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Stability of shared appraisal: The role of attachment and implications for relationships and health

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Abstract

In the context of coping with chronic illness, shared appraisal refers to one person's perception that the illness is a shared issue. Despite increasing research linking shared appraisal to positive relationship and health outcomes, whether it is static or fluctuates across time has not yet been investigated. Fluctuations in shared appraisal may affect patient and spouse well-being and influence disease management. We investigated the association of daily shared appraisal fluctuations (operationalized as intraindividual standard deviations) to relationship satisfaction, psychological well-being, and diabetes-specific well-being over 2 weeks among 199 couples in which one person had type 1 diabetes. In addition, we examined attachment insecurity as a correlate of shared appraisal fluctuations. Individuals higher in anxiety or avoidance may more frequently reevaluate their relationship. Thus, their shared appraisal may be more reactive to daily events. Actor–partner interdependence models showed greater fluctuations in spouse appraisal were associated with lower patient relationship satisfaction (partner effect) but not with spouse relationship satisfaction and with greater spouse psychological distress (actor effect) but not patient psychological distress. There were no actor or partner effects of patient appraisal fluctuations on these

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outcomes. In terms of diabetes outcomes, regression analyses showed that greater fluctuations in patient and spouse appraisal were each associated with higher patient diabetes distress, and greater fluctuations in spouse appraisal were associated with lower patient self-care. Higher attachment anxiety was related to greater appraisal fluctuations in the spouse but not the patient. These findings highlight the importance of spouse appraisal stability for spouse relationships and well-being and for patient diabetes outcomes and suggest that attachment insecurity may be implicated in the instability of shared appraisal.

Keywords
Actor–partner interdependence modeling, attachment, communal coping, health, relationships, shared appraisal, stability, type 1 diabetes

Communal coping is an interpersonal form of coping that emphasizes the relational rather than individual nature of coping (Helgeson et al., 2018; Lyons et al., 1998). In the context of couples dealing with chronic illness, communal coping involves two important components: (1) a person's perception that the illness is a shared problem rather than solely the patient's problem (shared appraisal) and (2) collaborative efforts to manage the illness (collaboration). Studies on collaboration in communal coping have found greater collaboration is associated with positive outcomes (Berg et al., 2008; Johnson et al., 2013). There is reason to believe, however, that the appraisal component of communal coping may be critical to its benefits.

Recent studies have found that greater shared appraisal, measured either explicitly in self-reports (Zajdel et al., 2018) or implicitly through the use of first-person plural pronouns (i.e., "we-talk"; Helgeson et al., 2017; Rohrbaugh et al., 2008), is related to better relationship and health outcomes for both the patient and spouse. In a study of couples in which one member had type 2 diabetes, greater partner diet-related support was linked to less diabetes-related distress under conditions of high compared to low shared appraisal (Stephens et al., 2013). Results from couples in the present study in which one person had type 1 diabetes showed that greater patient reports of shared appraisals were associated with more collaborative and supportive behaviors, which were related to better psychological and physical patient health (Helgeson et al., 2019).

Regarding we-talk, studies have found greater patient (Rohrbaugh et al., 2008) and spouse (Lee et al., 2019; Robbins et al., 2013) we-talk to be associated with higher patient (Lee et al., 2019; Robbins et al., 2013; Rohrbaugh et al., 2008) and spouse (Lee et al., 2019) relationship quality. Studies have also found greater patient we-talk to be associated with improvements in patient health behavior (Hallgren & McCrady, 2016) and greater spouse we-talk to be associated with better patient (Helgeson et al., 2017; Lee et al., 2019; Robbins et al., 2013) and spouse health (Lee et al., 2019). A recent meta-analysis found that we-talk in couples was linked to higher relationship and personal functioning (Karan et al., 2019). In studies of patients and spouses, the above relations were stronger for spouse we-talk than patient we-talk.

One limitation of past research is that studies have examined mean levels of shared appraisal, assuming that it does not change over time. However, shared appraisal may not

be static. For example, one study showed that 39% of the variance in appraisal scores measured daily across 14 days were attributed to within-person fluctuations among patients with type 2 diabetes (Zajdel & Helgeson, in press). Although this finding suggests fluctuations in appraisal exist, the researchers did not specifically study fluctuations or examine their correlates or links to relationship and health.

Fluctuations in other self or relationship constructs have been linked to poorer relationship and health. For example, among participants who experienced considerable daily hassles, those who showed more daily fluctuations in self-esteem reported higher depressive symptoms than participants whose self-esteem was more stable (Kernis et al., 1998). Studies have found greater weekly fluctuations in relationship satisfaction and perceived partner commitment to be associated with lower commitment (Arriaga, 2001) and a higher probability of breaking up (Arriaga et al., 2006), respectively. Additionally, greater fluctuations in overall relationship quality assessed quarterly have been associated with higher psychological distress and lower life satisfaction (Whitton et al., 2014). Greater weekly fluctuations in relationship quality have been associated with higher depression in couples (Whitton & Whisman, 2010), and greater daily fluctuations in relationship quality have been linked to more partner destructive behaviors during a conflict discussion task (Campbell et al., 2010). Thus, greater fluctuations in shared appraisal over time may lead to detrimental relationship and health or contribute to irregularities in disease management.

Despite the research linking high fluctuations in relationship evaluations with greater negative outcomes, the correlates of relationship evaluation instability have been relatively understudied. In one study, Campbell and colleagues (2010) found higher trust toward the partner predicted greater stability in relationship quality. In explaining this finding, the authors suggested that people who feel unsure of their partner's dependability and reliability evaluate the partner and relationship based on daily cues of perceived rejection and acceptance. Building on this idea, individual difference factors that reflect the extent to which the partner can be relied upon when needed may be important in predicting fluctuations in shared appraisal. One such individual difference factor is adult attachment.

Adult attachment represents individual differences in how people approach close relationships and tends to be conceptualized in two orthogonal dimensions of avoidance and anxiety (Brennan et al., 1998), both reflecting attachment insecurity. Avoidance reflects low levels of trust to close others and a strong preference to avoid intimacy and dependence. Anxiety involves a fear of rejection or abandonment and is associated with low levels of self-worth, doubts about close others' support, and a high desire for reassurance. People who are low on both dimensions (or exhibiting attachment security) show high levels of self-worth and are comfortable with intimacy and depending on others (Shaver & Mikulincer, 2006).

Because of these differences in general tendencies regarding close others' dependability, people who are highly insecure may have a greater need to frequently reevaluate the relationship, resulting in greater fluctuations. Indeed, previous research has found avoidant attachment among college students to be associated with fluctuations in closeness to social network members over 10 weeks—especially so when respondents also

scored high on anxious attachment (Lee & Gillath, 2016). In other words, the more insecurely attached people were, the greater the fluctuations in closeness.

Present study

In the current article, we examined fluctuations in daily shared appraisal in couples in which one person is diagnosed with type 1 diabetes. Type 1 diabetes is a chronic disease that is difficult to manage, requiring a daily self-regulatory process that involves the coordination of multiple daily blood glucose checks, adjusting the amount and timing of insulin, food intake, and frequency and intensity of physical activity. This daily management is important for maintaining good glycemic control, which is crucial in preventing long-term health complications. Although the majority of those living with type 1 diabetes are adults, there is very little research on how the social context during adulthood (an important one being the marital relationship) may foster effective diabetes management. Compared to other adult chronic diseases (e.g., type 2 diabetes), type 1 diabetes is largely regarded as being managed by individuals. Thus, it is important to examine what, if any, role spouses play in type 1 diabetes disease management. Previous research using the current data set showed spouse shared appraisal was related to fewer patient self-regulation failures across 14 days (Berg et al., 2020). However, only mean levels of appraisal were examined in that report.

The first goal of the current article was to determine whether appraisal fluctuations existed and whether there was variation between participants in their level of fluctuation. To the extent this is the case, the second goal of the article was to examine the associations of shared appraisal fluctuations to relationship and health. Patients who have larger fluctuations in appraisal may have less confidence in their spouse's availability and support (Girme et al., 2018). As such, they may be less likely to use the spouse as a resource for disease management. Spouses who have larger fluctuations in appraisal may vary in the extent to which they provide support and involve themselves in diabetes management, contributing to the patient's uncertainty in managing the disease. Based on this reasoning, we expected that greater shared appraisal fluctuations over time would be associated with worse relationships and poorer health. To test this hypothesis, we measured relationship satisfaction, psychological well-being (psychological distress and life satisfaction), diabetes-specific well-being (diabetes distress, diabetes self-efficacy), and diabetes health (diabetes self-care, glycemic control [HbA1c]). We predict that greater appraisal fluctuations in either patients or spouses would be associated with worse outcomes for both patients and spouses.

The third goal of the article was to examine the relation of the relatively stable dimensions of attachment to appraisal stability. Following the above theoretical reasoning and findings, we expected higher attachment insecurity to be associated with greater fluctuations in shared appraisal. Based on prior research (Lee & Gillath, 2016), we hypothesized that own attachment insecurity rather than partner attachment insecurity would be related to own appraisal stability. However, as one study found partner effects of trust on fluctuations in relationship satisfaction (Campbell et al., 2010), we also explored partner effects of attachment on appraisal stability.

In order to achieve these goals, we collected data on shared appraisal, attachment insecurity, and relationship and health variables from couples in which one partner was diagnosed with type 1 diabetes. These data were collected from a larger study that was focused on the implications of communal coping for relationships and health among couples in which one person had type 1 diabetes. Shared appraisal was measured using a daily diary for each couple member over 14 days, and attachment insecurity, relationship satisfaction, general well-being, diabetes-specific well-being, and diabetes health were measured once in a background survey. The data set used in the article has been used in four prior publications (Helgeson et al., 2019; Lee et al., 2020; Tracy et al., 2019; Van Vleet et al., 2019). However, none of the prior papers contain any data on the stability of appraisal over time.

Although we do not hypothesize differences between patients and spouses in terms of the associations between appraisal stability and outcomes, we view having data from both patients and spouses as a strength of the study. The inclusion of both patients and spouses enables us (1) to test the hypothesis that shared appraisal fluctuations are associated with negative outcomes twice, once in the patient and once in the spouse; and (2) to expand on previous research on communal coping which has focused on the patient and neglected the spouse (Lee et al., 2019).

Method

Participants

The current study is part of a larger project investigating couples coping with type 1 diabetes. After receiving Institutional Review Board approvals, patients were recruited from two university-affiliated endocrinology clinics in Pittsburgh, PA, and Salt Lake City, UT. Patients were eligible if they had been diagnosed with type 1 diabetes for at least 1 year, were taking insulin within 1 year of diagnosis, spoke English as their primary language, were 25+ years old, were married or cohabiting for at least 1 year, and the spouse had not been diagnosed with diabetes.

The final sample included 199 couples (398 individuals). The majority were married (92%) with the rest cohabiting (mean relationship length = 19.36 years, standard deviation [*SD*] = 14.56), and 97% were in heterosexual relationships. Patients (mean age = 46.81, *SD* = 13.95; 90% White, 52% female) had been diagnosed with type 1 diabetes for 26.97 years (*SD* = 13.88). Over half had a bachelor's degree or higher (60%), and 66% reported an annual family income of USD 60,000 or higher. Spouses were on average age 46.40 (*SD* = 14.17). See Helgeson et al. (2019) for recruitment details and a complete sample description.

Procedure

Participants completed both a 2-hr in-lab assessment and a 2-week daily diary. Each member of the couple completed an online consent form and survey prior to the in-lab session. During the laboratory visit, couple members individually provided written consent for all study procedures and completed another online survey and other tasks not

relevant to this article. The survey consisted of questions regarding attachment insecurity, relationship satisfaction, and measures assessing diabetes distress, diabetes self-efficacy, and diabetes self-care. A measure of glycemic control also was taken from patients during the in-lab assessment. After the in-lab session, each couple member was sent an online daily survey each evening for 14 days. Participants were asked to complete the daily diaries at the end of each day before they went to bed and were instructed not to discuss their answers with their partners. In the event that a participant missed an entry, they had until 10 a.m. the following day to complete the entry with respect to the previous day. Patients completed on average 13.82 days, and spouses completed on average 13.71 days. For patients, 88% completed all 14 days, 8% completed 13 days, and 4% completed between 10 days and 12 days. For spouses, 84% completed all 14 days, 10% completed 13 days, and 6% completed between 7 days and 12 days. Participants were compensated individually based on their participation in each portion of the study.

Independent variables

Shared appraisal mean. For daily shared appraisal, patients and spouses were presented with the following question in the daily diary: "When you thought about diabetes today, did you view diabetes as 'our issue' (shared by you and your partner equally), mainly your own issue, or your partner's issue?" Additionally for spouses, the phrase "your partner's" was included in front of the word "diabetes." Patients chose from the following options: "completely my issue" (scored as 1), "mostly my issue" (scored as 2), and "both of our issue" (scored as 3). Spouses chose from the corresponding following options: "completely my partner's issue" (scored as 1), "mostly my partner's issue" (scored as 2), and "both of our issue" (scored as 3).

From these daily responses, the intraindividual mean of shared appraisal for each participant was computed by aggregating the data over the 14 days ($M_{\text{patients}} = 1.87$, $SD_{\text{patients}} = 0.63$, $M_{\text{spouses}} = 2.53$, $SD_{\text{spouses}} = 0.50$). To validate our single-item daily measure of shared appraisal, we correlated the aggregated measure of shared appraisal with a measure of we-talk that was calculated from a 5-min discussion in the lab. Patients and spouses were separately asked to describe how they were coping with diabetes, and we-talk was calculated from transcriptions of their responses to this question (for details on the we-talk measure see Lee et al., 2019). For patients, the we-talk score and appraisal mean aggregated across the 14 days was marginally positively correlated ($r[196] = .13$, $p = .059$). For spouses, the we-talk score and appraisal mean aggregated across the 14 days was positively correlated ($r[196] = .16$, $p = .02$). Importantly, we note that although we measured mean levels of shared appraisal, it is not the focus of the study. The focus of the study—and our primary independent variable—is fluctuations in shared appraisal, which we describe below.

Shared appraisal fluctuations. We operationalized the stability of shared appraisal across 14 days as the intraindividual *SD* computed for each participant. Higher *SD*s reflected greater fluctuations or lower stability ($M_{\text{patients}} = 0.38$, $SD_{\text{patients}} = 0.35$, $M_{\text{spouses}} = 0.27$, $SD_{\text{spouses}} = 0.26$). We used *SD* rather than other measures of intraindividual variability that take into account the time ordered nature of measurements because the temporal

relationship is not relevant to our hypotheses. We are interested in how much one person cumulatively varies across several days and whether this variation is associated with relationship and health outcomes, rather than how much one person varies from one day to the next. This is reflected in the data collection of a random 2 weeks in participants' lives, rather than a specific time point that would matter to people with diabetes such as shortly after their diagnosis or another significant event. Appraisal *SD* was the primary independent variable in models predicting relationship and health outcomes. But also note that appraisal *SD* also served as the primary dependent variable in models examining patient and spouse attachment style as predictors.

Attachment insecurity. During the in-lab assessment, patients and spouses completed a measure of attachment insecurity using a shortened version of the Experiences in Close Relationships–Revised scale (Fraley et al., 2000). This 26-item version was reduced from the original 36-item measure to reduce participant burden in the larger protocol. Attachment insecurity was assessed on two continuous subscales: attachment anxiety and attachment avoidance. Participants were instructed to "think about how you generally feel in important relationships" in responding to each statement. The anxiety subscale ($\alpha_{patients} = .89$, $\alpha_{spouses} = .91$; $M_{patients} = 2.82$, $SD_{patients} = 1.17$, $M_{spouses} = 2.82$, $SD_{spouses} = 1.23$) consisted of 13 items relating to anxious attachment (e.g., "I worry about being abandoned"). The avoidance subscale ($\alpha_{patients} = .88$, $\alpha_{spouses} = .88$; $M_{patients} = 3.14$, $SD_{patients} = 1.08$, $M_{spouses} = 3.33$, $SD_{spouses} = 1.08$) consisted of 13 items that related to avoidant attachment (e.g., "I prefer not to show people how I feel deep down"). Response options were rated on a scale from 1 (*disagree strongly*) to 7 (*agree strongly*). Correlation of anxiety and avoidance in patients was $r(196) = .28$, $p < .001$; correlation of anxiety and avoidance in spouses was $r(196) = .46$, $p < .001$.

Dependent variables

Relationship satisfaction. During the in-lab assessment, patients and spouses completed a 16-item version of the Couples Satisfaction Index (Funk & Rogge, 2007; $\alpha_{patients} = .97$, $\alpha_{spouses} = .98$; $M_{patients} = 65.74$, $SD_{patients} = 14.27$, $M_{spouses} = 63.93$, $SD_{spouses} = 15.06$). Higher numbers indicate greater relationship satisfaction.

Psychological well-being. During the in-lab assessment, patients and spouses completed three measures of psychological well-being: the 4-item Perceived Stress Scale (Cohen et al., 1983; $\alpha_{patients} = .80$, $\alpha_{spouses} = .80$; $M_{patients} = 2.30$, $SD_{patients} = 0.71$, $M_{spouses} = 2.24$, $SD_{spouses} = 0.71$), with higher numbers indicating greater stress; the 20-item Center for Epidemiologic Studies Depression scale (Radloff, 1977; $\alpha_{patients} = .90$, $\alpha_{spouses} = .92$; $M_{patients} = 9.85$, $SD_{patients} = 8.33$, $M_{spouses} = 9.69$, $SD_{spouses} = 8.99$), with higher numbers indicating greater depressive symptoms; and the 7-item Satisfaction With Life Scale (Diener et al., 1985; $\alpha_{patients} = .87$, $\alpha_{spouses} = .86$; $M_{patients} = 5.20$, $SD_{patients} = 1.17$, $M_{spouses} = 5.38$, $SD_{spouses} = 1.08$), with higher numbers indicating greater life satisfaction. Due to the high correlation between stress and depressive symptoms in both patients and spouses (Table 1), we standardized the two scores and took their average to

Table 1. Summary of zero-order correlations between key variables.

	Variable	1	2	3	4	5	6	7	8	9	10	11	$M \pm SD$	Range
1.	saM	.37**	−.43**	−.20**	−.0005	.08	.01	.01					Pt: 1.88 ± 0.63	Pt: 1−3
													Sp: 2.53 ± 0.50	Sp: 1.07−3
2.	saSD	−.04	−.02	.26**	.09	−.14	.20**	.002					Pt: 0.38 ± 0.25	Pt: 0−0.97
													Sp: 0.27 ± 0.26	Sp: 0−1
3.	Anxiety	−.14	.12	.37**	.46**	−.32**	.57**	−.30**					Pt: 2.82 ± 1.17	Pt: 1−5.92
													Sp: 2.82 ± 1.23	Sp: 1−7
4.	Avoidance	−.16*	.05	.28**	.21**	−.36**	.43**	−.30**					Pt: 3.14 ± 1.08	Pt: 1−5.62
													Sp: 3.33 ± 1.08	Sp: 1−6.38
5.	Relationship satisfaction	.37**	.04	−.38**	−.31**	.56**	−.45**	.54**					Pt: 65.74 ± 14.27	Pt: 9−81
													Sp: 63.93 ± 15.06	Sp: 14−81
6.	Psych distress	−.09	.13	.46**	.34**	−.45**	.34**	−.54**					Pt: 0 ± 0.92	Pt: −1.51−2.76
													Sp: 0 ± 0.92	Sp: −1.36−3
7.	Life satisfaction	.08	−.05	−.24**	−.33**	.51**	−.57**	.32**					Pt: 5.2 ± 1.17	Pt: 1.4−7
													Sp: 5.38 ± 1.08	Sp: 1.6−7
8.	Diabetes distress	−.17*	.25**	.41**	.24**	−.25**	.51**	−.27**	—				1.98 ± 0.74	1−4.71
9.	Self-efficacy	.10	−.07	−.31**	−.06	.24**	−.26**	.18*	−.37**	—			79.26 ± 15.26	8.17−100
10.	Self-care	.10	−.07	−.31**	−.07	.12	−.27**	.10	−.39**	.59**	—		3.67 ± 0.56	2.08−4.85
11.	HbA1c	−.04	.04	.03	−.004	−.07	.07	−.09	.20**	−.20**	−.32**	—	7.57 ± 1.06	4.9−11.2

Note. Correlations below the diagonal are for patients, those presented above the diagonal are for spouses, and those along the diagonal are between patients and spouses. *SD* = standard deviation; saM = shared appraisal intraindividual mean, saSD = shared appraisal intraindividual *SD*, Anxiety = attachment anxiety, Avoidance = attachment avoidance, Psych = psychological.

*$p < .05$; **$p < .01$.

create one composite score of psychological distress. Thus, we have two measures of psychological well-being: psychological distress and life satisfaction.

Diabetes-specific well-being. During the in-lab assessment, patients completed the 17-item Diabetes Distress Scale (DDS; Polonsky et al., 2005) to assess the distress individuals living with diabetes experience. Patients were asked to "indicate the degree to which each item may be bothering you in your life, NOT merely whether the item is true for you" from 1 (*not a problem*) to 6 (*a very serious problem*). Items assess distress in four distinct domains: emotional burdens (e.g., "Feeling that diabetes is taking up too much of my mental and physical energy every day"; $\alpha = .90$), physician distress (e.g., "Feeling that my doctor doesn't know enough about diabetes and diabetes care"; $\alpha = .79$), regimen distress (e.g., "Feeling that I am not testing my blood sugars frequently enough"; $\alpha = .85$), and interpersonal distress (e.g., "Feeling that friends or family are not supportive enough of my self-care efforts"; $\alpha = .84$). The total DDS showed high internal consistency ($\alpha = .90$).

During the in-lab assessment, patients completed the 6-item self-efficacy subscale from the Multidimensional Diabetes Questionnaire (Talbot et al., 1997; $\alpha = .83$; $M = 79.26$, $SD = 15.26$), in which they indicated how confident they were on a 0–100% scale in managing different aspects of diabetes.

Diabetes health. Diabetes health was measured in terms of adherence to physician recommendations for self-care behavior and in terms of glycemic control. During the in-lab assessment, patients completed the 15-item Self-Care Inventory (Lewin et al., 2009; $\alpha = .76$; $M = 3.67$, $SD = 0.56$), in which they rated how often they engaged in self-care behaviors (e.g., glucose testing, administering correct insulin dose, exercising regularly) as recommended by their physician in the past month, with higher numbers indicating better diabetes self-care. Glycosylated hemoglobin (HbA1c) reflects the average level of blood glucose control over the past 6 weeks and was measured via finger prick during the in-lab assessment using a DCA Vantage Analyzer ($M = 7.57$, $SD = 1.06$). Higher numbers reflect poorer glycemic control.

Overview of analysis

We examined the association of demographic variables (patient age, patient gender, patient race [White vs. non-White], patient education level, household income [using an average of patient-reported and spouse-reported household income], marital status, cohabitation length, and site of data collection [Pittsburgh vs. Utah], diagnosis length, timing of diagnosis, continuous glucose monitoring use, and patient comorbidity) to our predictors of patient and spouse mean of shared appraisal, stability of shared appraisal, and attachment style. We used t tests for categorical variables and correlations for continuous variables. We then statistically controlled for variables that were related to the predictors of each model (for details, see subsection "Examination of potential covariates" under "Results" section). We also ran each model without covariates and included them in the Supplemental Materials.

To test the associations of appraisal fluctuations to patient and spouse relationship and health, we used multivariate modeling using actor–partner interdependence models (APIMs; Kenny et al., 2006) to analyze distinguishable dyadic data. APIMs allow us to examine both actor effects and partner effects, such that each person in the couple is both an actor and a partner. For example, an actor effect would be the effect of one's own independent variable on one's own dependent variable, such as the effect of patient appraisal fluctuations on patient life satisfaction or spouse appraisal fluctuations on spouse life satisfaction. A partner effect would be the effect of one's own independent variable on the partner's dependent variable, such as the effect of patient appraisal fluctuations on spouse life satisfaction or the effect of spouse appraisal fluctuations on patient life satisfaction. The package nlme (Version 3.1-137, Pinheiro et al., 2018) in R was used to model potential interdependence between the patient and spouse variables using a two-intercept model (Kenny et al., 2006), as this models different error variances for the actor and partner dependent variables and covariances between them. Couple member (patient, spouse) was the distinguishing variable. We ran a two-intercept multivariate model for the three outcomes common to patients and spouses: relationship satisfaction, psychological distress, and life satisfaction.

Because the four diabetes outcomes were unique to patients (and therefore did not constitute nested data), we ran linear regression models. In all the models, patient and spouse appraisal *SD* was used to predict the diabetes outcomes, controlling for patient and spouse appraisal means to see if the associations of appraisal *SD* held over and beyond appraisal means.

To test the association between attachment style and appraisal fluctuations in patients and spouses, we again used a two-intercept APIM. Attachment anxiety and avoidance were predictors, and appraisal *SD* was the dependent variable. Couple member was the distinguishing variable.

Results

Examination of shared appraisal fluctuations

For patients, the intra-class coefficient showed that 36% of the variability in shared appraisal was accounted for by within-participant fluctuations, and the remaining 64% was due to between-participant differences. For spouses, the intra-class coefficient showed that within-participant fluctuations accounted for 37% of the variability in shared appraisal, and 63% was accounted for by between-participant differences. Thus, our data showed there were fluctuations in shared appraisal across days in both patients and spouses. Correlations among shared appraisal fluctuations, attachment insecurity, and relationship and health variables are presented in Table 1. Means, standard deviations, ranges, and reliabilities (when applicable) of the variables are presented in Table 1.

Examination of potential covariates

No demographic variables were related to shared appraisal *SD* (the intraindividual standard deviation of appraisal across the 14 days computed for each participant), our

primary predictor variable. There was only one demographic variable related to shared appraisal mean: spouses from households with higher income reported lower mean appraisal, $r(191) = -.16$, $p = .03$, 95% CI [−0.29, −0.02]. As such, we controlled for family income in the appraisal fluctuations and relationship/health models.

There were four demographic variables related to attachment anxiety. Patients who were married or cohabited longer reported lower attachment anxiety, $r(195) = -18$, $p = .01$, 95% CI [−0.31, −0.04], and spouses who were married or cohabited longer reported lower attachment anxiety, $r(195) = -.21$, $p < .001$, 95% CI [−.34, −.07]. Married spouses reported lower attachment anxiety ($M = 2.75$, $SD = 1.19$) compared to cohabiting partners ($M = 3.54$, $SD = 1.44$), $t(196) = 2.56$, $p = .01$, 95% CI [0.18, 1.39]. Spouses whose data were collected in Utah showed higher anxiety ($M = 3.02$, $SD = 1.29$) compared to spouses whose data were collected in Pittsburgh ($M = 2.59$, $SD = 1.11$), $t(196) = 2.47$, $p = .01$, 95% CI [0.09, 0.77]. Spouses of households with greater income reported lower attachment anxiety, $r(190) = -.24$, $p = .001$, 95% CI [−0.37, −0.11].

There were two demographic variables related to attachment avoidance. Female patients reported lower attachment avoidance ($M = 2.72$, $SD = 1.06$) compared to male patients ($M = 2.91$, $SD = 1.02$), $t(196) = 3.89$, $p < .001$, 95% CI [0.28, 0.87]. Patients diagnosed before marriage reported lower attachment avoidance ($M = 2.86$, $SD = 1.07$) than patients diagnosed after marriage ($M = 3.22$, $SD = 1.07$), $t(193) = 1.99$, $p = .047$, 95% CI [0.004, 0.71]. Thus, we controlled for cohabitation length, marital status, site, income, patient sex, and diagnosis timing in the models that involved attachment.

Relation of shared appraisal fluctuations to relationship satisfaction for patients and spouses

The effects of shared appraisal fluctuation (saSD) on relationship satisfaction are presented in Table 2, controlling for family income and shared appraisal means (saM). There were no actor effects of appraisal *SD* on relationship satisfaction for patients or spouses. However, there was a partner effect of spouse appraisal *SD*, such that greater spouse appraisal *SD* was associated with lower patient relationship satisfaction.

Relation of shared appraisal fluctuations to health outcomes for patients and spouses

For psychological distress, there was no actor effect for patient appraisal *SD*, but an actor effect for spouse appraisal *SD* showed that greater spouse appraisal *SD* was associated with higher spouse psychological distress. There were no partner appraisal *SD* effects for either patient or spouse psychological distress.[1]

For life satisfaction, there were no actor or partner effects of appraisal *SD* for either patients or spouses.

Relation of shared appraisal fluctuations to patient diabetes outcomes

As presented in Table 3, both greater patient and spouse appraisal *SD* were associated with greater patient diabetes distress. Greater spouse appraisal *SD* was associated with

Table 2. Multivariate models of shared appraisal fluctuations and patient and spouse relationship and health.

	Relationship satisfaction				Psychological distress				Life satisfaction			
Predictor	β (*SE*)	*t*(375)	95% CI	*p*	β (*SE*)	*t*(375)	95% CI	*p*	β (*SE*)	*t*(375)	95% CI	*p*
Pt int	52.86 (7.12)	7.42	[38.90, 66.82]		0.69 (0.46)	1.51	[−0.12, 1.60]		4.75 (0.60)	7.95	[3.58, 5.92]	
Sp int	56.90 (7.76)	7.33	[41.70, 72.11]		0.32 (0.45)	0.71	[−0.56, 1.20]		4.05 (0.56)	7.24	[2.95, 5.15]	
Fam inc	0.20 (0.31)	0.62	[−0.42, 0.81]	.02	−0.09 (0.02)	−5.10	[−0.13, −0.06]	−.26	0.09 (0.02)	3.89	[0.04, 0.13]	.17
Actor effects												
Pt saM	7.71 (1.61)	4.79	[4.55, 10.86]	.33	−0.14 (0.11)	−1.31	[−0.35, 0.07]	−.09	0.20 (0.14)	1.40	[−0.08, 0.47]	.10
Sp saM	−1.57 (2.49)	−0.63	[−6.44, 3.31]	−.04	0.09 (0.15)	0.65	[−0.19, 0.38]	.05	0.01 (0.19)	−0.91	[−0.34, 0.36]	.01
Pt saSD	3.37 (3.77)	0.89	[−4.02, 10.76]	.06	0.40 (0.25)	1.56	[−0.10, 0.89]	.11	−0.11 (0.33)	−0.34	[−0.76, 0.54]	−.03
Sp saSD	−6.08 (4.45)	−1.37	[−14.81, 2.65]	−.10	**0.72 (0.26)**	**2.76**	**[0.21, 1.23]**	**.20**	0.07 (0.32)	0.21	[−0.65, 0.69]	.02
Partner effects												
Pt saM	5.23 (1.81)	2.90	[1.69, 8.77]	.21	0.02 (0.11)	0.14	[−0.19, 0.22]	.01	0.27 (0.13)	2.15	[0.02, 0.53]	.16
Sp saM	−0.57 (2.22)	−0.26	[−4.92, 3.78]	−.02	0.03 (0.15)	0.18	[−0.26, 0.32]	.02	−0.18 (0.19)	−0.91	[−0.56, 0.20]	−.07
Pt saSD	3.16 (4.23)	0.75	[−5.13, 11.44]	.06	−0.05 (0.25)	−0.22	[−0.54, 0.43]	−.02	−0.12 (0.31)	0.02 (0.30)	[−0.57, 0.62]	.01
Sp saSD	**−11.14 (3.97)**	**−2.80**	**[−18.92, −3.36]**	**−.20**	0.38 (0.27)	1.43	[−0.14, 0.90]	.10	−0.60 (0.35)	−1.73	[−1.28, 0.08]	−.13

Note. Confidence intervals that did not include zero for primary predictors are bolded. Unstandardized regression coefficients are shown. *SD* = standard deviation; Fam = family, inc = income, Pt = patient, int = intercept, Sp = spouse, saM = shared appraisal intraindividual mean, saSD = shared appraisal intraindividual *SD*.

Table 3. Regression models of shared appraisal fluctuations and patient diabetes outcomes.

	Diabetes distress				Self-efficacy				Self-care				HbA1c			
Predictor	β (*SE*)	*t*(183)	95% CI	*p*	β (*SE*)	*t*(183)	95% CI	*p*	β (*SE*)	*t*(183)	95% CI	*p*	β (*SE*)	*t*(182)	95% CI	*p*
Intercept	2.37 (0.39)	6.08	[1.60, 3.13]		71.66 (8.65)	8.29	[54.60, 88.72]		3.45 (0.31)	11.00	[2.83, 4.06]		7.71 (0.61)	12.65	[6.51, 8.91]	
Fam inc	−0.05 (0.02)	−2.81	[−0.09, −0.02]	−.20	0.33 (0.40)	0.82	[−0.47, 1.13]	.06	0.03 (0.01)	2.13	[0.002, 0.06]	.15	−0.02 (0.03)	−0.70	[−0.08, 0.04]	−.05
Pt saM	−0.19 (0.09)	−2.26	[−0.36, −0.02]	−.16	1.81 (1.90)	0.95	[−1.94, 5.55]	.07	0.11 (0.07)	1.63	[−0.02, 0.25]	.12	−0.05 (0.13)	−0.34	[−0.31, 0.22]	−.03
Sp saM	−0.01 (0.12)	−0.04	[−0.24, 0.23]	−.003	1.79 (2.64)	0.68	[−3.41, 6.99]	.05	−0.05 (0.10)	−0.50	[−0.24, 0.14]	−.04	−0.01 (0.19)	−0.05	[−0.38, 0.36]	−.004
Pt saSD	**0.71 (0.20)**	**3.52**	**[0.31, 1.10]**	**.25**	−3.39 (4.47)	−0.76	[−12.20, 5.43]	−.06	−0.09 (0.16)	−0.56	[−0.41, 0.23]	−.04	0.21 (0.31)	0.68	[−0.40, 0.83]	.05
Sp saSD	**0.55 (0.21)**	**2.63**	**[0.14, 0.97]**	**.19**	−6.95 (4.68)	−1.49	[−16.19, 2.28]	−.11	**−0.38 (0.17)**	**−2.23**	**[−0.71, −0.04]**	**−.16**	0.17 (0.33)	0.51	[−0.49, 0.82]	.04

Note. Confidence intervals that did not include zero for primary predictors are bolded. Unstandardized regression coefficients are shown. *SD* = standard deviation; Fam = family, inc = income, Pt = patient, int = intercept, Sp = spouse, saM = shared appraisal intraindividual mean, saSD = shared appraisal intraindividual *SD*.

Table 4. Multivariate model of patient and spouse attachment predicting shared appraisal fluctuations.

	Shared appraisal *SD*			
Predictor	β (*SE*)	*t*(360)	95% CI	*p*
Patient intercept	0.43 (0.11)	3.79	[0.21, 0.66]	
Spouse intercept	0.13 (0.12)	1.17	[−0.09, 0.36]	
Cohabitation length	−0.001 (0.001)	−0.48	[−0.003, 0.002]	−.02
Patient gender	−0.02 (0.03)	−0.77	[−0.08, 0.08]	.03
Diagnosis timing	0.001 (0.04)	0.02	[−0.07, 0.08]	.01
Marital status	−0.01 (0.05)	−0.29	[−0.11, 0.08]	−.001
Site	0.02 (0.03)	0.76	[−0.03, 0.08]	.10
Family income	−0.005 (0.01)	−0.92	[−0.01, 0.01]	−.14
Actor effects				
Patient attachment anxiety	0.03 (0.02)	1.58	[−0.01, 0.06]	.12
Patient attachment avoidance	0.02 (0.02)	0.96	[−0.02, 0.06]	.10
Spouse attachment anxiety	**0.05 (0.02)**	**2.55**	**[0.01, 0.08]**	**.19**
Spouse attachment avoidance	−0.01 (0.02)	−0.56	[−0.05, 0.03]	−.03
Partner effects				
Patient attachment anxiety	0.004 (0.02)	0.22	[−0.03, 0.04]	.02
Patient attachment avoidance	0.03 (0.02)	1.45	[−0.01, 0.07]	.07
Spouse attachment anxiety	−0.03 (0.02)	−1.49	[−0.07, 0.01]	.02
Spouse attachment avoidance	−0.01 (0.02)	−0.52	[−0.05, 0.03]	.07

Note. Confidence intervals that did not include zero for primary predictors are bolded. Unstandardized regression coefficients are shown. *SD* = standard deviation.

poorer patient self-care but patient appraisal *SD* was not linked to self-care. There were no effects of patient or spouse appraisal *SD* on patient self-efficacy or HbA1c.[1]

Attachment style and shared appraisal fluctuations

As presented in Table 4, there was an actor effect of spouse attachment anxiety on appraisal *SD*, indicating that greater spouse attachment anxiety was associated with greater spouse appraisal *SD*. There was no actor effect for patient attachment anxiety. There were no partner effects of attachment anxiety on appraisal *SD* for either patients or spouses. There were also no actor or partner effects of attachment avoidance on appraisal *SD*.

We reran all the above models without covariates and showed them in Supplemental Tables S1 to S3. All results were similar with the exception of life satisfaction, which showed a partner effect for spouse appraisal *SD* such that greater spouse appraisal *SD* was associated with lower patient life satisfaction—consistent with other findings in this report.

Discussion

The current research provides the first evidence that fluctuations in daily shared appraisal exist in couples in which one person had type 1 diabetes. These within-person fluctuations had important links to relationships and health for both patients and spouses.

These fluctuations in appraisal also were predicted by attachment insecurity (specifically attachment anxiety). Below we review these findings and discuss their implications.

Links of shared appraisal fluctuations to relationship and health

We found that fluctuations in spouse appraisal rather than patient appraisal were more consistently related to both patient and spouse relationship and health. Specifically, greater fluctuations in spouse appraisal predicted lower relationship satisfaction, greater diabetes distress, and poorer self-care in the patient and higher psychological distress in the spouse. These results suggest that compared to fluctuations in patient appraisal, spouse appraisal fluctuations seem to matter more for both the patient and spouse's relationship and health. Fluctuations in the spouses' appraisal may be important for patient outcomes because greater fluctuation could indicate that spouses are varying in the amount of support they provide to the patient and the extent to which they are involved in disease management. Because we had a measure of daily support reported by the spouse in the current data set, we took the opportunity to test this possibility. Spouses with greater appraisal fluctuations did report lower overall means of support provision ($r[197] = -.16$, $p = .02$). Thus, to the extent that spouses are inconsistent in their appraisal of diabetes as a shared problem, they may provide less support to patients, which may signal to patients that the spouse is not a reliable resource for disease management. The end result is that patient adherence to recommended self-care is diminished. In regard to spouse outcomes, fluctuations in spouses' own appraisal may lead to uncertainty in how involved they should be in disease management, resulting in lower satisfaction in the relationship and greater stress and strain.

We found that patient fluctuations in appraisal were not related to patient relationship satisfaction or spouse health but were related to patient diabetes outcomes. Specifically, greater fluctuations in patient appraisal across 14 days predicted greater diabetes distress. For patients, fluctuations in their own appraisal may lower their confidence that their spouse will be available and supportive when diabetes needs arise (Girme et al., 2018), ultimately making them less likely to utilize their spouse as a resource in managing the disease and thus increasing diabetes burden.

Importantly, these associations of appraisal fluctuations held controlling for the intraindividual mean of appraisal, indicating greater fluctuations have negative implications for patients and spouses regardless of whether the mean of appraisal is low or high. In other words, even for people with a high mean of shared appraisal, which has shown to be associated with beneficial relationship and health outcomes (e.g., Helgeson et al., 2019; Zajdel et al., 2018), greater variation in appraisal had adverse effects. These results highlight the importance of examining fluctuations in appraisal in addition to the mean level for a more complete picture of appraisal's role in relationships and health.

Thus, for both patients and spouses, varying levels of daily appraisal may undermine precisely what communal coping is thought to offer—greater resources (the spouse's resources) in handling illness issues. The stability of appraisal may be important in terms of how people respond to daily stressors regarding diabetes. People who have stable levels of appraisal may be more likely to interpret and react to ambiguous events regarding the disease in a consistent manner, making day-to-day disease management

predictable and easier. In contrast, people with high fluctuations in appraisal would vary in their interpretation and reactions to ambiguous events, contributing to inconsistencies in dealing with the disease.

These negative consequences of greater appraisal fluctuations are consistent with previous research showing that a large degree of variation from the mean over time in self- and relationship evaluations are associated with detrimental relationship and health outcomes (Arriaga, 2001; Arriaga et al., 2006; Campbell et al., 2010; Kernis et al., 1998; Whitton et al., 2014; Whitton & Whisman, 2010). Explanations for these negative effects of evaluation instability range from heightened affect reactivity and excessive fixation to daily events (Kernis, 2005) and doubts or uncertainty about the relationship (Arriaga et al., 2006; Campbell et al., 2010; Girme et al., 2018). In addition, higher instability in appraisal may motivate the person to evaluate their partner more accurately, thereby reducing the benefits of positive partner bias on relationships (Lemay & Clark, 2015; Murray et al., 1996). This heightened affect reactivity, uncertainty about the relationship, and lowered positive bias about the partner will in turn worsen relationships and health (Arriaga, 2001; Girme et al., 2018; Kernis, 2005; Lemay & Clark, 2015; Moore & Fresco, 2012).

We believe our findings add to the growing literature on communal coping by suggesting that the stability of one component—the appraisal of the illness—is important. Research and theory on communal coping has focused on mean levels of communal coping, with higher levels in both patients and spouses shown to be better for both parties (Helgeson et al., 2018; Lyons et al., 1998; Rentscher, 2019). Even discussion on the conditions under which communal coping might be more or less beneficial has centered on mean levels (Helgeson et al., 2018). Our findings suggest the best situation for patients is to have a partner who not only has a shared appraisal, but who is also dependable in terms of viewing the illness as shared. Our findings especially show stability in the spouse's appraisal to be important for the patient's relationship satisfaction, diabetes distress, and self-care.

Attachment style and shared appraisal fluctuations

We found that spouses' attachment anxiety predicted greater fluctuations in their own appraisal. Our results follow previous research predicting greater fluctuations in relationship evaluations by attachment insecurity (namely, when participants were higher both in anxiety and avoidance; Lee & Gillath, 2016). These results indicate that spouses who are worried about being abandoned by close others and doubt their relational worthiness tend to reappraise the responsibility regarding their partner's disease to a greater degree. In other words, their ambivalence regarding the relationship transfers to ambivalence about their role in the patient's disease.

However, patient attachment anxiety did not predict instability, despite the fact that patients also showed variability in appraisal across the 2 weeks. This is not surprising as appraisal stability from both the patient and the spouse's point of view is about the extent to which the *spouse* is involved in the illness. In accordance, spouses who are anxious would think or behave in an inconsistent way regarding diabetes. The patient's anxiety might have a weaker connection to appraisal instability, as the instability relies on the

spouse's involvement, which is a less direct reflection of the patient's own appraisal process. Thus, the patient's appraisal fluctuations are more likely to be affected by the spouse's behavior than patient's own personality.

In our study, attachment avoidance did not predict appraisal fluctuations in either the patient or the spouse. However, it would be premature to assume no link between avoidance and appraisal fluctuations; rather, there might be specific contexts in which the association arises. For example, the attachment system is theorized to be activated in times of negative relational events (Simpson & Rholes, 2017). For avoidant people, the link between avoidance and appraisal fluctuations might only appear when there is a high occurrence of negative relational events, such as conflict with the spouse, during the assessed period. In contrast, the link between anxiety and appraisal fluctuations may be less context-dependent, as anxious people's appraisal changes likely depend more on their internal worries about the relationship rather than external events.

One way to explain the link between attachment insecurity and fluctuations in relationship evaluations is to adopt a life span strategy model (e.g., Simpson, 2019) of attachment security. For people who have grown up in social environments in which close others were consistently unavailable or unpredictable (insecurely attached), constant reevaluation of relationships would be beneficial as the risks of making oneself vulnerable in the relationship would be high, based on past experiences of rejection. In contrast, for people who have been raised in a social environment in which close others were consistently available and supportive (securely attached), their past experiences prepare them to expect a low probability of rejection from close others. As such, it would be more advantageous to spend time and energy in other venues rather than reevaluation of relationships.

Another way attachment security leads to lower fluctuations in relationship evaluations draws from a resource model of attachment security (Canterberry & Gillath, 2013). According to this idea, attachment security acts as a mental resource for emotional or behavioral self-regulation. For example, the *broaden and build cycle of attachment security* (Mikulincer & Shaver, 2007) is thought to provide people with resources to maintain mental health in times of stress. In regard to relationships, attachment security may act as a cushion for relational transgressions, protecting the person from hurt feelings. Because of this extra protection, people who are securely attached can afford to disengage from spending time and energy on reevaluating relationships. Conversely, people who are insecurely attached are left with little defenses against getting hurt and thus will benefit from consistently monitoring changes in their relationships.

Based on these two lines of thought, we propose a theory of *attachment and relationship evaluation stability*. People who are securely attached, because of their (1) experiences regarding high availability and support from close others (which includes both early developed and earned security) and (2) greater security-related mental resources to protect themselves from relational transgressions, will refrain from spending time and energy to constantly evaluate their relationships. Instead, their initial relationship evaluations will hold over time. People who are insecurely attached, on the other hand, have (1) had a history of being rejected or unsupported by close others and (2) lack security-related mental resources to protect themselves from being hurt. As such, they would diligently engage in frequent reevaluations of close relationships in order to

protect themselves. Indeed, one study found anxiously attached people to report higher tendencies of critically evaluating alternative means and goals compared to less anxious people (Orehek et al., 2017). Another study using daily diaries found daily events, whether positive or negative, led anxious people to reevaluate their relationship the next day whereas relationship evaluations of less anxious people were not as dependent on daily events (Campbell et al., 2005). Future research should aim to further develop and test specific aspects of this theory: For example, are insecure people aware of their frequent reevaluations or is it an unconscious or automatic process? Are there certain relationship evaluations that are not affected by attachment orientations?

Our results emphasize the importance of examining appraisal fluctuations, as most research on appraisal has focused on mean levels, whether interindividually or intraindividually (Rentscher, 2019). Notably, spouse attachment anxiety did not affect mean levels of appraisal, only its fluctuations. Thus, a focus on mean levels of appraisal alone may result in overlooking important correlates, which is another reason to examination appraisal fluctuations in future studies.

Limitations and future directions

Our findings should be interpreted in the context of a few limitations. First, our results suggest that one possible sequential path is that attachment insecurity leads to greater appraisal fluctuations which then has a negative impact on health—at least in the case of spouses. However, although we suspect the sequential path of attachment insecurity leading to appraisal fluctuations which impact health, we were unable to conduct a mediation analysis with the three constructs due to temporal inconsistencies in data collection (attachment insecurity and relationship/health variables were collected before appraisal fluctuations). In addition, although we collected longitudinal data across the 14 days, we collapsed across the 14 days to yield a single measure of appraisal fluctuations. Thus, the analyses are cross-sectional, making the directionality of effects and causality unclear. Theoretically, attachment orientations tend to be developed early in life, appraisals are developed after being diagnosed with the disease and meeting the partner, and relationship and health outcomes likely ensue from those appraisals (Bowlby, 1969/1982; Helgeson et al., 2018; but see Fraley, 2019 for a review on attachment style changes in adulthood). Future studies should conduct experimental or longitudinal research with newly diagnosed individuals to further strengthen our claims about the causal sequence. Research on the causality of effects will also shed light on whether connections between spouse attachment insecurity and patient health found in previous studies (e.g., Porter et al., 2007) may be accounted for (to some degree) by fluctuations in spouse appraisal.

Second, there are likely a myriad of antecedents to shared appraisal fluctuations that we have not examined. For example, it might be the case that the demands of the illness are changing on a daily basis, which results in corresponding appraisal fluctuations. Appraisal might also be changing because it is not clear within the couple what role the spouse has in managing diabetes. Future research should test additional situational, dispositional, and disease-related factors that might affect fluctuations in appraisal.

Third, determining directionality and causality of the associations in our findings is also important for the development of interventions targeting better well-being of patients with chronic illness and their spouses. If causality of our findings is established, then a targeted intervention to stabilize spouse appraisal would benefit both couple members. Additionally, finding ways to lower spouse attachment anxiety would also be expected to improve the health of the couple.

Fourth, as the vast majority of our sample is White it is important to note that our findings may not generalize to couples from other racial or cultural backgrounds. We encourage researchers to make greater efforts to recruit demographically diverse samples of those with type 1 diabetes in the future.

Conclusions

We found individual differences in the stability of shared appraisal in both patients with type 1 diabetes and their spouses. The current research extends the literature on communal coping by demonstrating that fluctuations in one component—shared appraisal—matter for relationship and health over and beyond mean levels of appraisal. More specifically, greater fluctuations—especially in spouse appraisal—are associated with poor outcomes for both patients and spouses. Furthermore, for spouses, these fluctuations in appraisal were predicted by attachment anxiety. These findings imply spouse attachment anxiety may lead to greater variation in daily appraisals of the illness, which in turn worsens health for both patients and spouses.

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Open research statement

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Supplemental material

Supplemental material for this article is available online.

Note

1. We also ran the models controlling for anxious and avoidant attachment to see if appraisal stability effects held over and beyond attachment style. For relationship satisfaction, the partner effect of spouse appraisal standard deviation (SD) became marginal ($p = .056$). For psychological distress, the actor effect of spouse appraisal *SD* became marginal ($p = .08$). For life satisfaction, the results were the same. For diabetes distress, the effect of patient appraisal *SD* remained the same, but the effect of spouse appraisal *SD* became marginal ($p = .07$). For self-efficacy, self-care, and HbA1c, the results remained the same.

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