

## ORIGINAL ARTICLE

# Physiological bases of secure base support provision in a longitudinal study of married older adult couples

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**Abstract**

Close others often serve as a source of support for our pursuit of personal goals. Although social psychological research indicates that individuals and relationships benefit when couple members provide each other with secure base support for personal goals, few studies have investigated the physiological bases of these types of support interactions. This study of married older adults examined *support providers'* cardiovascular challenge-threat responses while they engaged in a laboratory social interaction about the most important goal that their partner (the target) wanted to make progress toward during the next year. Consistent with our hypothesis, support providers' cardiovascular challenge responses were positively associated with targets' ratings of their secure base support provision during the discussion. This study also used structural equation modeling to test a theoretical model of support providers' cardiovascular challenge responses as a physiological basis of secure base support provision that promotes targets' goal progress and thriving over time. Consistent with our theory, support providers' cardiovascular challenge responses were positively associated with targets' goal progress at Year 2 follow-up. In turn, targets' goal progress at Year 2 predicted increases in targets' overall thriving from Year 1 to Year 3. This investigation provides novel evidence for attachment theory's assertion that biobehavioral caregiving system activation facilitates the provision of secure base support that promotes close others' goal progress and thriving over time. Results of this study also contribute to recent evidence that cardiovascular challenge responses are associated with social behaviors during dyadic interactions.

**KEYWORDS**

attachment, cardiovascular reactivity, challenge-threat reactivity, older adulthood, social support

## 1 | INTRODUCTION

Close others often serve as a source of support for our pursuit of personal goals. In fact, a core function of close relationships across the lifespan is to provide support for

engagement in life's opportunities for exploration and growth (Bowlby, 1988; Feeney & Collins, 2015). It is, therefore, surprising that there have been few previous investigations of specific social interactions involving this type of support. Moreover, there has been a dearth of research

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examining the physiological bases of support provision in specific interactions, as well as the ways in which these physiological responses relate to the immediate and long-term outcomes of these support interactions. This investigation addresses these gaps by examining a candidate physiological basis of *secure base support provision* in married older adult couples and testing longitudinal associations with goal progress and thriving.

Older adult couples represent an important context for studying these processes because of the importance that close relationships (Carstensen et al., 1999) and goal pursuit (Jakubiak & Feeney, 2016; Wrosch et al., 2005) assume during this stage of life. According to socioemotional selectivity theory (Carstensen et al., 1999, 2003), older adulthood is associated with normative increases in motivation to invest in close relationships, such as marriage, and to seek emotional meaning from life, such as through pursuing personal goals. However, past research on secure base support in close relationships has tended to focus on couples in early or middle adulthood, and there remains a need for research focused on couples in older adulthood.

Below, we integrate two key relational theories—attachment theory (Bowlby, 1969, 1988) and a theoretical perspective on thriving through relationships (Feeney & Collins, 2015)—with the biopsychosocial conceptualization of challenge and threat (Blascovich & Tomaka, 1996) to generate a guiding theory and predictions for investigating the physiological bases of secure base support provision in married older adults. We theorize that support providers' cardiovascular challenge-threat responses will play an important role in facilitating (or impeding) their secure base support provision, and in promoting (or hindering) their partners' goal progress and thriving. Because our theory addresses the physiological bases of support provision, we focus on *support providers'* cardiovascular responses (rather than targets' cardiovascular responses) as being of central importance in driving the nature and quality of the support interaction.

## 1.1 | Relational theories of the importance of support for goals

Attachment theory provides a rich framework for understanding the biobehavioral processes involved in secure base support interactions. According to attachment theory, authentic exploration (often operationalized as goal progress) represents a cornerstone of well-being across the lifespan, including older adulthood (Bowlby, 1988). Consistent with this assertion, earlier studies have demonstrated the importance of goal progress for maintaining and promoting subjective well-being in older adulthood (Jakubiak & Feeney, 2016; Wrosch et al., 2005). Although

this perspective is shared by other theories of well-being (e.g., Deci & Ryan, 2000), attachment theory and its extensions uniquely emphasize the critical role of close others in facilitating goal progress through the provision of secure base support (Feeney & Collins, 2015).

Previous investigations have identified three core features of secure base support that facilitate goal progress in adult attachment relationships—encouragement, communicating availability to assist if needed, and (non) interference in a partner's exploration when assistance is not needed (Feeney & Thrush, 2010; Feeney & Van Vleet, 2010). Earlier studies indicate that receiving secure base support from close others promotes overall thriving following support interactions (review by Feeney & Collins, 2019). Moreover, longitudinal investigations have found that receiving secure base support is associated with a greater likelihood of goal pursuit and increases in thriving during 6 months of follow-up (Feeney et al., 2017; Tomlinson et al., 2016).

Attachment theory asserts that support behaviors are regulated by a biological caregiving system that motivates individuals to support the independent goal pursuit of close others (Bowlby, 1988; Sbarra & Hazan, 2008). In theory, activation of this biobehavioral system will facilitate the provision of encouraging and non(interfering) secure base support that is needed to promote close others' goal progress and overall thriving. However, no earlier studies have examined the physiological bases of secure base support provision in specific interactions or evaluated their potential associations with the immediate and long-term outcomes of these interactions.

## 1.2 | Biopsychosocial model of challenge and threat

The biopsychosocial (BPS) model of challenge and threat provides a validated methodological approach for studying physiological bases of secure base support provision (Blascovich, 2008; Blascovich & Tomaka, 1996). Drawing from Lazarus and Folkman's (1984) appraisal theory, the BPS model proposes that evaluations of environmental demands (e.g., time, energy, effort, or risk of harm) relative to personal coping resources (e.g., situationally relevant skills and knowledge, perceived support availability) determine whether individuals engaged in goal-relevant situations experience psychological states of challenge versus threat (Blascovich & Tomaka, 1996). *Challenge* states occur when individuals perceive their personal coping resources to exceed situational demands, whereas *threat* states occur when situational demands are perceived to exceed personal coping resources. Challenge states have a positive valence and

are associated with approach motivations that drive individuals to pursue desired events, whereas threat states have a negative valence and are associated with avoidance motivations that drive individuals to move away from aversive events (Elliot et al., 2006).

The BPS model asserts that challenge and threat states are associated with distinct physiological response patterns. Psychological states along the challenge-threat continuum are indexed using a combination of cardiac output (CO) and total peripheral resistance (TPR) (Blascovich, 2008; Blascovich & Tomaka, 1996). CO is the amount of blood that is pumped by the left ventricle per minute, such that greater CO indicates greater cardiac efficiency (Seery, 2011). TPR is a measure of overall systemic vascular resistance during one cardiac cycle, such that greater TPR indicates greater vascular resistance (Seery, 2011; Sherwood et al., 1990). The BPS model contends that challenge responses are associated with greater CO and lower TPR than threat responses (Blascovich, 2008). Previous studies investigating cardiovascular responses associated with challenge-threat states have often computed a standardized composite measure including both CO reactivity and (reverse scored) TPR reactivity (Blascovich et al., 2004; Jamieson et al., 2012; Seery et al., 2009).

Cardiovascular measures of challenge versus threat (CO and TPR) provide an unobtrusive method for assessing these psychological states in real time (Seery, 2011). These markers have been previously validated and have been shown to correlate with both goal pursuit and social behavior (reviews by Blascovich, 2008; Mendes & Park, 2014). For example, two earlier studies found that greater cardiovascular challenge reactivity during a laboratory speech task predicted superior performance in a related real-world outcome (e.g., college athletes giving a speech about athletics then performing better during the subsequent baseball season several months later) (Blascovich et al., 2004; Seery et al., 2010). Moreover, Peters et al. (2018) found that couple members who had greater challenge reactivity while discussing a potentially conflictual topic were rated by observers as being more responsive to their partner during the discussion (i.e., behaving in ways that communicated understanding, validation, and care). Feeney and Collins (2015) posited that cardiovascular challenge reactivity may be associated with secure base support provision and subsequent goal progress and thriving outcomes. However, there have been no studies to our knowledge testing these predictions.

Based on this review of past literature, we posit that cardiovascular challenge responses when discussing a close partner's personal goal will indicate activation of the biological caregiving system (Bowlby, 1988) and facilitate the provision of secure base support that promotes

a partner's goal progress and overall thriving. In theory, cardiovascular challenge responses in this context will indicate that support providers feel comfortable with their partner's personal goal pursuit and excited about providing him/her with support. In contrast, cardiovascular threat responses in this context will indicate that support providers feel distressed or threatened by their partner's personal goal pursuit, by their partner's personal goal, and/or by the need to provide their partner with secure base support. Cardiovascular threat responses will theoretically represent caregiving system inhibition (and attachment system activation) and prevent effective secure base support provision (Kunze & Shaver, 1994) because support providers who feel threatened by discussing their partner's goals will be focused on their own attachment needs and less willing and able to provide their partner with support. The BPS model describes challenge and threat as opposite ends of the same psychological dimension (Seery et al., 2009). However, we framed our investigation in terms of cardiovascular challenge responses (rather than cardiovascular threat responses) because we theorize this as the physiological response underlying responsive secure base support provision.

### 1.3 | Current investigation and hypotheses

This study assessed cardiovascular responses associated with the psychological dimension of challenge threat, while married older adult couples engaged in a laboratory social interaction. One individual was randomly assigned to the role of *target* and asked to tell their partner, the *support provider*, about the most important personal goal that he/she wanted to make progress toward during the next year. Targets completed longitudinal follow-up assessments of their goal progress at Year 2 and their overall thriving at Year 3. As described earlier, our study focused on older adulthood because close relationships and goal pursuit assume increased importance during this life stage (Carstensen et al., 1999, 2003) and because older adults are underrepresented in research on close relationships.

This study had multiple objectives. First, we aimed to evaluate a candidate's physiological basis of secure base support provision in a laboratory goal discussion. We predicted that more skilled support providers would have greater challenge reactivity (and less threat reactivity) during a laboratory goal discussion (Hypothesis 1a). In turn, we also predicted that support providers who had greater cardiovascular challenge reactivity during a goal discussion would be rated as providing more secure base support for targets' goal pursuit (Hypothesis 1b). We also

tested whether support providers' cardiovascular challenge reactivity was associated with observers' ratings of: (i) targets' receptiveness to support attempts; and (ii) couples' overall discussion quality.

Second, we aimed to test and refine a theoretical model of how support providers' cardiovascular challenge responses and secure base support facilitate targets' goal progress and increase targets' overall thriving. We predicted that targets would report greater goal progress at Year 2 when support providers had greater cardiovascular challenge reactivity during the goal discussion (Hypothesis 2a). In turn, we also predicted that targets would increase in overall thriving (i.e., a multidimensional assessment of hedonic, eudaimonic, psychological, relational, and physical well-being) at Year 3 when they made more progress toward their personal goal at Year 2 (Hypothesis 2b).

## 2 | METHOD

### 2.1 | Participants

Participants were married couples, with at least one partner over the age of 65, who were recruited for a parent study focused on relationships and health during older adulthood. Individuals who were taking beta-blockers were excluded from this study because this medication affects cardiovascular responses. At the start of the study, couple members were randomly assigned to the roles of "target" and "support provider" if both individuals were older than 65. For the 27.9% of couples in which only one individual was older than 65, that person was automatically assigned to the role of target and his/her partner was assigned to the role of support provider, given that this study was focused on goals in older adulthood.

Targets were 70.9 years old ( $SD = 5.3$ , range = 65–88) on average and 47.1% were female. Most targets were white (81.7%) and 33.5% of targets had completed a bachelor's degree or higher. Support providers were 69.1 years old ( $SD = 7.8$ , range = 48–89) on average and 53.9% were female. Most support providers were white (84.3%) and 34.0% of support providers had completed a bachelor's degree or higher. On average, couples had been romantically involved for 40.4 years ( $SD = 14.3$ ).

There were cardiovascular reactivity data available from support providers for 210 of 271 couples (77.5%) who were enrolled in the parent study. Reasons why participants were missing reactivity data included experimenter error, technical issues with the recordings (e.g., wires unplugged, software froze), participant discomfort with the physiological assessments, and other physical limitations

(e.g., arm too small/large for blood pressure cuff) that resulted in invalid data.

We used G\*Power to conduct a sensitivity power analysis for a multiple linear regression with one tested predictor and seven control variables, using a Type I error rate of .05 and a sample size of 202 (based on the number of participants available for testing the association of support providers' challenge reactivity and targets' rating of support providers' secure base support during the discussion). We calculated a required effect size of  $f^2 = .06$ . This indicates that our study had the sensitivity to detect a small-medium effect of support providers' challenge reactivity on targets' goal progress (Cohen, 2013).

### 2.2 | Procedure and measures

This was a longitudinal investigation that involved several phases of data collection. Study protocols were approved by the Carnegie Mellon University Institutional Review Board. In Year 1, participants provided informed consent, completed an initial survey session, an observational/activity session that occurred approximately 1 week later, and a daily diary period (diary data reported in Jakubiak et al., 2020; Jakubiak & Feeney, 2016). In Years 2 and 3, participants completed follow-up assessments of goal progress and thriving outcomes. A longitudinal diagram of study procedures and measures is shown in Figure 1.

#### 2.2.1 | Year 1 survey session

Couples visited the laboratory to complete questionnaires assessing their demographics, cardiovascular medication usage, and thriving. Targets also completed questionnaires asking about their most important personal goals for the next year.

##### *Thriving*

We assessed five dimensions of targets' baseline thriving—hedonic, eudaimonic, psychological, relational, and physical well-being. We also computed a composite measure of targets' overall thriving by averaging  $z$  scores of the five dimensions ( $\alpha = .81$ ).

##### *Hedonic well-being*

We assessed targets' baseline hedonic well-being using the 5-item Satisfaction with Life Scale (Diener et al., 1985), which asks participants to rate how satisfied they are with how their life is going right now (e.g., "In most ways my life is close to my ideal") on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Items were averaged to

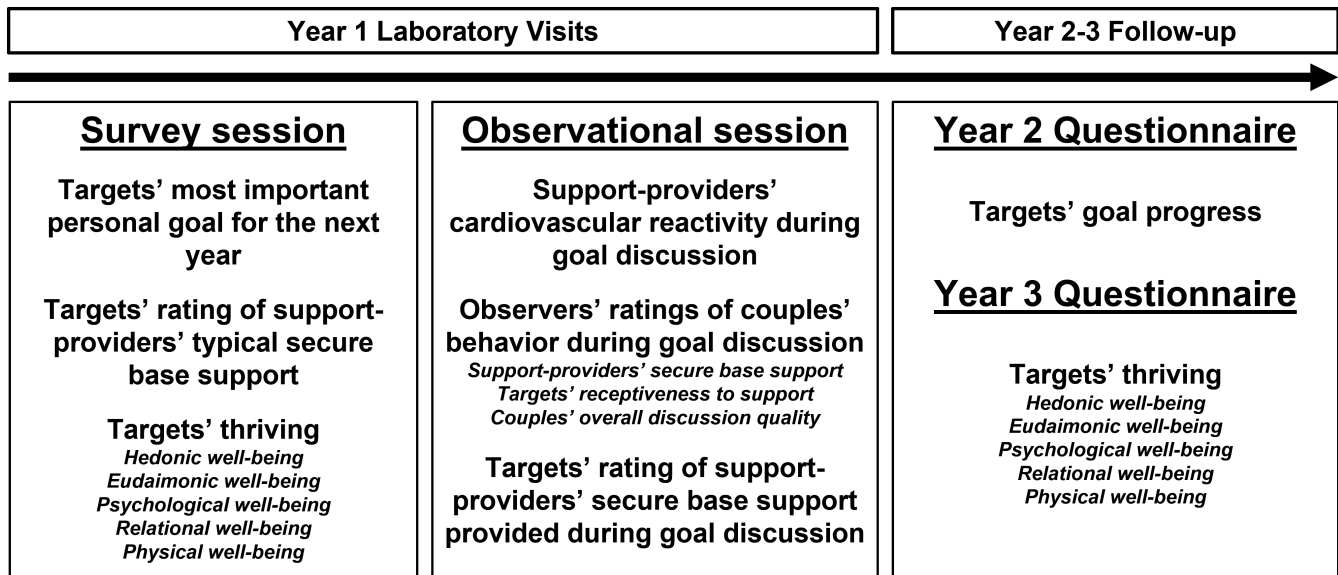


FIGURE 1 Longitudinal diagram of study procedures and measures

create a composite score representing baseline hedonic well-being ( $\alpha = .87$ ).

#### *Eudaimonic well-being*

We assessed two measures of targets' baseline eudaimonic well-being. Self-efficacy was assessed using an 8-item adaptation of the General Self-Efficacy Scale (Sherer et al., 1982), which asks participants to rate their beliefs in their own capabilities (e.g., "When I make plans, I am certain I can make them work") on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Items were averaged to create a self-efficacy composite score ( $\alpha = .85$ ). Life engagement was assessed using the 6-item Life Engagement Test (Scheier et al., 2006), which asks participants to rate their engagement in life activities that are personally valued (e.g., "To me, the things I do are all worthwhile") on a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Items were averaged to create a life engagement composite score ( $\alpha = .78$ ). Scores on each measure were standardized and averaged to create a eudaimonic well-being composite score ( $\alpha = .66$ ).

#### *Psychological well-being*

We assessed four measures of targets' baseline psychological well-being. Self-esteem was assessed using the 10-item Rosenberg Self-Esteem Scale (Rosenberg, 2011), which asks participants to rate their thoughts and feelings about themselves (e.g., "I feel that I am a person of worth, at least on an equal basis with others.") on a 7-point scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Items were averaged to create a self-esteem composite score ( $\alpha = .84$ ). Targets also completed a 39-item adaptation of the Brief

Symptom Inventory (Derogatis & Melisaratos, 1983), which was used to assess three aspects of their psychological well-being—*anxiety*, *depression*, and *anger*. Items were rated on a 5-point scale with appropriate anchors (i.e., *never* to *almost always*). The anxiety subscale ( $\alpha = .72$ ) included six items assessing how often participants have felt anxious during the past month (e.g., "During the past month, how much have you experienced nervousness or shakiness inside?"). The depression subscale ( $\alpha = .74$ ) included five items assessing how often participants felt depressed during the past month (e.g., "During the past month, how much have you experienced feeling hopeless about the future?"). The anger subscale ( $\alpha = .67$ ) included five items assessing how often participants felt angry during the past month (e.g., "During the past month, how much have you experienced feeling easily annoyed or upset?"). Scores on each measure were standardized and averaged to create a psychological well-being composite score ( $\alpha = .76$ ).

#### *Relational well-being*

Targets completed a 20-item assessment of three aspects of their marriage – *satisfaction*, *commitment*, and *conflict* (Collins & Read, 1990; Feeney et al., 2017; Van Lange et al., 1997). Items were rated on a 9-point scale with appropriate anchors (e.g., *not at all* to *completely*). The marital satisfaction subscale included six items assessing how happy/satisfied couple members felt with their marriage (e.g., "All things considered, how satisfied do you feel with your relationship?") ( $\alpha = .95$ ). The marital commitment subscale included seven items assessing the degree to which couple members felt committed to their spouse and intended to continue their relationship into the future

(e.g., “Do you feel committed to maintaining your relationship with your spouse?”) ( $\alpha = .73$ ). The marital conflict subscale included six items assessing the amount of interpersonal conflict in the marriage (e.g., “Overall, how much conflict is there in your relationship?”) ( $\alpha = .89$ ). Scores on each measure were standardized and averaged to create a relational well-being composite score ( $\alpha = .82$ ).

### *Physical well-being*

We assessed two measures of targets’ baseline physical well-being. Targets completed an 11-item adaptation of the physical symptoms subscale of the Brief Symptoms Inventory (Derogatis & Melisaratos, 1983) that was used to assess how often they have experienced physical symptoms during the past month (e.g., headaches, chest pain, and back pain) ( $\alpha = .76$ ). Items were rated on a 5-point scale with appropriate anchors (i.e., *never* to *almost always*). Targets also completed the general health subscale of the Short Form Survey (Ware & Sherbourne, 1992) which included five items assessing their perceived health (e.g., “I am as healthy as anybody I know”) ( $\alpha = .80$ ). Items were rated on a 5-point scale with appropriate anchors (i.e., *definitely true* to *definitely false*). Scores on each measure were standardized and averaged to create a physical well-being composite score ( $\alpha = .78$ ).

### *Targets’ goal*

As part of the questionnaires administered during the survey session, targets were asked to identify the most important goal that they wanted to accomplish or make progress toward during the next year. Targets were asked to select a personal goal that could be completed independently of the support provider and not a joint goal that would involve the support providers’ active participation. Targets also rated the extent to which they had already taken steps to achieve their specific goal at baseline.

### *Support providers’ typical secure base support*

Targets completed a questionnaire assessing support providers’ typical secure base support provision (Feeney et al., 2013; Feeney & Thrush, 2010). Items were rated on a 6-point scale from 1 (*disagree strongly*) to 6 (*agree strongly*) and assessed three aspects of how support providers typically respond when targets engage in new/challenging activities—availability, encouragement, and (non)interference. The availability subscale included five items ( $\alpha = .79$ ) assessing the degree to which support providers are generally available to provide the support that is sensitive and responsive to targets’ needs (e.g., “When I am facing a challenging or difficult situation, my spouse tries to make him/herself available to me in case I need him/her”). The encouragement subscale included six items ( $\alpha = .86$ ) assessing the degree to which support providers actively

encourage targets’ goal pursuit and autonomy (e.g., “My spouse usually encourages me to accept challenges and try new things”). The interference subscale included six items ( $\alpha = .73$ ) assessing the degree to which support providers either overtly or subtly interfere with targets’ goal pursuit (e.g., “My spouse sometimes interferes with my ability to accomplish my personal goals”). We averaged these subscales (with the interference subscale reverse scored) to create a composite measure of support providers’ skillfulness at providing secure base support.

## 2.2.2 | Year 1 observational/activity session

One week later, couples returned for a second laboratory visit where they engaged in activities and interactions that included the goal discussion. At the start of the activity session, support providers were attached to physiological recording equipment that was used to record cardiovascular measures during a 3-min resting baseline period and during a 7-min goal discussion. Continuous audio and video recordings of the session were obtained using cameras placed unobtrusively in the laboratory space.

### *Goal discussion*

Targets were reminded of their most important personal goal (that they reported during the survey session) and asked to discuss that goal with the support provider. Couples were instructed to discuss targets’ goal in whatever way they normally would, such as if they were at home or driving in the car together. This 7-min discussion was videotaped and later viewed by trained coders who used a behavioral coding system to evaluate couple members’ behaviors during the discussion.

### *Cardiovascular reactivity*

Cardiovascular measures were recorded noninvasively and following accepted guidelines (Sherwood et al., 1990). We recorded electrocardiography (ECG), impedance cardiography (ICG), and blood pressure; we also recorded electrodermal responses that are not reported here. ECG/ICG signals were sampled at 1000 Hz and integrated using a Biolab system (MindWare Technologies). We used a standard Lead II configuration to record the ECG signal. Spot sensors were used to measure impedance (Z0) and its first derivative (dZ/dt). Positive leads were placed on the left collarbone (slightly to the left of the voice box) and the back of the neck (1.5 inches higher). Negative leads were placed on the sternum and the middle back (separated by 1.5 inches). This hardware has been previously validated for assessing the cardiovascular measures collected in this investigation (e.g., Curtin et al., 2007). Continuous blood pressure recordings also were obtained from each couple

member using a CNAP 500 blood pressure monitor, and two blood pressure cuffs were placed over the brachial artery and on the index/middle fingers.

Trained analysts visually examined the ECG/ICG signals to remove artifacts. We analyzed ensemble averages for each cardiovascular measure using 1-min epochs. We computed average values for the resting baseline and the goal discussion when sufficient data were available (defined here as having valid data for 2/3 min during resting baseline and 4/7 min during the goal discussion).

Consistent with previous research, we assessed CO and TPR as cardiovascular measures of challenge and threat (Seery et al., 2009). Following accepted guidelines (Sherwood et al., 1990), TPR was calculated using the following formula:  $TPR = (\text{Mean Arterial Pressure}/CO) * 80$ . Following the approach of earlier studies (Blascovich et al., 2004; Jamieson et al., 2012; Seery et al., 2009), we created a composite measure of cardiovascular challenge reactivity by averaging standardized reactivity scores for CO and (reverse scored) TPR. Support providers' reactivity scores were standardized and outliers (defined as scores  $>3$  SD from the mean;  $n = 5$ ) were removed prior to analysis.

#### *Observationally coded behaviors*

Trained observers who were blind to study hypotheses viewed each videotaped discussion and used a behavioral coding system to independently rate the extent to which couple members exhibited several types of behaviors on a 5-point scale ranging from 1 (*not at all*) to 5 (*a great deal*). Different coders rated targets' and support providers' behaviors, and two coders independently rated each behavior. Significant discrepancies were resolved through joint discussion, followed by a third (and if needed, a fourth) independent coder providing additional ratings (see online Appendix for more detail). We examined the average of coders' ratings in all analyses. Intraclass correlations (ICCs) were calculated to assess interrater reliability using two-way random effects models assessing consistency between multiple raters.

We coded support providers' secure base support provision using a 10-code composite adapted from Feeney et al. (2013) including availability ( $ICC = .76$ ), encouragement ( $ICC = .80$ ), (reverse coded) interference ( $ICC = .83$ ), and seven specific behaviors reflecting the provision of a secure base in this context: listening ( $ICC = .74$ ), emotional support ( $ICC = .85$ ), instrumental support ( $ICC = .83$ ), expressing confidence in target ( $ICC = .76$ ), comfort with targets' autonomous goal pursuit ( $ICC = .76$ ), sensitive/responsive caregiving ( $ICC = .81$ ), and support for targets' goal and autonomy ( $ICC = .75$ ). We also coded targets' receptiveness to support attempts assessed with a 2-code composite of receptiveness to support attempts

( $ICC = .81$ ) and (reverse coded) rejection of support attempts ( $ICC = .86$ ).

Finally, each couple also received a shared (dyadic) rating representing the extent to which the couple engaged in an open and fluid discussion of the targets' goal ( $ICC = .75$ ). This code was intended to capture the extent to which coders observed a "special quality" in the couple's interaction (e.g., a secure communication pattern reflecting joint comfort and openness with one another, use of shared special language, and references to shared history that only the two couple members have).

#### *Perceived secure base support*

After the discussion, couple members were separated, and targets completed a questionnaire rating support providers' behavior during the discussion on a 5-point scale ranging from 1 (*not at all*) to 5 (*extremely*). We assessed targets' perceived secure base support during the goal discussion using a 10-item composite ( $\alpha = .92$ ) of ratings of the extent to which the support provider was interested, encouraging, listening/attentive, caring/supportive, helpful/supportive, confident, kind, thoughtful/considerate, engaged in the discussion, and (reverse coded) interfering/meddlesome.

### 2.2.3 | Year 2 and Year 3 follow-ups

Targets completed mailed follow-up questionnaires assessing their goal progress (Year 2) and their overall thriving (Year 3).

#### *Targets' goal progress*

Targets were reminded of their most important goal and asked to rate their goal progress during the past year using a single item rated from 1 (*none at all*) to 5 (*I accomplished it*).

#### *Changes in overall thriving*

Targets completed the same measures assessing dimensions of overall thriving that were administered at baseline: (a) hedonic well-being was assessed using a life satisfaction score ( $\alpha = .87$ ); (b) eudaimonic well-being was assessed using a composite score ( $\alpha = .76$ ) of self-efficacy ( $\alpha = .88$ ) and life engagement ( $\alpha = .80$ ); (c) psychological well-being was assessed using a composite score ( $\alpha = .80$ ) of self-esteem ( $\alpha = .87$ ), anxiety ( $\alpha = .77$ ), depression ( $\alpha = .84$ ), and anger ( $\alpha = .56$ ); (d) relational well-being was assessed using a composite score ( $\alpha = .78$ ) of marital satisfaction ( $\alpha = .94$ ), marital commitment ( $\alpha = .44$ ), and marital conflict ( $\alpha = .88$ ); and (e) physical well-being was assessed using a composite score ( $\alpha = .71$ ) of physical symptoms ( $\alpha = .78$ ) and general health ( $\alpha = .79$ ). Finally, we computed a composite measure of overall thriving by averaging z scores of the five dimensions ( $\alpha = .81$ ).

## 2.3 | Data analysis

We tested Aim 1 using linear regression models with covariates for targets' age and sex; support providers' age, sex, and use of medications that affected the cardiovascular system; and couples' relationship length.

We tested Aim 2 using a structural equation model estimated in Stata with the *sem* command. Figure 2 (Panel A) shows the hypothesized conceptual model of support providers' cardiovascular challenge reactivity, targets' goal progress, and targets' thriving. We examined changes in targets' goal progress at Year 2 by controlling for targets' prior steps taken toward their goal at Year 1. We examined prospective changes in targets' thriving at Year 3 by controlling for targets' thriving at Year 1. This model also included covariates for targets' age and sex; support providers' age, sex, and use of medications that affected the cardiovascular system' and couples' relationship length.

## 3 | RESULTS

Descriptive statistics and zero-order correlations among study variables are shown in Table 1.

### 3.1 | Testing associations of support providers' cardiovascular challenge reactivity with secure base support and other interaction behaviors (Aim 1)

We predicted that more skilled secure base support providers would have greater cardiovascular challenge reactivity during a subsequent laboratory goal discussion (Hypothesis 1a). We also predicted that support providers who had greater cardiovascular challenge reactivity during a goal discussion would be rated as providing more secure base support for the target's personal goal during the discussion (Hypothesis 1b). Results of covariate-adjusted

linear regression models used to test these hypotheses are shown in Tables 2 and 3.

Consistent with Hypothesis 1a, we found that more skilled secure base support providers had greater cardiovascular challenge reactivity during a subsequent laboratory goal discussion,  $B = .07$ ,  $SE = .03$ ,  $p = .020$ .

Consistent with Hypothesis 1b, we found that support providers who had greater cardiovascular challenge reactivity during a laboratory goal discussion were subsequently rated by targets as providing more secure base support during the discussion,  $B = .30$ ,  $SE = .13$ ,  $p = .022$ . We also found that support providers' cardiovascular challenge reactivity was associated with observers' ratings of how receptive the target was to their support attempts,  $B = .53$ ,  $SE = .17$ ,  $p = .002$ , and with observers' ratings of couples' overall discussion quality,  $B = .38$ ,  $SE = .17$ ,  $p = .026$ . However, support providers' challenge-threat reactivity was not associated with observers' ratings of their secure base support provision during the goal discussion,  $B = .13$ ,  $SE = .15$ ,  $p = .39$ .

### 3.2 | Testing hypothesized model of cardiovascular reactivity, secure base support, goal progress, and thriving (aim 2)

We predicted that targets would report greater goal progress at Year 2 when support providers had greater cardiovascular challenge reactivity during goal discussion (Hypothesis 2a). We also predicted that targets would increase in overall thriving at Year 3 when they made more progress toward their personal goal at Year 2 (Hypothesis 2b). The input path diagram that was used to test these hypotheses is shown in Figure 2 (Panel B). Results of the structural equation model are shown in Table 4,  $\chi^2(4) = 1.75$ ,  $p = .78$ .

Consistent with Hypothesis 2a, we found that targets reported greater goal progress at Year 2 when support providers had greater cardiovascular challenge reactivity during the goal discussion,  $\beta = .16$ ,  $SE = .07$ ,  $p = .025$ .

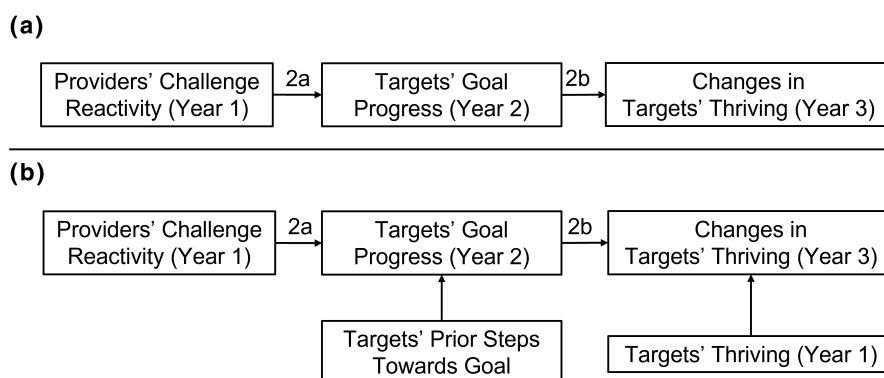


FIGURE 2 Longitudinal model of support providers' cardiovascular challenge reactivity, targets' goal progress, and changes in targets' thriving represented as a conceptual model (a) and as an input path diagram (b)



TABLE 1 Descriptive statistics and zero-order correlations between major study variables

Variable	Mean (SD)	Range	N	1	2	3	4	5	6	7	8	9
1. Support providers' challenge reactivity	0.0 (0.3)	-2.0, 1.4	205	-								
2. Targets' rating of support providers' typical secure base support	4.8 (0.8)	2.2, 6.0	204	.12	-							
3. Targets' rating of support providers' secure base support during the discussion	4.3 (0.6)	1.6, 5.0	202	.12	.50**	-						
4. Observers' rating of support providers' secure base support during the discussion	3.3 (0.6)	1.6, 4.5	172	.04	.27**	.37**	-					
5. Observers' rating of targets' receptiveness to support attempts	3.5 (0.7)	1.0, 5.0	174	.18*	.23**	.24*	.31**	-				
6. Observers' rating of couples' overall discussion quality	3.6 (0.7)	1.5, 5.0	172	.15	.26**	.32**	.77**	.36**	-			
7. Targets' goal progress at Year 2	3.3 (1.3)	1.0, 5.0	186	.18*	.01	.17*	-.09	-.04	.06	-		
8. Targets' overall thriving at Year 1	0.0 (0.6)	-2.0, 1.2	205	.23*	.50**	.45**	.11	.20*	.10	.11	-	
9. Targets' overall thriving at Year 3	0.0 (0.6)	-1.9, 1.2	174	.11	.36**	.39**	.00	.13	.00	.17*	.81**	-

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

Consistent with Hypothesis 2b, we found that targets' goal progress at Year 2 predicted increases in targets' thriving from Year 1 to Year 3,  $\beta = .11$ ,  $SE = .04$ ,  $p = .016$ .

Follow-up linear regression analyses evaluating the association of targets' goal progress with changes in individual dimensions of targets' thriving and individual scales used to assess targets' thriving are presented in Online Appendix A.

## 4 | DISCUSSION

This study of married older adult couples examined support providers' cardiovascular challenge responses while they engaged in a laboratory social interaction about the most important goal that their partner (the target) wanted to make progress toward during the next year. Consistent with our hypothesis, support providers' cardiovascular challenge responses were associated with targets' ratings of their secure base support provision during the discussion, as well as with targets' prior reports of support providers' typical secure base support provision in the relationship. This study also tested a theoretical model of support providers' cardiovascular challenge responses as a physiological basis of secure base support provision that promotes targets' goal progress and thriving over time. Consistent with our theory, support providers' cardiovascular challenge responses were positively associated with targets' goal progress at Year 2 follow-up. In turn, targets' goal progress at Year 2 predicted increases in targets' overall thriving from Year 1 to Year 3. Below, we interpret key findings from each aim of our investigation in the context of key relationships theories (Bowlby, 1988; Feeney & Collins, 2015) and the BPS model of challenge/threat (Blascovich, 2008; Blascovich & Tomaka, 1996).

### 4.1 | Cardiovascular challenge responses as a physiological basis of secure base support provision

Consistent with Hypothesis 1a, more skilled secure base support providers (as rated by targets) had greater cardiovascular challenge reactivity during a subsequent goal discussion. This result was consistent with the BPS model's assertion that cardiovascular challenge-threat responses reflect individuals' appraisals of situational demands compared to personal coping resources (Blascovich, 2008; Blascovich & Tomaka, 1996). In theory, more skilled and responsive support providers appraised themselves as being more capable of aiding targets' goal pursuit and appraised the need to support targets' goal pursuit as less demanding and threatening. However, we could not directly

**TABLE 2** Linear regression model testing hypothesized association of targets' rating of support providers' typical secure base support and support providers' challenge reactivity during a laboratory goal discussion

	Support providers' challenge reactivity			
	<i>B</i>	<i>SE</i>	95% CI	<i>p</i>
Targets' age	.01	.01	−.01, .02	.25
Targets' sex	−.74	.24	−1.22, −.27	.002
Support providers' age	−.00	.01	−.02, .01	.50
Support providers' sex	−.70	.25	−1.18, −.21	.005
Support providers' use of cardiovascular medication	.04	.05	−.05, .14	.39
Couples' relationship length	.00	.00	.00, .01	.054
Targets' prior steps taken toward goal	.00	.02	−.04, .04	.96
Targets' rating of support providers' typical secure base support	.07	.03	.01, .13	.020
Model $R^2$	.11			
Partial $R^2$ (targets' rating of support providers' typical secure base support)	.03			

Note: Data were available from 201 of 205 dyads.

test this explanation in our study. Future investigations are needed to test theorized links between support providers' cardiovascular challenge-threat responses and their appraisals of coping resources versus situational demands (Quigley et al., 2002). Future investigations could also test this hypothesis by experimentally manipulating support providers' resource appraisals before the goal discussion (Turner et al., 2014).

Consistent with Hypothesis 1b, support providers' cardiovascular challenge reactivity during a goal discussion predicted targets' ratings of support providers' secure base support provision during the discussion. This result was consistent with our theory that cardiovascular challenge responses could underlie the provision of secure base support. In theory, support providers' cardiovascular challenge responses represent activation of their biobehavioral caregiving system (Bowlby, 1988; Sbarra & Hazan, 2008), which, in turn, facilitates their provision of secure base support for targets' goal. Consistent with this explanation, support providers' cardiovascular challenge responses were also associated with observers' ratings of targets' receptiveness to support attempts and couples' overall discussion quality.

These findings contribute to growing evidence that cardiovascular measures of challenge threat are associated with social behavior in various interaction contexts. For example, Peters et al. (2018) found that couple members' cardiovascular challenge responses during a conflict interaction were associated with ratings of how responsive they were to their partner. Future studies are needed to evaluate the association of cardiovascular challenge responses with social behavior in other types of interaction contexts. For example, attachment theory also posits that the caregiving system will facilitate the provision of safe haven support when close others are coping with stressful

life events (Bowlby, 1988; Feeney & Collins, 2015; Kuncze & Shaver, 1994). Future studies should test this assertion by investigating whether cardiovascular challenge responses could also underlie the provision of effective safe haven support in stressful contexts (Cohen & Wills, 1985).

Our investigation focused on the support providers' cardiovascular responses because we were interested in studying the physiological bases of secure base support provision. Couple members were randomly assigned to distinct and distinguishable roles (i.e., support provider and target), and the dyad was the unit of analysis. However, future studies should also investigate the potential role of biobehavioral co-regulation in these associations by modeling the linkages between support providers' and targets' physiological responses (Butler & Randall, 2013).

## 4.2 | Theoretical model of cardiovascular challenge reactivity, goal progress, and thriving

We tested and refined a theoretical model of how support providers' cardiovascular challenge responses facilitate targets' goal progress and overall thriving.

Consistent with Hypotheses 2a, we found that targets made more progress toward their personal goal at Year 2 when support providers had greater cardiovascular challenge reactivity during the goal discussion. This observation is consistent with attachment theory's assertion that a core function of close relationships is to promote authentic exploration through the provision of secure base support that is facilitated by activation of a biological caregiving system (Bowlby, 1988; Feeney & Collins, 2015), and with earlier studies demonstrating that receiving secure base support from a romantic partner increases individuals'

TABLE 3 Linear regression models testing the hypothesized association of support providers' challenge reactivity during a laboratory goal discussion with ratings of couple members' behaviors

	Targets' rating of support providers' secure base support			Observers' rating of support providers' secure base support			Observers' rating of targets' receptiveness to support attempts			Observers' ratings of couples' overall discussion quality						
	B	SE	95% CI	p	B	SE	95% CI	p	B	SE	95% CI	p				
Targets' age	.01	.01	-.01, .03	.45	.01	.01	-.02, .03	.59	.01	.02	-.02, .04	.66	.00	.02	-.03, .03	.93
Targets' sex	.86	.44	-.01, 1.73	.051	.26	.46	-.66, 1.17	.58	1.16	.52	.13, 2.19	.028	.35	.53	-.69, 1.39	.51
Support providers' age	-.01	.01	-.03, .01	.37	-.01	.01	-.03, .01	.41	-.00	.01	-.03, .03	.95	.01	.01	-.02, .03	.56
Support providers' sex	.80	.45	-.09, 1.68	.08	.19	.47	-.75, 1.12	.69	1.05	.54	-.01, 2.10	.053	.49	.54	-.58, 1.56	.37
Support providers' use of cardiovascular medication	-.02	.09	-.19, .15	.83	.03	.10	-.17, .23	.74	.01	.11	-.21, .23	.94	-.02	.11	-.24, .21	.88
Couples' relationship length	-.00	.00	-.01, .00	.41	-.00	.00	-.01, .01	.38	-.01	.01	-.02, -.00	.037	-.01	.01	-.02, .00	.16
Targets' prior steps taken toward goal	.02	.04	-.05, .10	.54	.02	.04	-.07, .10	.69	.01	.05	-.08, .11	.80	.02	.05	-.08, .11	.75
Support providers' challenge reactivity	.30	.13	.04, .56	.022	.13	.15	-.16, .42	.39	.53	.17	.20, .86	.002	.38	.17	.05, .71	.026
Model R <sup>2</sup>				.06				.02				.10				.05
Partial R <sup>2</sup> (support providers' challenge reactivity)				.03				.01				.06				.03

Note: Data were available from 199 of 205 dyads for targets' rating of support providers' secure base support, from 171 of 205 dyads for observers' rating of support providers' secure base support, and from 169 of 205 dyads for observers' rating of targets' receptiveness to support attempts and observers' rating of couples' overall discussion quality.

likelihood of goal pursuit (Feeney et al., 2017; Tomlinson et al., 2016). Our findings build on this evidence by identifying a candidate physiological basis of secure base support provision that predicted partners' goal progress during 1 year of follow-up. Moreover, these findings contribute to limited past research on attachment processes in older adulthood. Although Bowlby (1988) specified that the principles of attachment theory operated "from the cradle to the grave," older adults have been historically understudied in research on attachment relationships. This investigation helps to fill this gap by providing novel longitudinal evidence for secure base support processes in married older adult couples.

Future investigations are needed to characterize the numerous intermediate steps underlying this longitudinal association. One possible explanation is that support providers' physiological and behavioral responses during a laboratory goal discussion were analogous to their responses during similar discussion about the targets' goal in the couples' daily life (Kamarck & Lovallo, 2003). Future studies could test this hypothesis by combining ecological momentary assessments with ambulatory physiological assessments to compare support providers' responses in the laboratory and in daily life. Additional research is also needed to more precisely characterize the trajectory of goal progress by conducting follow-up assessments at more frequent intervals (e.g., each month) and to investigate these effects from a transactional perspective that considers both couple members' physiology, goals, and secure base support (Fitzsimons et al., 2015).

Consistent with Hypothesis 2b, we found that targets' goal progress at Year 2 was associated with increases in their overall thriving at Year 3. This result is consistent with attachment theory's assertion that authentic exploration facilitated by secure base support is a key component of thriving through close relationships (Feeney & Collins, 2015), and with earlier evidence that goal progress is associated with increased subjective well-being during older adulthood (Klug & Maier, 2015). We also extended this earlier work by assessing whether goal progress was associated with increases in specific dimensions of thriving (Feeney & Collins, 2015) and with increases in specific measures that were used to assess each thriving dimension (see Online Appendix A). Future research is also needed to evaluate this association using validated assessments that specifically assess each dimension of thriving (Feeney & Collins, 2014).

### 4.3 | Strengths, limitations, and future directions

This investigation had several strengths including its integration of diverse theoretical perspectives, its focus on

Structural equation model estimates	$\beta$	SE	95% CI	p
<i>Targets' goal progress at Year 2</i>				
Targets' age	.03	.10	-.16, .22	.74
Targets' sex	-.78	.33	-1.43, -.13	.019
Support providers' age	.06	.12	-.18, .30	.62
Support providers' sex	-.67	.34	-1.34, -.01	.048
Support providers' use of cardiovascular medication	-.03	.07	-.17, .10	.63
Couples' relationship length	-.15	.08	-.31, .01	.07
Targets' prior steps taken toward goal	.30	.06	.18, .43	<.001
Support providers' challenge reactivity	.16	.07	.02, .30	.025
<i>Targets' overall thriving at Year 3</i>				
Targets' age	.01	.01	-.12, .13	.92
Targets' sex	.10	.21	-.31, .50	.64
Support providers' age	-.18	.08	-.34, -.02	.030
Support providers' sex	.12	.21	-.30, .53	.57
Couples' relationship length	.12	.05	.02, .22	.017
Targets' overall thriving at Year 1	.81	.03	.76, .86	<.001
Targets' goal progress at Year 2	.11	.04	.02, .19	.016
<i>Model fit</i>				<i>p</i>
$\chi^2$	1.75 (4 df)			.78
Akaike information criterion	6261.66 (73 df)			
Bayesian information criterion	6504.24 (73 df)			

Note: Model was estimated using maximum likelihood with missing values ( $N = 205$ ).

married older adults (ages 65 and older) who are historically understudied in research on attachment, social support, and cardiovascular reactivity, and its utilization of multiple types of assessments (observational, physiological, and longitudinal) and analytic approaches (structural equation models).

Several limitations of the current investigation provide opportunity for future research. First, it is unknown whether associations observed in this study are generalizable to other couple populations. Although this investigation was focused on married older adult couples because of the importance of close relationships and goal pursuit during this life stage (Carstensen et al., 1999, 2003), attachment theory contends that these effects would be observed in close relationships throughout the lifespan (Bowlby, 1988). Future studies are needed to determine whether age represents a potential moderator of the effects that we observed in this study. For example, it is unknown whether these associations would also be observed in dating or newlywed couples in young adulthood. Moreover, future studies are needed to examine individual difference variables that might moderate the associations

**TABLE 4** Summary of structural equation model testing hypothesized associations of support providers' cardiovascular challenge reactivity and targets' goal progress and overall thriving

found in this investigation (e.g., support providers' physiology might predict goal progress more strongly when both couple members are high in attachment security). Second, future research is needed to examine whether the coregulatory dynamics (Butler & Randall, 2013; Leo et al., 2021) between support providers' and targets' cardiovascular challenge-threat responses are associated with the goal and thriving outcomes; testing this possibility was beyond the scope of the current investigation. Third, our measure of goal progress (i.e., self-reported progress) was relatively crude. Although we attempted to mitigate this limitation by statistically controlling for the extent to which targets had already taken steps to achieve their goal at baseline (before the discussion), future studies are needed to replicate these associations using objective and standardized measures of goal progress. Fourth, our investigation attempted to mitigate the challenges of measuring cardiovascular responses in older adults by removing outlier reactivity scores, by excluding individuals who were taking beta-blockers, and by statistically controlling for support providers' age, sex, and use of other medications that affect the cardiovascular system. However, future

investigations are needed to evaluate whether normative changes in cardiovascular physiology that occur during older adulthood (Dai et al., 2015) impact the magnitude of older adults' cardiovascular challenge-threat responses.

## 5 | CONCLUSIONS

Close others often serve as a supportive secure base from which individuals can pursue their personal goals and desires; however, there has been a lack of research on cardiovascular responses associated with this important form of support. This investigation adds to growing evidence for the importance of secure base support in adult attachment relationships (review by Feeney & Collins, 2019) by providing novel evidence that support providers' cardiovascular challenge responses during a laboratory goal discussion were longitudinally associated with a target partner's personal goal progress and overall thriving. Our study also builds on recent evidence indicating that cardiovascular challenge responses are associated with social behaviors during dyadic interactions (Peters et al., 2018).

## CONFLICT OF INTEREST

All authors declare no conflicts of interest.

## AUTHOR CONTRIBUTIONS

**Brian N Chin:** Conceptualization; data curation; formal analysis; investigation; methodology; writing – original draft; writing – review and editing. **Brooke Feeney:** Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; resources; software; supervision; writing – review and editing.

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## SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

## Appendix

**TABLE 1** Summary of covariate-adjusted linear regression models testing the prospective association of targets' goal progress on dimensions of thriving

**TABLE 2** Descriptive statistics for individual thriving scales at each assessment

**TABLE 3a** Summary of covariate-adjusted linear regression models testing the prospective association of targets' goal progress with measures assessing hedonic and eudaimonic dimensions of thriving

**TABLE 3b** Summary of covariate-adjusted linear regression models testing the prospective association of targets' goal progress with measures assessing psychological dimension of thriving

**TABLE 3c** Summary of covariate-adjusted linear regression models testing the prospective association of targets' goal progress with measures assessing relational dimension of thriving

**TABLE 3d** Summary of covariate-adjusted linear regression models testing the prospective association of targets' goal progress with measures assessing physical dimension of thriving

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