

Does imagining you never met a romantic partner boost relationship satisfaction and gratitude? A conceptual replication and extension of the effect of mentally subtracting a partner

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Abstract

Previous research has found that thinking about the presence of a partner in one's life can, at least temporarily, increase relationship satisfaction. However, other studies have found that doing the opposite—thinking about the *absence* of a partner from one's life (i.e., mentally subtracting a partner)—can boost relationship satisfaction. The current study is a conceptual replication and extension of a previous study demonstrating that people who imagined never meeting their current partner reported greater satisfaction than people who thought about the presence of a partner in their life or a neutral control. We expected that thinking about the absence of a partner could boost gratitude and, in turn, promote greater relationship satisfaction. However, we did not find support for the mental subtraction effect on relationship satisfaction or gratitude. That is, participants who mentally subtracted their romantic partners from their lives did not report greater relationship satisfaction or gratitude compared to

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participants who thought about the presence of their partner in their lives (or those in a control condition). Our study suggests that mentally subtracting positive life events may not always boost feelings of satisfaction.

Keywords

Conceptual replication, gratitude, mental subtraction, relationship satisfaction, romantic relationships

Romantic relationship satisfaction is among the strongest predictors of overall health and well-being (Burman & Margolin, 1992; Kiecolt-Glaser & Newton, 2001), in part because romantic relationships help people to fulfill fundamental needs, such as needs for belonging, intimacy, and support (Gordon et al., 2012; Vollmann et al., 2019). However, relationship quality can be difficult to maintain over time, and a growing body of research is devoted to understanding the factors that are associated with relationship satisfaction. While research has shown there are several ways in which people can foster relationship satisfaction, such as comforting their partner when they are upset (Cramer, 2006) or using humor to create closeness (Butzer & Kuiper, 2008), some work has demonstrated that it might be possible for a person to feel greater relationship satisfaction *without* the active involvement of their romantic partner (Borelli et al., 2015).

In fact, some past research suggests that simply *thinking* about a romantic partner can be sufficient to positively influence a person's feelings of relationship satisfaction (Acitelli et al., 1999; Alea & Bluck, 2007; Brown, 2018). Reflecting on the presence of a good life event (e.g., meeting a romantic partner; Burton & King, 2004)—sometimes referred to as counting one's blessings—has been shown to boost relationship satisfaction because it can bring to mind some of the ways in which one is fortunate to be the recipient of another's resources (Watkins et al., 2004). Although some research has found that this phenomenon can increase positive affect—such as feelings of happiness or joy—and subjective well-being (e.g., Emmons & McCullough, 2003), most empirical support for this effect, especially in the context of romantic relationships, has been mixed, with several studies finding that reflecting on positive past experiences has no significant effect on relationship satisfaction or overall well-being (Lyubomirsky et al., 2006; Mallory et al., 2018; Sheldon & Lyubomirsky, 2006). For example, in one study, counting one's blessings did not boost relationship satisfaction, but it resulted in the positive memories becoming more familiar and the person having a less intense emotional reactions to the event (Lyubomirsky, 2011). The mixed findings suggest that the effects of reflecting on past positive experiences are not well understood and that simply thinking about the presence of a partner in one's life may not always boost relationship satisfaction.

Another, somewhat counterintuitive, way that one can boost their relationship satisfaction is by thinking about the absence of a romantic partner from one's life (i.e., imagining having never met a romantic partner). For instance, although one study by Miller (2003) demonstrated that imagining a positive experience a person shared with a romantic partner enhanced their feelings of relationship satisfaction from baseline

reports, so did imagining the death of a partner. In this study, thinking about a partner's absence resulted in boosts to relationship satisfaction that were similar in size to the boosts in relationship satisfaction experienced by participants who reflected on a positive experience with a romantic partner.

In a novel study by Koo et al. (2008), researchers found that mentally subtracting a romantic partner (i.e., imagining never meeting a romantic partner) evoked *greater* perceived relationship satisfaction and happiness compared to recalling the presence of a partner in one's life (i.e., recalling how a person met their partner). However, given the mixed findings in previous work, we sought to conduct a conceptual replication of this study in which we compare the effect of imagining the absence of a partner (i.e., mentally subtracting a partner) to a presence and control condition. We also sought to extend past work and test whether feelings of gratitude for a partner explain the boost in satisfaction associated with mentally subtracting a partner.

Mentally subtracting a partner and relationship satisfaction

One way that individuals may be able to, at least temporarily, improve their overall well-being is through the mental subtraction of a positive life event. By mentally subtracting a positive life event, like meeting a romantic partner, one may experience surprising and positive feelings toward the event that may make them feel more satisfied with their life circumstances (Burton & King, 2004). Speculating about alternative life paths (such as never meeting a romantic partner) can happen regularly in daily life (Ruiselova & Prokopcakova, 2011) and can play a role in decision making, shaping emotions, and putting information into context (Roese & Morrison, 2009), which is why it is important to understand. In a series of studies, researchers found that mentally subtracting a positive event from one's life was associated with improved affective states, such as feeling greater joy (Koo et al., 2008). Specifically, in one of their studies, Koo and colleagues focused on the mental subtraction of a romantic partner and demonstrated that thinking about the absence of a long-term romantic partner in one's life (i.e., imagining never having met their partner) resulted in greater relationship satisfaction and happiness, compared to when people thought about the presence of their partner in their life (i.e., reflecting on how they met their partner) or did not think about their romantic partner at all (i.e., a neutral control condition). Importantly, these findings were counterintuitive to people's expectations. That is, in their study, the researchers also included a group of participants, termed "forecasters," who were asked to imagine how they would respond if they were tasked with either imagining the presence or absence of a romantic partner. The majority of forecasters predicted that they would feel worse being in the *absence* condition than in the *presence* condition and reported a preference for being in the *presence* condition over the *absence* condition.

The rationale for thinking about the absence (versus the presence) of a partner boosting satisfaction is based on *counterfactual reasoning*, or the process of speculating about a possible alternative world in which different events may have occurred (Beck et al., 2014). By speculating about a life without their current romantic partner, this may have lessened participants' felt familiarity with their partners, which in turn may have led them to have more positive and surprising feelings toward their partners (Koo et al.,

2008). Counterfactual reasoning produces an *affective contrast effect* in which thinking about the absence of a good event from one's life, such as one's relationship, makes the good event seem even better (Koo et al., 2008). In other words, thinking about how something important in their lives may never have happened introduced an element of surprise and consideration for an alternative life path in which they might have been worse off, subsequently leading people to feel more satisfied with that aspect of their lives. That is, thinking about having never met a partner may provide a *downward social comparison*, or a comparison to one's hypothetical self who is in a less attractive situation (Beck et al., 2014). In the study by Koo et al., which included participants who were in satisfying relationships, when participants compared their current happy relationship to a hypothetical scenario in which they may have been worse off for not being in the relationship, participants may have felt better about their romantic partner and relationship in general (Koo et al., 2008).

Of course, it is also possible for an individual to generate surprising thoughts of how their life could have turned out better if they had not met a romantic partner. The act of comparing oneself to a hypothetical self who is better off, or making an *upward social comparison*, could result in greater negative affect (e.g., regret; Roesse, 1994). That is, individuals who believe that they would have had a more favorable life outcome had they not met their romantic partner may feel worse about their past decisions to enter into a relationship. One study found that mentally subtracting a romantic partner brought to mind real or imagined alternatives to a current partner, such as past partners who may have been more favorable, and this led to more negative feelings toward a current partner in comparison (Mattson et al., 2012). Therefore, the extent to which thinking about the presence versus absence of a romantic partner is associated with feelings of relationship satisfaction might depend on a person's initial satisfaction with their current relationship.

Positive influence of gratitude on relationship quality

If, in fact, imagining having never met a partner boosts relationship satisfaction, it is possible that comparing one's current life to a life without a romantic partner may lead individuals to feel more grateful for their partner. Several studies have demonstrated that making downward social comparisons (i.e., comparing your current situation to a worse situation) can lead to people feeling more grateful for their life circumstances (Adler & Fagley, 2005; Buunk et al., 1990). *Gratitude* is a positive emotion that a person feels toward another when they recognize that they have been the recipient of another person's resources, efforts, or sacrifices (Fagley, 2016). In the context of a romantic relationship, partners invest energy, time, and other valuable resources into their relationship—all of which would be lost if a partner were to end the relationship (Joel et al., 2013). When an individual makes a downward social comparison against a hypothetical self that is worse off for not being in a relationship with their current partner, they may feel grateful for their partner's contributions to the positive aspects of their lives as a result.

Gratitude for a romantic partner has widely been shown to help maintain, and even strengthen, romantic relationships (Algoe et al., 2010; Gordon et al., 2012; Lambert et al., 2010; Vollmann et al., 2019). Specifically, when individuals feel grateful for their romantic partners, they tend to feel more satisfied with their relationships

(Algoe et al., 2010), which may be because feelings of gratitude remind people of their partner's positive qualities, such as their kindness and responsiveness (Kubacka et al., 2011). Gratitude may also increase relationship satisfaction because grateful partners are more motivated to perform relationship maintenance behaviors, such as actively trying to work on resolving relationship problems (Kubacka et al., 2011). Therefore, it is possible that, if imagining never meeting a partner provides a downward comparison in which one's life would be worse without their partner, it could boost gratitude for their partner and in turn, enhance relationship satisfaction.

The proposed study

The current study is a high-powered conceptual replication and extension of Koo et al.'s (2008) study on the impact of mentally subtracting a romantic partner, which had three main goals. Our first goal was to replicate the original findings in a larger sample with a more balanced gender distribution (as the original study included a small sample of mostly women, $N = 65$ women, 23 men). Specifically, we aimed to replicate the finding that thinking about the absence of a partner in one's life would lead to greater relationship satisfaction, compared to thinking about the presence of a partner or a neutral control. Given that past work has found gender differences in how men and women think about and evaluate their romantic relationships—women tend to think more positively about their relationships than men do (Acitelli et al., 1999)—we also tested whether any effects were moderated by gender.

Second, in the original study, they only recruited participants who reported being moderately to highly satisfied with their relationships at the outset of the study. To test whether imagining the absence of a partner (compared to the presence and control conditions) only boosts relationship satisfaction if people are in satisfying relationships, we assessed relationship satisfaction at baseline and tested whether baseline levels of relationship satisfaction moderated the effect of the manipulation on subsequent feelings of relationship satisfaction.

Finally, if the original findings replicate, we aim to test whether feelings of gratitude for a partner accounted for the association between mentally subtracting a partner and relationship satisfaction. That is, we will test if people in the absence condition reported more gratitude compared to the other two conditions, and if so, whether feelings of gratitude mediate or explain the effects of mentally subtracting a partner on relationship satisfaction.

We conducted a two-part online survey following the methodological design of Koo et al. (2008). We first tested whether the results from the original study replicated. Specifically, we tested whether people who mentally subtracted their partners from their lives (i.e., those in the absence condition) reported higher relationship satisfaction (or greater increases in their relationship satisfaction from baseline), compared to those who did not mentally subtract (i.e., those in the presence or control condition). In addition, as research has shown that counterfactual reasoning may elicit gratitude for a partner, and as gratitude has been frequently associated with relationship satisfaction, we also tested the prediction that gratitude would account for the link between mentally subtracting a partner and relationship satisfaction. We also tested whether any effect differed based on initial

relationship satisfaction or gender. We have preregistered our hypotheses and analytic strategies: https://osf.io/y7e83?view_only=8da8b53031b34b99a25bda9d2835707e. We have also shared our data and syntax on the Open Science Framework: https://osf.io/s2zx3/?view_only=c6084649219549c499c8eddd13c6613f.

Method

Participants

Participants were recruited through Prolific Academic (<https://www.prolific.co/>). To determine sample size, we conducted a power analysis using G*Power.¹ To achieve 95% power at an alpha of .05 based on a small effect size ($f = .15$) consistent with the small effect size from the original study, we calculated that we needed 348 participants for three groups assessed at two time points. We oversampled by approximately 20% to account for attrition rates that we saw in a smaller pilot study; therefore, we recruited a total of 418 participants. Our final sample was slightly smaller than our preregistered sample size because we had to exclude 114 of the initial 418 participants: two participants did not meet the inclusion criteria (e.g., being in a committed relationship), 25 participants indicated that they were tired or distracted when completing the survey, 11 participants indicated that they did not comply with survey instructions, 38 participants had missing data in essential measures for either of the two surveys, 35 participants did not comply with task instructions for the written exercise, and 5 participants did not return to complete the second survey. The final sample consisted of 304 participants ($N = 112$ men, 190 women, one trans-identified as male, one “other” defined as non-binary). Participants ranged in age from 21 to 70 years ($M = 40.22$, $SD = 11.09$). The sample was primarily White (84.5%), straight/heterosexual (86.8%), and married (82.2%), and the average relationship duration was 15.45 years ($SD = 8.96$). For more information, see Table 1.

Procedure

Although half of the sample from the original study completed the surveys and experimental tasks in a lab, in order to recruit a high-powered sample, we conducted the current study completely online. Participants were assessed for eligibility via a pre-screening questionnaire. Consent was then obtained in the first of two online surveys that were administered in Qualtrics. Once eligibility and consent were confirmed, participants completed a 15-minute online survey, which included demographic questions and baseline measures of relationship satisfaction, gratitude, happiness, and general positive and negative affect. The first survey was administered to assess initial levels of relationship satisfaction at baseline, separately from the second survey (when the manipulation was administered). Three days later, participants were invited to complete a second survey. In this survey, participants were randomly assigned to one of three writing conditions: the presence condition, the absence condition, or the control condition. Although participants were instructed to write for 15 to 20 minutes, and were shown a timer for their convenience, participants spent 13 minutes on average (1.54 – 81.62, $M = 12.98$, $SD = 7.99$) completing their writing tasks. A one-way analysis of

Table 1. Sample characteristics (N = 304).

Characteristic	M (range) or n	SD or %
Age (years)	40.22 (21–70)	11.09
Relationship duration (years)	15.45 (5–46.2)	8.96
Gender		
Male	112	36.8%
Female	190	62.5%
Trans-Identify as male	1	0.3%
Other (Non-binary)	1	0.3%
Ethnicity		
White (e.g., North American, European, etc.)	257	84.5%
Black (e.g., African, Caribbean, etc.)	5	1.6%
East Asian (e.g., Chinese, Korean, etc.)	16	5.3%
South Asian (e.g., Indian, Pakistani, etc.)	1	0.3%
Latin American (e.g., Columbian, Mexican, etc.)	11	3.6%
Native American/First Nation (e.g., Cree/Ojibway, Metis, etc.)	4	1.3%
Bi- or multi-ethnic/racial	10	3.3%
Relationship status		
Dating	2	0.7%
Cohabiting	29	9.5%
Common-law	13	4.3%
Married	250	82.2%
Engaged	10	3.3%
Sexual orientation		
Asexual	3	1.0%
Bisexual	27	8.9%
Gay	1	0.3%
Lesbian	2	0.7%
Straight/heterosexual	264	86.8%
Pansexual	5	1.6%
Queer	2	0.7%
Highest level of education		
No formal qualifications	9	3.0%
Secondary school/ GCSE	39	12.8%
College/A levels	64	21.1%
Undergraduate degree (BA/BSc/other)	124	40.8%
Graduate degree (MA/MSc/MPhil/ other)	55	18.1%
Doctorate degree (PhD/MD/other)	13	4.3%
What country do you live in?		
United States	268	88.2%
Canada	36	11.8%

variance revealed a significant effect of condition on writing time, $F(2, 301) = 5.12$, $p = .006$. Specifically, participants in the presence condition spent significantly more time completing the writing tasks ($M = 14.91$, $SD = 10.07$) compared to the control condition ($M = 11.51$, $SD = 7.21$, $p = .005$). There were no significant differences between participants in the absence ($M = 12.60$, $SD = 5.43$) and presence conditions ($p = .132$) or the absence and control conditions ($p = .997$) in writing time. Participants

had 4 days to complete the second survey before it expired. Open-ended results were reviewed to ensure that participants followed task instructions. Participants who did not comply with task instructions, did not write about one or more of the three task prompts, were significantly off topic (e.g., writing about meeting a partner instead of how one could *not* have met a partner), or did not respond in enough detail to allow us to assess if they followed instructions (e.g., responding with brief, single sentence answers to a prompt) were removed prior to analyses. Thirty-five participants were removed in total. More participants were dropped from the absence condition ($n = 19$) compared to the presence ($n = 9$) and control ($n = 7$) conditions, mainly because participants did not follow instructions and wrote more about how they met their partners instead. We also eliminated participants who indicated at the end of the survey that they 1) were tired or distracted when answering survey questions, 2) did not read the instructions carefully, 3) thought we should not use their data in our analysis, or 4) thought they did not provide high quality responses in their written feedback. We believe these exclusions were an added check to ensure that the quality of our data was not compromised due to potential distractions or challenges associated with completing the study online.

As in the original study, in the *presence condition*, participants were asked to write in detail about how they met their partner, how they started dating their partner, and how they ended up together in a romantic relationship. In the *absence condition*, participants wrote about how they may have never met their partner, how they may have never started dating their partner, and how they may have never ended up together in a relationship. Finally, in the *control condition*, participants were asked to write about how they spend their typical weekday. In this condition, participants were asked to break down their typical day into three sections: morning (9 AM to 11:30 AM), mid-day (11:30 AM to 2 PM), and afternoon (2 PM to 5 PM). It is important to note that the original study included three control conditions. In one version of the control condition, participants recalled their typical weekday. In the second version, participants described how they met and formed a relationship with a close friend. In the third version, participants described how they might never have met and formed a relationship with their friend. However, as all of these conditions yielded the same effects in the original study, we opted to use the most neutral version (e.g., writing about a typical day) that would allow us to compare the other conditions to a condition that did not involve a romantic partner.

After completing the writing task, participants spent an additional 5 minutes completing a condensed version of the relationship measures from baseline. Upon completion of the study, participants viewed a debriefing form. Participants were compensated £1.25 (\$2.18 CAD) for completing the first survey, and £1.67 (\$2.91 CAD) for completing the second survey.

Measures

In addition to the key variables, participants reported their age, relationship duration, and ethnicity. Consistent with the original study, relationship satisfaction was measured twice using a composite score of three scales (i.e., Relationship Assessment Scale [Hendrick, 1988], Passionate Love Scale [Hatfield & Sprecher, 1986], Rubin's Love Scale [Rubin, 1970]): once in the first survey as a baseline measure, and once again 3 days later following

the writing tasks in the second survey. Unlike the original study, we used full scales—rather than condensed scales—to assess the measures at baseline. Truncated versions of the baseline measures were administered post-manipulation (consistent with the original study). We also assessed one new mediator variable (i.e., gratitude).

Relationship satisfaction. A composite measure of relationship satisfaction was measured using three scales: Passionate Love Scale (Hatfield & Sprecher, 1986), Relationship Assessment Scale (Hendrick, 1988), and Love Scale (Rubin, 1970). All scales were assessed from 1 to 7, and the mean of the three scales was taken to create the aggregate relationship satisfaction score (i.e., the aggregate variable was centered around the grand mean of the sample). With the Passionate Love Scale, participants were asked to rate their relationship satisfaction on 30 7-point scales from 1 = “not at all true” to 7 = “definitely true” ($\alpha = .96$, $M = 5.05$, $SD = 1.02$). Three items from the original measure (e.g., “I would rather be with my partner than anyone else”) were administered post-manipulation ($\alpha = .87$, $M = 5.84$, $SD = 1.29$). Next, with the Relationship Assessment Scale, participants were asked to rate their relationship satisfaction on seven 7-point scales from 1 = “not much” to 7 = “very much” ($\alpha = .93$, $M = 5.75$, $SD = 1.10$). Four items from the original measure (e.g., “How much do you love your partner?”) were administered post-manipulation ($\alpha = .86$, $M = 5.75$, $SD = 1.13$). Finally, with the Love Scale, participants were asked to rate their relationship satisfaction on 13 7-point scales from 1 = “not at all true” to 7 = “definitely true” ($\alpha = .90$, $M = 5.34$, $SD = 1.00$). Two items from the original measure (e.g., “One of my primary concerns is my partner’s welfare”) were administered post-manipulation ($r = .46$, $p < .001$, $M = 6.00$, $SD = 1.12$).

Gratitude. Gratitude for one’s romantic partner was assessed using two items (e.g., “I feel lucky to have my partner in my life”). Participants rated their feelings of gratitude for their partner using 7-point Likert-type scales from 1 = “strongly agree” to 7 = “strongly disagree” ($r = .87$, $p < .001$, $M = 6.23$, $SD = 1.16$). The same items were administered post-manipulation ($r = .82$, $p < .001$, $M = 6.22$, $SD = 1.11$).

Analyses

We took two approaches to analyzing the data. First, we conceptually replicated the analytic approach from the original study. The authors from the original study used two methods in analyzing their data. The first method of analysis involved subtracting post-manipulation measures from baseline measures and predicting a change in relationship quality from pre- to post-manipulation. The second method was an analysis of covariance (ANCOVA), in which the authors assessed whether there were any significant differences between the experimental conditions in relationship satisfaction post-manipulation, controlling for baseline relationship satisfaction. As such, we performed the same analyses to aim to replicate the original findings.

Second, we conducted several new analyses. In one analysis, we ran an ANCOVA to assess whether there were any significant differences between the experimental conditions in gratitude post-manipulation, controlling for gratitude at baseline levels. If we found significant effects of the manipulation on gratitude, we planned to conduct a

mediation analysis with Hayes' PROCESS macro. We then ran a pre-registered multiple analyses of variance (MANOVA) to compare differences in relationship satisfaction and gratitude across the three conditions. Finally, we used Hayes' PROCESS macro with 95% confidence intervals to determine if gender or baseline levels of relationship satisfaction moderated any of the main effects.

Results

Effects of mental subtraction on relationship satisfaction

As the original study subtracted post-manipulation measures of relationship satisfaction from baseline measures, we also tested our predictions using the same approach.² However, we did not replicate the original findings. Overall, the experimental condition (e.g., presence, absence, or control) did not have a significant effect on changes in relationship satisfaction from baseline, $F(2, 301) = .16, p = .853$. Participants in the absence condition ($M = .60, SD = .54$) did not show significant differences in pre-post changes in relationship satisfaction compared to participants in the presence ($M = .64, SD = .53$) or control ($M = .60, SD = .55$) conditions. Next, we conducted pre-registered moderation analyses using Hayes' PROCESS Macro to assess if gender or baseline relationship satisfaction moderated any of the main effects. Consistent with the original study, we did not find any significant moderations by gender for comparisons between the absence and presence conditions ($b = -.08, SE = .16, t[296] = -.49, p = .625$) or between the absence and control conditions ($b = -.08, SE = .16, t[296] = -.48, p = .631$). We also found no significant moderations by baseline relationship satisfaction for comparisons between the absence and presence conditions ($b = .01, SE = .08, t[298] = .15, p = .878$) or between the absence and control conditions ($b = -.03, SE = .09, t[298] = -.37, p = .710$). These findings suggest that the associations did not differ for men versus women, or for people with higher versus lower initial levels of relationship satisfaction.

We also performed an ANCOVA to test the effects of the manipulation on relationship satisfaction post-manipulation, controlling for relationship satisfaction at baseline. Using this approach, we also did not find any significant effects of condition on relationship satisfaction post-manipulation, $F(2, 300) = .11, p = .893$. The effect of condition on relationship satisfaction was also not significant if baseline relationship satisfaction was not controlled, $F(2, 301) = .13, p = .883$. Comparisons between the absence and presence conditions ($b = -.07, SE = .16, t[295] = -.45, p = .653$) or between the absence and control conditions ($b = -.08, SE = .16, t[295] = -.51, p = .608$) were not moderated by gender. We also tested whether the manipulation affected people's broader feelings of happiness and positive and negative affect, but, if anything, the presence condition was associated with greater happiness and more positive affect than the absence and control conditions, as well as less negative affect compared to the control condition (see Online Supplemental Materials).

Next, we conducted additional exploratory tests to see whether any effects would emerge if we tested the measures of relationship satisfaction separately. In the following analyses, we used the same procedure from the original study and subtracted the outcome measure from baseline to assess change. However, as reported in Table 2, we did not find

Table 2. Means and standard deviations of pre- and post-manipulation relationship satisfaction, gratitude, and positive and negative affect across conditions.

Measure	Pre-Manipulation						Post-Manipulation					
	Absence		Presence		Control		Absence		Presence		Control	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Composite	5.27	.90	5.16	1.06	5.25	.90	5.86	1.00	5.79	1.14	5.85	.98
Relationship Assessment Scale	5.88	.92	5.59	1.32	5.80	.98	5.80	1.11	5.67	1.26	5.79	1.02
Passionate Love Scale	5.07	.97	5.00	1.12	5.09	.97	5.86	1.23	5.84	1.40	5.84	1.25
Love Scale	5.38	.96	5.30	1.06	5.34	.98	6.01	1.07	5.99	1.15	6.00	1.15
Gratitude	6.28	1.08	6.18	1.12	6.24	1.27	6.17	1.19	6.15	1.11	6.31	1.07

Note: Composite = composite of relationship satisfaction measures. Based on a multiple analysis of variance, there were no significant differences between any of the variables of interest pre- or post-manipulation.

significant differences between the experimental conditions and changes in any of the measures of relationship satisfaction. Additionally, we did not find any significant moderations by gender for comparisons between the absence and presence conditions ($b = -.05$, $SE = .15$, $t[295] = -.31$, $p = .758$) or between the absence and control conditions ($b = -.05$, $SE = .14$, $t[295] = -.33$, $p = .744$). However, the effects differed based on baseline levels of relationship satisfaction (as assessed by the RAS), but if anything the pattern of results suggested that for people highly satisfied in their relationship at baseline, they experienced greater boosts in satisfaction in the presence and control conditions compared to the absence condition (see Online Supplemental Materials).

Effects of mental subtraction on gratitude

Even though we did not replicate the main effects of condition predicting changes in relationship satisfaction, we conducted an ANCOVA to assess whether the manipulation had an effect on participants' gratitude for their partners, controlling for gratitude at baseline. However, we did not find any significant differences between any of the three conditions, $F(2, 300) = .98$, $p = .378$. That is, the presence ($M = 6.15$, $SD = 1.11$), absence ($M = 6.17$, $SD = 1.19$), and control ($M = 6.31$, $SD = 1.07$) conditions did not significantly differ in levels of gratitude post-manipulation after accounting for initial feelings of gratitude for a partner. Post-manipulation gratitude also did not differ if baseline gratitude was not controlled, $F(2, 301) = .62$, $p = .538$ or in models including relationship satisfaction (see Online Supplemental Materials). We did not find any significant moderations by gender for comparisons between the absence and presence conditions ($b = -.01$, $SE = .26$, $t[295] = -.04$, $p = .969$) or between the absence and control conditions ($b = .05$, $SE = .25$, $t[295] = .18$, $p = .855$). Additionally, we did not find any significant moderations by baseline relationship satisfaction for comparisons between the absence and presence conditions ($b = -.01$, $SE = .12$, $t[297] = -.11$, $p = .913$) or between the absence and control conditions ($b = .05$, $SE = .13$, $t[297] = .37$, $p = .715$).

Discussion

The current study is a conceptual replication and extension of a study by Koo et al. (2008) testing whether mentally subtracting a romantic partner from one's life (i.e., thinking about how one may have never met a partner) compared to imagining the presence of a partner (i.e., thinking about how one met their partner) or a control condition boosts relationship satisfaction and gratitude. Although in our pre-registered analyses we expected to replicate the original effects, we did not find any significant differences in relationship satisfaction when partners imagined never meeting their partner compared to when they thought about how they met their partner or their typical day (control condition). Specifically, participants who mentally subtracted their partner from their life did not report significantly greater boosts to their relationship satisfaction from baseline, compared to participants who imagined the presence of their partner in their life or participants who did not think about their partners at all. Although participants in the presence condition reported marginal increases in relationship satisfaction

post-manipulation compared to baseline measures on one indicator of relationship satisfaction (i.e., Relationship Assessment Scale; Hendrick, 1988), we did not find strong evidence from any of the other indicators of relationship quality that thinking about the presence of a partner in one's life boosts relationship satisfaction to a greater degree than mentally subtracting a partner (or a control condition). Overall, we did not find that gender or baseline levels of relationship satisfaction moderated the effects.

Past research on mental subtraction has shown that mentally subtracting something positive from one's life can make people feel more satisfied with that aspect of their lives (e.g., Johannsen, 2018). Although one study focusing on the mental subtraction of a romantic partner specifically found that this effect is comparable in size to the boosts in satisfaction one might experience from thinking about the presence of a partner (Miller, 2003), other studies have found that mentally subtracting a romantic partner led to greater increases in relationship satisfaction compared to thinking about the presence of a romantic partner or not thinking about a partner at all (Koo et al., 2008; Studer, 2016). Given the mixed findings in past research and the current findings showing no differences in relationship satisfaction across conditions, it is possible that the effects are dependent on moderators that were not assessed in the current study. Perhaps, for some people, reflecting on a life without a romantic partner reminds them of alternatives (e.g., partner or life outcomes) that may be more attractive than their current relationship (Mattson et al., 2012), whereas for others, mentally subtracting a partner might make them feel more grateful to have their partner in their life. We expected that differences in initial levels of relationship satisfaction might account for these effects—with people who are highly satisfied feeling more grateful and, in turn, happier with their relationship when imagining never having met a partner, and people who are less satisfied being unaffected by the manipulation. However, we did not find that people who were more satisfied at baseline, experienced boosts in relationship satisfaction or gratitude when they imagined never having met their partner.

There are several possible explanations for why we did not replicate the original findings. First, we conducted this study completely online and it is possible that the benefits of mentally subtracting a romantic partner would be more pronounced if we could confirm participants' focused attention to the task in the lab. Although we only included participants who followed the instructions and wrote a substantial amount in response to the questions, an in-lab experiment could have helped to ensure that participants were not distracted or multitasking while completing the study. Although the original study was conducted partly online, it was conducted prior to 2008 at a time when participating in an online study may have been more novel compared to participating in an online study today. Today, online studies are commonplace, and as the current sample was recruited from a website for people interested in taking online studies, it is possible that participants may have been less engaged in the task. Second, although we tried to follow the design of the original study closely, our design differed in a few ways. We instructed participants to spend 15–20 minutes on the writing task, but participants spent about 13 minutes on average to complete the task before submitting their answers. Although a separate analysis (ANCOVA) controlling for the time spent writing did not reveal any significant effects of the manipulation on relationship satisfaction, $F(2, 300) = .11, p = .898$, or gratitude, $F(2, 300) = .56, p = .574$, it is possible that spending more

time and attention on the manipulation could strengthen the effects. The mental subtraction effect may be stronger when conducted under a longer frame of time and with repeated practices, as some studies show that writing about positive events only once and for a short time may not be long enough to create the desired effect (Emmons & McCullough, 2003).

We also administered the second survey beginning 3 days after the first survey, rather than spacing the surveys 2 weeks apart as in the original study. It is possible that the manipulation did not impact responses in any condition if participants could more easily recall how they responded to baseline measures and aimed to be consistent with how they responded in the baseline survey. If we allowed for more waiting time between surveys like the original study did, we may have found stronger effects. Third, there were some discrepancies in sample characteristics between the present study and the original study. For example, researchers in the original study only included participants who were already moderately to highly satisfied in their relationships, but we did not use this inclusion criterion and instead tested whether any effects differed across participants who were more versus less satisfied with their relationship at baseline. As such, we tested baseline relationship satisfaction as a moderator, but generally the effects did not differ based on participants' initial reports of relationship satisfaction. Finally, it is possible that participants in our study may have found it challenging to truly "subtract" their partners from their lives, as imagining having never met a partner may be difficult to do in a meaningful way. In fact, we did exclude more people in the absence condition for failing to follow instructions than the other two conditions. In addition, given that "forecasters" in the original study predicted that they would feel worse being in the absence condition compared to the presence condition, it is possible that participants in our study also felt apprehensive about thinking of the absence of a partner from one's life and may have found ways to disengage with the task.

Based on previous work that has reported an association between counterfactual thinking and boosts in gratitude (e.g., Adler & Fagley, 2005), we also considered the role of gratitude as a mediator of this effect. Prior research has suggested that mentally subtracting a romantic partner may lead to a comparison of oneself against a hypothetical self that may be worse off for not being in the relationship (Buunk et al., 1990). That is, when an individual recognizes all of the benefits they have received for being in a romantic relationship, they may feel more grateful toward their romantic partners as a result (Joel et al., 2013). Although we anticipated that gratitude might account for the link between mental subtraction and higher relationship satisfaction, feelings of gratitude for a partner did not differ across conditions. For some individuals, the absence of a partner may have been perceived to be more beneficial (e.g., alternative partners are seen as desirable) than having a partner in one's life. In other words, imagining what life would be like without ever meeting one's partner may instead highlight more attractive alternatives (i.e., partners or lifestyle), while emphasizing the less attractive qualities in a current partner (Roese, 1994). Relevant research on the use of gratitude journaling as a tool to explore grateful contemplation may also provide insight into our null findings of gratitude. Specifically, there is mixed support for temporary gratitude interventions to improve well-being, with some research suggesting that practicing grateful contemplation in short

periods of time may not be sufficient enough to produce immediate effects on health or general wellbeing (Emmons & McCullough, 2003; Rash et al., 2011).

The present findings contribute to the small but growing body of literature suggesting that mentally subtracting a positive life event may not reliably boost life satisfaction or positive affect (e.g., Ang et al., 2015). Specifically, our findings demonstrate that mentally subtracting a romantic partner from one's life may not be an effective way to boost relationship satisfaction. Given that the current study yielded null effects, future research might consider if there are people who benefit more from focusing on the presence of their partner in their lives compared to people who might feel more grateful and satisfied in response to imagining the absence of their partner. Individuals who believe that they have more attractive alternatives (Mattson et al., 2012), or those who tend to make upward social comparisons (Roese, 1994), may not benefit from imagining the absence of a partner, and instead might feel more satisfied when they count their blessings for the partner they have.

The current research also has implications for research on temporary cognitive manipulations involving imagining specific events of situations; given that neither the presence nor absence conditions led to significant boosts in relationship satisfaction, this may suggest that it is difficult to change people's feelings about their relationship through these types of brief manipulations. This aligns with extant research suggesting that imagining hypothetical situations may not always be effective, as imagining oneself to be in a hypothetical situation may not produce intense affective responses unless one *believes* that they could be in the hypothetical situation (Nichols, 2006). Furthermore, as imagination exercises may be less effective when conducted under constraints (e.g., specific instructions or timed writing), the spontaneous imagining of a hypothetical self may produce more pronounced affective consequences in comparison (Kind, 2016). Future work might consider the extent to which people imagine never having met their partner naturally in daily life, as this might have different consequences than a manipulation. In fact, speculating about alternate life paths is common (Ruiselova & Prokopcakova, 2011) and can have emotional and behavioral consequences (Roese & Morrison, 2009), which is one reason why it is important to understand when and for whom mentally subtracting a partner might be associated with relationship quality. In addition, as mental subtraction has been recommended in some positive psychology literature as an intervention tactic in preventing mental health disorders (i.e., major depressive disorder; D'raven & Pasha-Zaidi, 2014), further research on its effectiveness may better inform clinicians and mental health counselors of the wider implications of using mental subtraction as a therapeutic tool.

Limitations

Although our study contributes to the greater understanding of the effects of mental subtraction on relationship satisfaction and gratitude, there are limitations of the present research that warrant acknowledgment. First, the generalizability of our findings may be limited by our sample characteristics. Given that our sample was largely homogenous in composition (e.g., mostly White and heterosexual), and was recruited from a website for people who are interested in participating in research for payment, our sample is not

representative of the general population. Second, as many participants in the presence condition had fairly mundane or insignificant stories of meeting their partners, this may explain why participants were not more satisfied in this condition compared to the control condition. It is true that our instructions for the manipulations requested more factual information about how people met or could not have met their partner. Perhaps if we had asked participants to recount how they felt when they met their partner, or why they feel lucky to have met their partner (i.e., a condition more likely to lead participants to count their blessings), they would have felt more satisfied compared to the control condition. However, if mentally subtracting a partner does not boost satisfaction from a relatively mundane condition (e.g., recalling how you met your partner), we think it would be very unlikely to boost satisfaction beyond a fairly positive condition such as thinking of all the ways you are lucky to have your partner. Finally, given that our sample was smaller than anticipated due to exclusions ($n = 304$), it is possible that the non-significant moderations may have been the result of a lack of sufficient power and we cannot rule out the possibility that participants' baseline relationship satisfaction does not influence the effect of the manipulation on subsequent changes in relationship satisfaction.

Conclusion

In conclusion, this study sought to conceptually replicate and extend the findings of Koo et al. (2008) on the effects of mentally subtracting a romantic partner from one's life on relationship satisfaction and gratitude. Although we predicted that mentally subtracting a romantic partner would boost relationship satisfaction, we did not replicate the original findings. Specifically, there were no significant differences in post-manipulation relationship satisfaction between participants who mentally subtracted their partners, thought about the presence of their partners, or did not think about their partners at all. In an extension of the original study, we also explored the role of gratitude as a potential mediator of the effects. However, there were no significant differences between the conditions in post-manipulation measures of gratitude, and we found no support for the role of gratitude in boosting relationship satisfaction in response to mentally subtracting a partner from one's life. Our findings suggest that neither mentally subtracting a romantic partner nor thinking about the presence of a partner significantly influenced relationship satisfaction and highlights the limitations of brief hypothetical manipulations in boosting relationship quality.

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Open research statement

As part of IARR's encouragement of open research practices, the author(s) have provided the following information: This research was pre-registered. All aspects of the research were pre-registered. The registration was submitted to: <https://osf.io/y7e83>. The data used in the research are available. The data can be obtained at: <https://osf.io/s2zx3/>. A password is required to open the data and can be obtained by emailing: muisseamy@yorku.ca. The materials used in the research are available. Any additional materials can be obtained by emailing: muisseamy@yorku.ca.

Supplemental material

Supplemental material for this article is available online.

Notes

1. The original study did not test a moderation, but instead tested the effect only for those who were highly satisfied at baseline. We did not have an effect size to base an a-priori power analysis on, but if we set the power estimate to a small effect of $F^2 = .02$, we get a post-hoc power estimate of 69%, and 99% power for a medium effect of $F^2 = .15$.
2. Although we followed the subtraction method detailed in the original study, we subtracted the truncated scores from the full set of measures at baseline instead of subtracting truncated measures at both time points. As it is possible that this may not compare equal measures of the construct, we also conducted additional tests in which we subtracted the same set of truncated items at both time points. However, we did not find any significant effects of the experimental condition on relationship satisfaction. Consistent with our original findings, we found a significant effect of the manipulation on relationship satisfaction using the Relationship Assessment Scale, $F(2, 301) = 3.32, p = .037$. Specifically, participants in the presence condition reported higher relationship satisfaction at time 2 ($M = .16, SD = .47$) compared to participants in the absence condition ($M = -.03, SD = .54, p = .036$). However, there were no significant effects using the Passionate Love Scale, $F(2, 301) = .43, p = .649$, Love Scale, $F(2, 301) = .73, p = .485$, or a composite measure of the three, $F(2, 301) = 2.64, p = .073$.

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