(526)=2.87$, $p<0.01$) as compared to fathers, while no significant differences were found on mindfulness ($t(526)=-1.59$, $p=0.11$), and relationship satisfaction at T2 ($t(525)=1.05$, $p=0.29$).

Table 3 shows Pearson correlations between main variables of interest across genders as well as the preliminary correlational analyses regarding the covariates. Results revealed associations consistent with the hypotheses. Moreover, significant correlations with potential covariates highlighted two relevant demographic variables to include in the integrative model: relationship length and infant’s age in months. Other relevant demographic variables according to the literature were measured but too sparsely distributed to be considered: termination of the romantic relationship between parents at T2 (0.20%; $n=1$), child being a twin (0.80%; $n=4$), and ongoing pregnancy at T2 (4.90%; $n=26$).

CCT and Relationship Satisfaction

A basic saturated path analysis based on APIM examining direct links between CCT and relationship satisfaction at T2 was executed while controlling for relationship satisfaction at T1, and revealed a significant actor path from CCT to relationship satisfaction for fathers ($b=-0.15$, $p<0.01$) and a nonsignificant actor path for mothers ($b=-0.08$, $p=0.16$). Partners’ links were estimated but revealed as nonsignificant (fathers’ CCT on mothers’ relationship satisfaction: $b=-0.04$, $p=0.45$; mothers’ CCT on fathers’ relationship satisfaction: $b=-0.02$, $p=0.69$). To examine potential difference between coparents, the model was then computed while constraining actors and partners pairs of paths to be equal across mothers and fathers. Applying these constraints

Table 2 Prevalence of childhood interpersonal traumas

	Mothers		Fathers		χ^2	<i>p</i>	ϕ	Total sample	
	<i>n</i>	%	<i>n</i>	%				<i>n</i>	%
Physical violence	221	42%	242	45.90%	1.63	0.202	0.04	463	44%
Psychological violence	183	34.60%	146	27.70%	6.26	0.012	-0.08	329	31.20%
Physical neglect	64	12.10%	88	16.80%	4.48	0.034	0.07	152	14.40%
Psychological neglect	384	73%	361	68.60%	2.43	0.119	-0.05	745	70.80%
Interparental physical violence	42	7.90%	36	6.80%	0.51	0.475	-0.02	78	7.40%
Interparental psychological violence	223	42.40%	182	34.50%	6.87	0.009	-0.08	405	38.50%
Bullying by peers	233	44.40%	240	45.60%	0.17	0.685	0.01	473	44.90%
Sexual abuse	98	18.70%	40	7.60%	28.33	0.001	-0.16	138	13.10%

Notes: Five participants were excluded due to missing data (total $n=1053$; 527 fathers and 526 mothers)
 $\phi>0.05$ =weak, >0.10 =moderate, >0.15 =strong, >0.25 =very strong

Table 3 Means, standard deviations, and correlations among study main variables and covariates

	1	2	3	4	5	6	7	8	9	10	<i>M</i> (<i>SD</i>)
Correlations of the study of main variables within dyads											
1. M's CCT (T1; 0–8)	-										2.76 (1.91)
2. F's CCT (T1; 0–8)	0.12**	-									2.54 (1.87)
3. M's mindfulness (T1; 6–30)	-0.25***	-0.15***	-								23.54 (5.12)
4. F's mindfulness (T1; 6–30)	-0.09*	-0.22***	0.15**	-							24 (4.91)
5. M's experiential avoidance (T2; 6–40)	0.33***	0.11**	-0.36***	-0.013**	-						15.52 (7.83)
6. F's experiential avoidance (T2; 7–42)	0.11*	0.28***	-0.08	-0.26***	0.15***	-					13.39 (6.81)
7. M's RS (T1; 4–21)	-0.20***	-0.016***	0.21***	0.11*	-0.33***	-0.17***	-				17.53 (2.86)
8. F's RS (T1; 6–21)	-0.14**	-0.22***	0.11**	0.23***	-0.17***	-0.27***	0.43***	-			17.16 (2.70)
9. M's RS (T2; 2–21)	-0.18***	-0.13**	0.15**	0.13**	-0.40***	-0.20***	0.64***	0.35***	-		16.67 (3.08)
10. F's RS (T2; 5–21)	-0.11*	-0.23***	0.11*	0.27***	-0.20***	-0.38***	0.37***	0.63***	0.46***	-	16.55 (3.06)
Correlations of the study main variables and covariates within participants											
1. CCT (T1; 0–8)	-										2.65 (1.89)
2. Mindfulness (T1; 6–30)	-0.24***	-									23.77 (5.02)
3. Experiential avoidance (T2; 6–42)	0.31***	-0.32***	-								14.46 (7.41)
4. RS (T2; 2–21)	-0.20***	0.20***	-0.39***	-							16.61 (3.07)
5. Exposure to COVID-19 pandemic (T2; 0–1)	-0.02	-0.08*	-0.00	0.06*	-						-
6. Relationship length (T2; 1–258)	-0.02	0.06	-0.03	-0.06*	-0.73***	-					44.08 (52.41)
7. Infant's age (T2; 5–18)	0.07*	-0.03	0.07*	-0.11***	-0.07*	0.014***	-				8.44 (2.10)

Notes. M's, mothers' scores; F's, fathers' scores; CCT, childhood cumulative trauma; RS, relationship satisfaction

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

did not significantly change model fit ($\Delta\chi^2=0.93, p=0.82$). This model thus established both actor links as equally significant ($b = -0.07, p < 0.01$) and confirmed both partner links as nonsignificant ($b = -0.03, p = 0.41$) across gender. The explained variance of relationship satisfaction in this preliminary model was 40.90% for mothers and 40.20% for fathers.

CCT, Mindfulness, Experiential Avoidance, and Relationship Satisfaction

The full integrative APIM model was tested to examine the associations between CCT and relationship satisfaction through mindfulness and experiential avoidance. Significant structural paths from this model and their standardized estimates are shown in Fig. 1. Several models were computed with different configurations of constraints to assess potential gender differences on the size of actors and partners effects. Two pairs of paths were found to significantly alter model fit when constrained: the actor links between mindfulness at T1 and relationship satisfaction at T2 ($\Delta\chi^2=7.47, p=0.01$), and the partner links between CCT and mindfulness ($\Delta\chi^2=10.05, p=0.00$). Hence, these paths were allowed to vary freely across genders, while all other paths were constrained to be equal across mothers and fathers. The final model thus included two asymmetries. First, a significant path between fathers' CCT and mothers' mindfulness was found, but the path between mothers' CCT and fathers' mindfulness was nonsignificant. Second, a significant actor link between mindfulness and relationship satisfaction was found with fathers, but not with mothers. Additionally, the four paths between CCT at T1 and relationship satisfaction at T2 (i.e., all four actor and partner paths) could be constrained to be equal as it did not significantly change model fit ($\Delta\chi^2=1.06, p=0.30$), indicating that nonsignificant actor and partner links for mothers and fathers were statistically equivalent. Covariates previously identified by significant correlations with the variable of interest were introduced in all steps of the path analyses. Given that the inclusion of infant's age ($\chi^2(26)=652.50, p < 0.001, CFI=0.28, TLI=0.00, RMSEA=0.21$), exposure to the COVID-19 pandemic ($\chi^2(26)=735.79, p < 0.001, CFI=0.20, TLI=0.00, RMSEA=0.01$), and relationship length ($\chi^2(26)=180.67, p < 0.001, CFI=0.82, TLI=1.00, RMSEA=0.11$) resulted in nonsignificant associations with relationship satisfaction at T2, unchanged shared variance, and worsened model fit, they were excluded for parsimony. Fit indicators revealed a satisfactory model fit for the final model ($\chi^2(11)=7.82, p=0.80, \chi^2/df=0.65, CFI=1.00, TLI=1.00, RMSEA=0.00, 95\% CI [0.00, 0.03]$).

Congruent with the hypotheses, CCT was negatively associated with mindfulness, which was associated with lower experiential avoidance, which in turn predicted lower

relationship satisfaction. As shown in Fig. 1, results of path analyses revealed that all estimated actor associations were significant for both parents, with the exceptions of the links from CCT to relationship satisfaction and the link between mothers' mindfulness and their own relationship satisfaction. Three significant partner paths were found: the paths between (1) fathers' CCT and mothers' mindfulness, (2) mothers' experiential avoidance and fathers' relationship satisfaction, and (3) fathers' experiential avoidance and mothers' relationship satisfaction. This model explained 46% of mothers' and 45.20% of fathers' relationship satisfaction. As a comparison, in an analog APIM model computed without taking into account relationship satisfaction at T1, explained variances were respectively 18.30% and 21.10%, which still imply considerable effect sizes.

Overall, hypothesized actor and partner indirect paths were mostly confirmed by the results of the bootstrap procedure. A total of ten indirect effects (i.e., five actor and five partner pathways) were found using a 95% confidence interval (see Table 4 for details). For both mothers and fathers, actor indirect effects were found between their own exposure to CCT and their own relationship satisfaction, sequentially through their own mindfulness and experiential avoidance. Sequential indirect partner effects were also found, indicating that one parent's CCT was related, through their own lower mindfulness and higher experiential avoidance, to their coparent's lower relationship satisfaction. Additionally, five indirect effects (three actor and two partner pathways) went through only one mediator, either mindfulness or experiential avoidance. Notably, while experiential avoidance was found significant in nine out of ten indirect effects, mindfulness was found significant in six out of ten and acting as the sole mediator in only one (i.e., a path from fathers' CCT to their own relationship satisfaction). Finally, a partner indirect effect was found between fathers' CCT and mothers' relationship satisfaction, through mothers' mindfulness and experiential avoidance.

Discussion

The goal of the present study was to examine the roles of mindfulness and experiential avoidance in the associations between CCT and relationship satisfaction using a longitudinal dyadic design in a sample of parents of an infant. In line with the hypothesis regarding actor effects, mindfulness and experiential avoidance sequentially mediated the paths from parents' CCT to their own relationship satisfaction. These findings reveal previously unknown mechanisms explaining the associations between CCT and lower relationship satisfaction, namely hampered adaptive capacities (i.e., mindfulness) and dysfunctional self-regulatory strategies (i.e., experiential avoidance). These results provide empirical support

Table 4 Significant actor and partner indirect effects from the mediational model

IV	Mediator(s)	DV	<i>B</i>	95% CI	<i>p</i>
Actor indirect effects					
M's CCT	M's EA	M's RS	−0.05	−0.07 to −0.03	<0.001
M's CCT	M's mindfulness, M's EA	M's RS	−0.02	−0.02 to −0.01	<0.001
F's CCT	F's EA	F's RS	−0.05	−0.07 to −0.03	<0.001
F's CCT	F's mindfulness	F's RS	−0.02	−0.04 to −0.00	<0.05
F's CCT	F's mindfulness, F's EA	F's RS	−0.01	−0.02 to −0.00	<0.001
Partner indirect effects					
M's CCT	M's EA	F's RS	−0.02	−0.03 to −0.00	<0.05
M's CCT	M's mindfulness, M's EA	F's RS	−0.01	−0.01 to −0.00	<0.05
F's CCT	F's EA	M's RS	−0.02	−0.03 to −0.00	<0.05
F's CCT	F's mindfulness, F's EA	M's RS	−0.00	−0.01 to −0.00	<0.05
F's CCT	M's mindfulness, M's EA	M's RS	−0.01	−0.02 to −0.00	<0.05

IV independent variable, *DV* dependent variable, *Ms'* mothers' scores, *Fs'* fathers' scores, *CCT* childhood cumulative trauma, *EA* experiential avoidance, *RS* relationship satisfaction

for the Pain Paradox, which states that lower mindfulness disposition might arise from childhood trauma, leading to experiential avoidance and other negative outcomes such as poorer relationship satisfaction. Therefore, growing up with challenged dispositional mindfulness then seems to bring forth a reliance on experiential avoidance strategies to cope with stressors, namely having a new child with a romantic partner.

In the path analyses, the importance of mindfulness and experiential avoidance in regard to relationship satisfaction was revealed while examining the causal pathways in a temporal sequence. Lower mindfulness at baseline was found to predict experiential avoidance 6 months later, and while temporal associations between these two variables have been sparsely documented, findings support the plausibility of this directionality and shed light on a potential causal effect to be confirmed in further studies. As suggested by previous authors and the current findings, mindful awareness of post-traumatic distress and maladaptive coping behaviors might help trauma survivors to stave off from experiential avoidance as a deliberate regulatory mechanism (Brem et al., 2017; McCluskey et al., 2022; Thompson & Waltz, 2010). Interestingly, the only significant direct path between mindfulness and couple satisfaction that was found was relatively weak despite moderate correlations and strong associations in previous studies (Kozlowski, 2013). Indeed, experiential avoidance mediated most links between mindfulness and couple satisfaction 6 months later, which supports the postulate that experiential avoidance might be a key maladaptive response that stems from lower mindfulness and then influences relational processes. In light of the Pain Paradox framework, it is reasonable to assume that lower disposition toward mindfulness and experiential avoidance might have mutually enforced each other throughout survivors' socio-affective development, and that while usage of experiential

avoidance in adulthood is mainly due to triggered CCT-related schemes, it might also be maintained by low mindfulness. Moreover, early parenthood could potentially evoke negative childhood memories that survivors experienced with their own parental models, which could diminish participants' disposition to be mindful, and then inflate the importance of experiential avoidance. Subsequent research is therefore needed to verify whether similar findings can be found in samples of couples that do not share challenges comprising such stimuli or inherently stressful contexts.

The dyadic design of this study enabled the identification of explanatory mechanisms not only within individuals, but also between coparents in the same integrative model. In sum, parents' own characteristics most strongly predicted their own relationship dissatisfaction (actor effects), which suggest a mostly actor-oriented pattern in the examined model, but significant partner structural paths representing interinfluence between fathers and mothers were found, as well as indirect effects going from one parent's CCT to the other parent's relationship satisfaction (partner effects). CCT has been known to yield long-term couple issues for survivors (Godbout et al., 2020; Liu et al., 2019), which can also affect their partner's experience, but empirical documentation was lacking on the strength and the results of these interrelations. Both mothers' and fathers' experiential avoidance impacted on their partner's relationship satisfaction, and these specific paths explained almost all interinfluences of one's CCT on the other's relationship satisfaction. These findings may indicate that something in mothers' and fathers' lives, be it parental stress, triggered CCT memories, or both, might motivate them to cut themselves from activating stimuli in order to lessen their troublesome experience. Since the stimuli that are avoided might partly be found in the relationship with their coparent, survivors' access to recent positive couple interactions and memories might be

obstructed, hence diminishing their satisfaction. It is also possible that months of building-up experiential avoidance created distance between partners and lessened their intimacy, which would also explain mutual influences found in the APIMs and high correlations between both parents' relationship satisfaction. Findings thus confirm our exploratory second hypothesis about partners' interinfluences, and highlight the importance of dyadic designs in future research to improve scientific understanding of systemic effects of CCT.

Covariations in key variables suggest the occurrence of marital resemblance in the sample, which refers to the observed tendency for mated pairs to be more phenotypically similar for a given trait than would be expected by chance (Merikangas, 1982). This phenomenon might also partially explain why most of the actor links were found to be equal across gender in the distinguishability analyses. Yet, findings also highlighted asymmetries in partner pathways, implying gender differences. Fathers' CCT was indeed related to mother's lower mindfulness disposition, but mothers' CCT was not associated with fathers' mindfulness. Previous research indicates that women typically score higher on empathy than men and show higher sensitivity to their male partner (Frye-Cox & Hesse, 2013; Milfont & Sibley, 2016). It is thus plausible that mothers react more strongly to their partners' CCT history and sequelae, and thus experience them to some extent through vicarious traumatization. Additionally, a major difference between the parents in our sample is that mothers were until recently pregnant with a child, which is known to increase reactivity and to deplete adaptive resources (Bjelica et al., 2018), which could also explain why fathers' mindfulness was directly related to their relationship satisfaction whereas it was not the case with mothers. Further work with more focus on exploring gender differences among parental couples is required to support these interpretations of our results. To conclude, findings emphasize relationship satisfaction as an intrinsically systemic aspect of adult life that is sensitive to influences from numerous intra- and inter-personal factors, such as CCT, mindfulness, and experiential avoidance, as well as contextual determinants exerting pressure on one's resources like having a young infant.

Limitations and Future Research

Beyond its methodological strengths and empirical contributions, the present study has limitations that require consideration. Although the models were based on temporal precedence and control for relationship satisfaction at T1, results should be confirmed using multiwave longitudinal designs. The probabilistic recruitment of our sample is another important strength. Yet, findings should not be generalized outside heterosexual parental couples from the Quebec province with an infant. The sociodemographic profile

of the sample was representative of the general population regarding the mean age (between 30 and 35 years old), first language (around 75% are French speakers), and country of birth (around 20–25% are first-generation immigrants). However, education level and yearly income were higher in our sample compared to the general population. This may be explained by the fact that parents in our sample had to be in couple relationships, and research has shown that parents from single parent families tend to have lower education levels and annual incomes (McErlean, 2021; Pelletier, 2016). Hence, future research should try replicating these findings with more inclusive samples (e.g., separated parental couples, lower-income families, sex/gender diverse couples) or with children going through different developmental stages. Moreover, the conceptual validity of mindfulness is currently being scrutinized throughout theoretical and empirical studies on the construct (Van Dam et al., 2018). Along with other leading questionnaires (e.g., Five Facet Mindfulness Questionnaire; Baer et al., 2008), the MAAS questionnaire was described by some authors as suboptimal, particularly because of its unidimensional factorial structure and reverse-scoring. However, the MAAS psychometric qualities are more consistently validated than alternatives, and specifically measure the concept targeted in this study (i.e., attentiveness and awareness of present events and experiences). Results therefore need to be interpreted while referring to dispositional mindfulness as the awareness of one's experience and behavior in the present without distraction or forgetfulness (Brown & Ryan, 2003). Future research might benefit from examining the effects of other dimensions of mindfulness (e.g., nonjudgment, nonreactivity) in links with CCT, experiential avoidance, and relationship satisfaction. Relationship mindfulness, referring to the tendency to be mindful in the context of romantic relationships (Kimmes et al., 2018), is a promising construct that should also be considered to expand the current findings on the role of mindfulness in the link between CCT and relationship satisfaction. Regarding the assessment of CCT, it should be noted that retrospective and self-report measurements such as the CCTQ are subject to biases (memories, cultural norms, socially desirable responses, etc.) although studies supported that such measures are effective in screening childhood abuse (Thombs et al., 2006). More broadly, the examination of other key variables related to CCT could also shed light on the link between CCT and intimate relationships. In particular, disclosure of childhood trauma along with the reaction to disclosure has been shown to aggravate survivors' psychological and relational well-being in adulthood and should be examined in future studies on CCT (Godbout et al., 2014; Therriault et al., 2020). Future research should also consider taking into account other adverse childhood experiences (e.g., community violence, parental mental illness, substance abuse or incarceration)

that may co-occur with CCT and could explain the examined outcomes (Finkelhor, 2018). Despite these limitations, this study represents a considerable step toward improving our understanding of CCT survivors' relationship satisfaction and the underlying dyadic patterns. Future research could build upon these new empirical foundations and examine the potential of mindfulness in explaining post-traumatic processes and usage of experiential avoidance among vulnerable populations, so that ultimately, the scientific community build enough empirical support for clinical trials on new trauma-sensitive couple interventions.

Author Contribution FMH: writing – original draft preparation, reviewing and editing, visualization, data curation, formal analysis, investigation. AP: project administration, supervision, conceptualization, formal analysis, funding acquisition, writing – reviewing and editing. MED: writing – reviewing and editing. JD: writing – reviewing and editing. NG: project administration, supervision, conceptualization, formal analysis, funding acquisition, resources, writing – reviewing and editing.

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Data Availability The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Declarations

Ethics Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the University of Quebec in Montreal (UQAM) institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare no competing interests.

Use of Artificial Intelligence AI was not used.

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