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"A Well Spent Day Brings Happy Sleep": A Dyadic Study of Capitalization Support in Military-Connected Couples

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"A well spent day brings happy sleep": A dyadic study of capitalization support in military-connected couples

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Abstract

Among couples, sleep is theorized to be a dyadic process, within which relationship quality exerts a large influence (Troxel et al., 2007). In turn, research has shown that capitalization, or positive-event disclosure, influences relationship quality. The benefits of capitalization, however, are contingent on the receipt of a supportive response, here referred to as capitalization support (Reis & Gable, 2003). Accordingly, the current study examined daily capitalization support, loneliness, and intimacy as predictors of sleep (i.e., quality, duration, difficulty falling asleep). Post-9/11 military veterans and their spouses (N = 159) completed a 32-day internet-based survey assessing daily relationship experiences and health. Results of an actor-partner interdependence mediation model on aggregated daily data revealed actor indirect effects of capitalization support on sleep outcomes via loneliness and intimacy, for veterans and spouses. Partner indirect effects were observed for veteran capitalization support on spouse difficulty falling asleep and sleep quality, via spouse loneliness and intimacy. Lagged actor-partner models revealed similar actor effects for daily capitalization support on loneliness (spouses) and intimacy (spouses and veterans), which in turn uniquely predicted daily sleep. Partner effects were observed for veteran capitalization support on spouse intimacy, and veteran loneliness on spouse sleep quality. Results highlight potential new avenues for interventions to promote better sleep by promoting positive relationship functioning between romantic partners. Such work is especially important for high-risk individuals, including military veterans and their spouses for whom prolonged post-deployment sleep difficulties pose particular concern.

Keywords: interpersonal processes, perceived partner responsiveness, relationship intimacy, loneliness, sleep

Relationships are vital to the maintenance of physical health and psychological well-being. Extensive research has shown that individuals who are more socially integrated tend to perceive greater social support in times of need, feel less lonely, live longer, and exhibit greater health-promoting behavior (e.g., Pietromonaco & Collins, 2017). Pietromonaco and Collins' (2017) theoretical framework asserts that relationship processes impact physical and psychological health through the facilitation of intrapersonal mechanisms. For example, partner responsiveness, or the extent to which one's partner is thought of as a source of security, validation, and affection, can influence health by regulating responses to stress and promoting healthy behavior (Slatcher & Selcuk, 2017). Recent theory and research suggests that sleep is one pathway through which relationships impact physiological health (e.g., McHale, King, & Buxton, 2017). Sleep has a profound effect on health, as it relates to obesity, cardiovascular health, cancer, accidents, mortality (see Luyster, Strollo, Zee, & Walsh, 2012), and attenuates the wear and tear of stress (Akerstedt, Kecklund, & Axelsson, 2007).

Relationship functioning is closely tied to sleep (Hasler & Troxel, 2010; Troxel, Robles, Hall, & Buysse, 2007; Troxel, 2010). For example, the majority of partnered individuals report sleeping in the same bed as their significant other (National Sleep Foundation, 2012). Not surprisingly, sleep and relationship functioning covary (e.g., Lee, Chopik, & Schiamberg, 2017), such that one's relationship may affect one's sleep and vice versa. Indeed, Troxel et al. (2007) propose a conceptual model, wherein relationship functioning impacts sleep via biological, behavioral, and psychological mechanisms. Holliday and Troxel (2017) highlight the need for research to continue exploring these psychological, physiological, and behavioral pathways. The current study addresses this call by examining daily associations among perceived

responsiveness and sleep, as well as the psychological mechanisms of loneliness and intimacy. Importantly, we focus our study on military-connected couples.

Military Couples and Sleep

Active and separated service members may be particularly vulnerable to sleep disturbances. Regardless of time since deployment, military veterans demonstrate higher levels of sleep problems than the general population (e.g., Plumb, Peachey, & Zelman, 2014; Troxel et al., 2015). Whereas existing research on veteran sleep has typically focused on veterans, work has begun to explore military spouses and paired military couples, who may be at additional risk for relationship problems. Indeed, veterans and spouses report feelings of loneliness and interpersonal conflict within their relationship (Baptist et al., 2011), and evidence supports the relationship between marital functioning and combat-related mental health concerns (e.g., anxiety, depression, post-traumatic stress; Taft, Watkins, Stafford, Street, & Monson, 2011). Given concerns about long-lasting sleep deficits (e.g., Plumb et al., 2014), sleep is a key behavioral health outcome to consider when examining relationship processes within military-connected couples.

Recently, studies have begun considering the impact of relationship functioning on sleep among military couples, providing evidence that relationship-enhancing behaviors promote sleep (Fillo et al., 2017), and that higher levels of relationship conflict predict poorer sleep among military couples (Troxel, DeSantis, Germain, Buysse, & Matthews, 2017). In turn, poorer sleep quality among military spouses relates to lower marital satisfaction, poorer self-related health, and more depressive symptoms (Holliday, Haas, Shih, & Troxel, 2016). Though research regarding military relationships has begun to recruit more representative samples (e.g., sampling National Guard, Reservist components, and active duty; RAND Deployment Life Study;

Tanielian, Karney, Chandra, & Meadows, 2014), few studies of military couples have focused on military members who have successfully transitioned into the civilian workforce. The current study examines a matched, *community sample* of active and separated service members and their romantic partners in daily reports over 32 days, affording a unique opportunity to investigate relationship functioning and sleep in military-connected couples.

Perceived Responsiveness, Self-Disclosure, and Sleep

Importantly, research with military and civilian samples has elucidated that the association between relationship status and sleep depends on relationship quality (e.g., Holliday & Troxel, 2017). This reflects research from the more general study of relationships and health, wherein the association of marital status and better health depends on the quality of the relationship (Robles, Slatcher, Trombello, & McGinn, 2014). As such, it is important for couples to actively engage in relationship maintenance behaviors, which serve to sustain intimacy and maintain relationship satisfaction over time. One relationship maintenance behavior vital to intimacy development is self-disclosure. Recent work has revealed that daily self-disclosure predicts better sleep, above and beyond daily positive and negative mood (Kane et al., 2014). Though previous work has highlighted the relevance of self-disclosure to the study of sleep, associations among partner responses to self-disclosure (i.e., perceived responsiveness to disclosure) on sleep have not been explored. Perceived responsiveness to self-disclosure plays a crucial role in intimacy-development within close relationships, and is an important component of disclosure interactions (Laurenceau et al., 2005; Reis & Shaver, 1988). Indeed, Kane et al., (2014) note that partners' *responsiveness to self-disclosure* may be particularly important to sleep. Research has demonstrated that general perceptions of partner responsiveness (e.g., feeling validated, cared for, and understood) predict greater intimacy, relationship quality, and better

sleep (Selcuk, Stanton, Slatcher, & Ong, 2017). The current study builds on this research by exploring perceived responsiveness to specific daily disclosure attempts made to romantic partners.

We examine a specific type of self-disclosure, the disclosure of recent positive experiences, or capitalization. Research supports capitalization as an important relationship maintenance behavior, affording numerous intrapersonal (e.g., positive affect) and interpersonal (e.g., intimacy) benefits (Gable, Reis, Impett, & Asher, 2004). As with the more general study of disclosure, perceived responsiveness to capitalization, or *capitalization support*, is vital for reaping the benefits of this process (Gable & Reis, 2010). For example, when an individual tells their partner about a positive event and their partner responds enthusiastically, the individual and his/her partner feel closer and more secure in their relationship. Capitalization support is a specific type of relationship behavior that signals responsiveness, which in turn relates to greater relationship satisfaction, intimacy, positive affect, and felt security (Gable et al., 2004; Gable, Gosnell, Maisal, & Stratchman, 2012). Pietromonaco and Collins (2017) theorized that capitalization contributes to long-term health outcomes via mechanisms including relationship security, emotion processes, and healthy sleep. No research of which we are aware has examined responses to daily capitalization (i.e., capitalization support), specifically, in relation to sleep. The current study builds on previous research by examining links among capitalization support and sleep (i.e., quality, duration, and difficulty falling asleep).

Previous work has also provided insight into explanatory mechanisms for links among relationship quality and health (e.g., psychological, physiological, and behavioral mechanisms; Troxel et al., 2007). In the current study, we consider intimacy and loneliness as psychological mechanisms linking capitalization support and sleep. Capitalization predicts greater intimacy and

reduced loneliness (Gable & Reis, 2010; Reis et al., 2009). Relatedly, daytime loneliness predicts dysfunction the next day, an indicator of poor sleep quality (e.g., Hawkley, Preacher, & Cacioppo, 2010), and impairs sleep efficiency (Cacioppo et al., 2002; Segrin & Burke, 2015). Similarly, daytime intimacy predicts better nighttime sleep (Troxel et al., 2007) and reduced insomnia symptoms (Stadler, Snyder, Horn, Shrout, & Bolger, 2012). Whereas previous work has revealed down-regulating effects of responsiveness on stress and anxiety, research has yet to consider how responsiveness may affect health (i.e., sleep) via the dyadic regulation of positive emotions (e.g., intimacy). As proposed by Troxel and colleagues (2007), feelings of security in a relationship (e.g., capitalization support) may relate to decreased loneliness and increased positive emotion, which may subsequently relate to better sleep.

Study Aims and Hypotheses

The purpose of this study is to investigate interdependence among military couples' capitalization support and sleep outcomes, over a 32-day study. Further, we explore the mechanistic properties of loneliness and intimacy, via the Actor-Partner Interdependence Mediation Model (APIMeM; Ledermann, Macho, & Kenny, 2011; Figure 1.0). As a preliminary step we examine these processes, aggregating over the 32-day study. The decision to examine an aggregated APIMeM was based on the assumption that meaningful information can be gleaned from examining cumulative effects, which may be distinct from over-time models described subsequently. Based on previous research exploring general responsiveness, intimacy, and sleep (e.g., Selcuk et al., 2017; Troxel et al., 2007) and known consequences of loneliness on sleep (e.g., Hawkley et al., 2010; Segrin & Burke, 2015), we hypothesized that receiving greater capitalization support over the 32-day study would predict greater intimacy, less loneliness, and thus better sleep. Further, we hypothesized that capitalization support would predict sleep via

loneliness and intimacy. Previous research has also revealed the co-regulation of general responsiveness, relationship satisfaction, and sleep within romantic relationships (Butler & Randall, 2013). As such, we anticipated observing partner effects for capitalization support, intimacy and loneliness on sleep over the 32-day study.

To further explore relationships revealed at the aggregate level, we examined within-person and within-dyad associations among capitalization support, loneliness, intimacy, and sleep via a series of lagged actor-partner interdependence models (APIM; Kashy & Donnellan, 2012). The over-time APIM is important for the current study, as capitalization support, loneliness, and intimacy may fluctuate as a function of daily interactions with romantic partners, and thus influence sleep *within-person*, over time. Importantly, the APIM over-time approach allows for the examination of *within-person* stability (actor effects) and *cross-partner* influence (partner effects). In the current study, the following research questions were explored: Do deviations from one's average levels of capitalization support, loneliness, and intimacy relate to one's subsequent sleep (within-person stability, actor effects)? Do deviations in an intimate partner's level of capitalization support, loneliness, and intimacy from his/her average levels predict one's own sleep (cross-partner influence, partner effects)?

We expected that individuals with greater capitalization support, intimacy, and less loneliness, would subsequently experience greater sleep quality and sleep duration, and report having a less difficult time falling asleep (actor effects). We also expected that on days with less capitalization support, individuals would report greater loneliness and less intimacy (actor effects). Further, we anticipated that changes in daytime capitalization support, loneliness and intimacy would predict partner sleep (partner effects), though we did not specify a directional effect.

Methods

Study Overview

Data were collected as part of the Study for Employment Retention of Veterans (SERVe; Hammer, Wan, Brockwood, Mohr, & Carlson, 2017). This sample is diverse in terms of military background and experience with varied deployment history (see Hammer et al., 2017). Because the sample comprises mostly separated service members, with fewer active reservists (18%), and most participants have deployed (88.3%), we refer to the group collectively as veterans.

Veterans who agreed to participate in the larger SERVe project were invited to participate in the Daily Family Study (DFS) with spouses or cohabiting partners. The DFS was a 32-day web-based diary survey that took place *prior* to a larger intervention study. By design, dyads in the current study are distinguished based on the employed veteran initially recruited for the larger SERVe project, and their romantic partners who agreed to participate in the DFS. Thus, we used veteran/spouse as the distinguishing variable and controlled for gender in APIM analyses, consistent with other dyadic research on military couples (e.g., Blow et al., 2013). Our study comprises heterosexual couples, in which the veterans are mostly men (83.7%) and accordingly spouses are mostly women. The gender distribution of our sample corresponds closely with the gender distribution of the U.S. Department of Defense in which 84.5% of service members are men (U.S. Department of Defense, 2015).

Sample

Of the 509 SERVe veterans, 395 met eligibility criteria for the DFS (i.e., married or cohabiting with a romantic partner for at least six months). Eligible couples included dyad members wherein both veteran and spouse completed the baseline surveys; a total of 260 matched couples were eligible for the DFS. Of those, 191 veterans and 188 spouses consented

and enrolled in the DFS, resulting in 173 matched dyads. Nine couples completed a pilot version of the daily survey that did not include the present study variables and three couples responded in non-matching reporting windows (see procedure below). Thus, the analysis sample for the present study comprises 159 dyads. Most of the couples in this sample were married or in a civil union (n=145; 91.2%), leading us to refer to all partners of veterans in the sample as "spouses" for simplicity in reporting. On average, couples reported being together for 11.90 years (SD= 8.59). The majority of veterans and spouses in the current study were Caucasian (83%; see supplemental materials for an extensive overview of sample demographics).

DFS Procedure

Daily surveys were administered online via a secure email link, once daily for 32-days; each survey took 5-10 minutes to complete. Participants were required to complete the survey between 5:00 PM and 11:00 PM (after work but before bedtime). A small number of veteran employees (18%) did not have regular work hours (i.e., shift workers). To accommodate a shiftwork schedule, we created an alternate shift survey, wherein veteran employees (and their spouses) reported each morning from 5:00 AM to 11:00 AM. Dyad members were asked to complete their surveys independently and to refrain from discussing survey responses. On average, participants completed 23.88 survey days (of a possible 32) for a total of 7,916 survey-day observations, resulting in an average compliance of 78%. Veterans and their spouses could each earn up to $90 for their continued participation in the daily study. All research activities in the current study were approved by an Institutional Review Board and the U.S. Army Medical Research and Material Command, Human Research Protection Office.

Daily Measures

Sleep. At each survey time point, participants responded to three items adapted from the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989), probing daily sleep quality ("How would you rate last night's sleep quality overall?"; 1-Very bad to 4-Very good), sleep duration ("How many hours did you sleep last night?"; reported in hours and minutes), and difficulty falling asleep ("Did you have a hard time getting to sleep when you went to bed last night ('yesterday' for alternate shift)?"; 0-No, 1-Yes; adapted from insomnia symptoms on the PSQI). Daily sleep questions asked about "last night's" sleep. Previous research has similarly measured daily sleep via single items (e.g., Lee et al., 2018; Sin et al., 2017). For aggregated APIMeM analyses, sleep quality and duration were averaged within individuals over the 32-day study. Days on which participants indicated having a difficult time falling asleep were summed across the 32-day study and divided by the number of completed survey days. As such, values on aggregated "difficulty falling asleep" item represent the number of survey days in which participants reported sleep difficulty at night (in the past 24 hours for alternate shift participants), relative to how many survey days s/he completed.

Perceived Responsiveness to Capitalization Attempts (Capitalization Support). The 4-item Perceived Responsiveness to Capitalization Attempt Scale (PRCA; Gable et al., 2004) was used to assess capitalization support. On days when they reported sharing a positive event with their romantic partner, participants responded to items describing their partner's response to their disclosure (1-Strongly disagree, 5-Strongly agree). The scale assesses a variety of responses, ranging from active-constructive (e.g., "My spouse/partner reacted enthusiastically to this event"), to active–destructive (e.g., "My spouse/partner pointed out the potential problems to this event."). Each item in this 4-item scale represents a distinct category of responsiveness.

Given conventions delineated by Bollen and Lennox (1991) regarding indicators as causes (versus effects) of a latent construct, it was not appropriate to test for internal consistency of these four items. Following Gable et al.'s (2004) instructions, a single composite capitalization score was created by subtracting subscale composites from the active– constructive scores; higher scores indicate more active–constructive responses. For non-sharing days, capitalization support was entered as missing data. Capitalization support (CS) was averaged within-person over the 32-day study for aggregate analyses.

Loneliness. Loneliness was examined using the 3-item Brief Loneliness Scale (Hughes, Waite, Hawkley, & Cacioppo, 2004; $\alpha = .74$), assessing feelings of being left out, isolation, and a lack of companionship (1-Not at all, 3-Extremely). Scale items were summed to obtain a total score with higher total scores indicating more loneliness. Aggregated loneliness over the 32-day study was computed by averaging loneliness scores within-person.

Intimacy. Intimacy was assessed using a single-item ("How close did you feel to your partner over the lasts 24 hours?"; adapted from Laurenceau et al., 2005; 1-Not at all close, 5-Extremely close). Higher scores indicated greater intimacy. Intimacy was aggregated for APIMeM analyses by averaging intimacy scores within-person over the 32-day study.

Baseline Measures

Demographic information and covariates. A baseline survey collected demographic information (i.e., age, race, gender, relationship length, etc.). Demographic control variables included gender, veteran's deployment status, and relationship length (years).

The Post-Traumatic Stress Symptoms (PTSS) covariate was assessed in the veteran baseline survey via the Post-Traumatic Stress Checklist (Bliese et al., 2008; $\alpha = .92$). Participants indicated whether they had been bothered by a series of experiences over the last 30 days (e.g.,

"Repeated disturbing memories, thoughts, or images of the stressful experience"; 1-Not at all, 5-Extremely), with higher scores indicate greater PTSS. Veteran and spouse baseline surveys also included a 6-item measure probing the occurrence of general psychological distress over the past month (e.g., "How often do you feel worthless?"; 1- None of the time; 4- Most of the time; Kessler et al., 2002). Higher composite scores indicate greater emotional distress.

Data Analytic Strategy

Actor-partner models were deemed appropriate for the current data, as they control for nonindependence among dyad members' scores on key study outcomes (see Supple. Materials for tests of nonindependence). Our first set of analyses was based on the APIMeM, wherein we examined the indirect effects of capitalization support on sleep, via loneliness and intimacy, aggregated over the 32-day study (Ledermann et al., 2011; Figure 1.0). Consistent with other daily studies (e.g., Mohr et al., 2005), data from participants who provided at least seven days of surveys were retained for aggregated analyses (N=136 dyads in the current study; 84% of the total number of days). APIMeM models were tested via structural equation modeling (Mplus version 5.1; Muthén & Muthén, 2008); proposed indirect effects were examined via bootstrapped confidence intervals.

In addition, we tested an over-time lagged APIM model (Kenny, Kashy, & Cook, 2006), wherein we predicted daily sleep from daytime capitalization support, intimacy, and loneliness, controlling for previous day sleep. Within-day associations among capitalization support, intimacy, and loneliness were tested via the standard APIM over-time model. Specifically, we predicted each dyad members' sleep outcomes from his/her lagged daytime capitalization support, loneliness, and intimacy, and previous day sleep, as well as his/her *spouse's* capitalization support, loneliness, and intimacy. Lagged and standard over-time models were

tested as two-level models with separate intercepts for veterans and spouses, with daily reports (Level 1) nested within couples (Level 2). Intercepts and slopes were specified as random; actor and partner slopes were fixed if the model did not converge, or if variance was not significant ($p < .05$). Random effects were initially allowed to covary, but due to issues with model convergence these covariances were removed for final analyses. To account for similarity in observations closer together in time (i.e., days closer together), we specified an autoregressive structure for residual correlations. Key predictor variables were centered on the grand-mean and lagged to enable the prediction of subsequent sleep. Over-time APIM models were tested via multi-level modeling (mixed models; SPSS 22.0), using maximum likelihood estimation. Models predicting difficulty falling asleep (measured on a dichotomous scale) were tested via generalized linear mixed models in SPSS, with coefficients representing the probability of reporting having a difficult time falling asleep on a given night (0-no, 1-yes). Over-time indirect effects of daily loneliness and intimacy were tested via the Monte Carlo Method for Multilevel Mediation (\Preacher & Selig, 2012), which estimates confidence intervals (95% CI, 20,000 repetitions) for the distribution of paths *a* and *b*.

Correlations between demographic control variables, loneliness, intimacy, and sleep were examined in preliminary exploratory analyses. Variables with p-values less than .05 of theoretical relevance to the current study were included as covariates in aggregated and over-time actor-partner models (see Supple. Materials for covariate testing). To account for alternative survey response schedules for regular versus shift work couples (18% of sample were alternate shift), shift-work status was considered as a control variable in analyses. Results did not change with the inclusion of shift work as a covariate. Exploratory analyses tested hypotheses using only

dyads on a regular work schedule (N = 133 dyads); results were identical to those derived from the whole sample (N = 159 dyads). Results reported here include data from 159 dyads.

Results

Aggregated Actor-Partner Interdependence Mediation Model

Table 1.0 provides information on sample characteristics, as well as within-partner, within-spouse, and inter-partner bivariate correlations. Aggregated actor and partner effects of capitalization support, loneliness, and intimacy on sleep outcomes are reported in Table 2.0. All models controlled for relationship length, veteran deployment history, veteran PTSS, gender, and psychological distress.

Sleep Quality. In models predicting sleep quality (supplemental Figure 1.0), actor effects were revealed showing that receipt of CS over the 32-day study was related to less loneliness ($b_{veterans}$= -0.41, $p < .001$; $b_{spouses}$ = -0.22, $p = .039$). Spouses reporting greater CS ($b = 0.07$, $p = .030$) and less loneliness (b = -0.10, $p = .001$) reported greater sleep quality over the 32-day study. Partner effects were also revealed for veteran CS on spouse loneliness ($b = -0.48$, $p <.001$); across the 32-day study, greater CS experienced by veterans related to less loneliness among spouses. Further, CS predicted greater intimacy ($b_{veterans} = 0.36$, $p < .001$; $b_{spouses} = 0.22$, $p = .001$); intimacy was in turn predictive of greater sleep quality ($b_{veterans} = 0.07$, $p = .052$; ($b_{spouses} = 0.17$, $p < .001$). Partner effects were revealed for veteran CS predicting spouse intimacy ($b = 0.22$, $p = .002$), and spouse sleep quality ($b = -0.08$, $p = .032$); greater CS among veterans was related to greater intimacy though, surprisingly, lower sleep quality among spouses.

Actor indirect effects were revealed for CS on sleep quality, via intimacy, among veterans ($a_1b_1 = .026$, BC 95% CI: [.002, .061]) and spouses ($a_1b_1 = .037$, BC 95% CI: [.012, .074]). Partner indirect effects were revealed for veteran CS on spouse sleep quality, via spouse

loneliness (a_1b_1 = .049, BC 95% CI: [.013, .115]), and spouse intimacy (a_1b_1 = .037, BC 95% CI: [.010, .083]; supplemental Table 1.0). As loneliness and intimacy were moderately related (r = -.43), a series of multiple indirect effect models were also estimated to examine whether patterns of actor and partner indirect effects emerged with both loneliness and intimacy in the model. Actor and partner indirect effects for loneliness and intimacy on sleep quality remained significant within a multiple indirect effect model.

Sleep Duration. In models predicting sleep duration, similar actor effects emerged for CS on loneliness and intimacy and partner effects of veteran CS on spouse loneliness and intimacy (Table 2.0). Among spouses, loneliness predicted fewer hours of sleep over the 32-day study (b = -0.21, p = .001). Significant actor indirect effects emerged for spouse CS on sleep duration, via loneliness (a_1b_1 = .051, BC 95% CI: [.004, .114]; supplemental Table 1.0). As demonstrated with sleep quality, veteran CS predicted spouse sleep duration, via spouse loneliness (a_1b_1 = .102, BC 95% CI: [.024, .253]; partner indirect effect). Over the 32-day study, greater CS among veterans related to less loneliness, which in turn related to more sleep among spouses. These indirect effects emerged in a multiple indirect effect model.

Sleep Difficulty. Models predicting difficulty falling asleep (i.e, sleep difficulty) elucidated similar actor and partner effects for CS on loneliness and intimacy, and similar effects of CS, intimacy, and loneliness on sleep. Loneliness related to greater sleep difficulty ($b_{veterans}$ = 0.06, p = .042; $b_{spouses}$ = 0.06, p = .006). Actor indirect effects revealed that CS predicted sleep difficulty, via loneliness, among veterans (a_1b_1 = -.02, BC 95% CI: [-.051, -.003]) and spouses (a_1b_1 = -.01, BC 95% CI: [-.036, -.001]); over the 32-day study veterans with greater CS experienced fewer days on which they had a difficult time falling asleep because of their lower loneliness. An additional partner indirect effect was revealed for veteran CS on spouse sleep, via

spouse loneliness (a_1b_1 = -.03, BC 95% CI: [-.064, -.003]). A model examining multiple indirect effects revealed similar actor indirect effects for CS on sleep difficulty, via loneliness, for spouses and a veteran-spouse partner indirect effect. The veteran actor indirect effect was no longer significant upon the inclusion of loneliness and intimacy in the same model.

APIM Over-time Results

To further explore patterns of actor and partner effects revealed at the aggregate level, we tested a series of lagged actor-partner models wherein daily CS predicted that day's loneliness, intimacy, and subsequent sleep (as reported the following day), controlling for previous day's sleep (Table 3.0, supplemental Figure 2.0-3.0).

Capitalization Support and Sleep. Accounting for covariates, CS did not directly predict subsequent sleep quality or sleep duration for veterans or spouses. However, CS did predict later veteran difficulty falling asleep (b = 0.82, Wald $\chi^2(1) = 5.65$, p =. 017); on days with greater CS, veterans experienced greater subsequent difficulty falling asleep.

Capitalization Support, Loneliness, and Intimacy. There were significant actor effects of CS on loneliness for spouses (b = -0.30, $t(59.81) = -2.31$ p = .018); specifically, on days when spouses experienced greater CS from partners they reported lower levels of loneliness. Greater CS was also associated with greater daily intimacy (actor effects; $b_{veterans}$ = 0.20, $t(75.82) = 2.32$, p = .012; $b_{spouses}$ = 0.20, $t(55.10) = 2.86$, p = .008). Partner effects emerged for veteran CS on spouse reports of intimacy (b = 0.26, $t(76.44) = 3.35$, p = .003); on days when veterans reported receiving greater CS, spouses reported greater intimacy (Table 3.0).

Loneliness, Intimacy, and Sleep Outcomes. Controlling for previous day sleep, daily loneliness significantly predicted later sleep difficulty ($b_{veterans}$ = 0.17, Wald $\chi^2(1) = 27.05$, $p <$ .001, $b_{spouses}$ = 0.16, Wald $\chi^2(1) = 27.99$, $p < .001$). Specifically, a unit increase in loneliness on a

given day increased the odds of having a difficult time falling asleep by 1.18 for veterans and 1.17 for spouses. Partner effects were revealed for veteran daytime loneliness on spouse sleep quality (b = 0.02, t(3652.87) = 2.20, p = .028); on days veterans reported less loneliness, their spouses reported poorer subsequent sleep quality. There were significant actor effects of daily intimacy on subsequent sleep quality (b = 0.07, t(2149.23) = 4.19, p < .001); and sleep duration (b = 0.07, t(2948.37) = 2.21, p = .027) among veterans; greater intimacy on a given day predicted better and more sleep. Additionally, actor effects emerged for intimacy on difficulty falling asleep among spouses (b = -0.13, Wald $\chi^2(1)$ = 6.84, p = .009). A one unit increase in intimacy related to lower odds of having a difficult time falling asleep by about .88 for spouses.

Over-time Actor-Partner Indirect Effects. Results revealed that an actor indirect effect of capitalization support on sleep difficulty, via intimacy, differed significantly from zero in spouses (95% CI: [-.664, -.015]); among spouses, daily CS predicted less sleep difficulty, via increased intimacy. Further, a partner indirect effect for veteran CS on spouse sleep difficulty, via spouse intimacy, was also significantly different from zero (95% CI: [-.820, -.018]. Veteran perceived CS predicted greater intimacy among spouses, who were thus less likely to experience difficulty falling asleep that night.

Discussion

We sought to expand existing research on the sleep-promoting effects of general perceived responsiveness by examining how daily responsiveness to capitalization (i.e., capitalization support) relates to subsequent sleep. We were interested in exploring this relationship maintenance process within a sample of military veterans and romantic partners, given the well-known challenges of military couples in regards to relationship functioning (Fillo et al., 2017). Additionally, we expand on existing research by examining intimacy and loneliness

as explanatory mechanisms for responsiveness-sleep associations at the aggregate level. Previous dyadic studies of loneliness and sleep have been cross-sectional and utilized college student samples. Results of our over-time, actor-partner models provide a more nuanced insight into how relationship processes such as support-provision unfold within dyads over time.

Across multiple levels of analysis, capitalization support related to higher levels of intimacy, among veterans and spouses. Feelings of intimacy reported by veterans and spouses also predicted sleep, as originally hypothesized, at aggregate and daily levels. The relation between perceived partner responsiveness (capitalization support in particular) and intimacy is well-documented (Gable & Reis, 2010; Reis & Shaver, 1988). Responsiveness to the sharing of good news helps strengthen interpersonal relationships and improve relationship satisfaction and intimacy (Gable et al., 2004). Further examination of indirect actor effects (aggregated APIMeM) reveal intimacy as an intrapersonal mechanism between capitalization support and sleep quality for veterans and spouses. This indirect effect is supported by literature suggesting that relational well-being, such as a sense of security and belonging in one's close relationships, promotes healthier sleep (Troxel et al., 2007; Kane et al., 2014). Results of the current study reveal loneliness as an additional mechanism through which capitalization support (or a perceived lack of support) predicts sleep. Specifically, we found that capitalization support, when aggregated over the 32-day study, related to less loneliness, which in turn related to better sleep (less difficulty falling asleep, greater sleep quality and sleep duration). Previous work has considered the dyadic effects of loneliness on sleep, revealing that loneliness predicts poor sleep quality among individuals and their romantic partners (Segrin & Burke, 2015). To our knowledge, this was the first study to examine aggregate and daily associations among capitalization support, loneliness, and sleep.

Results of aggregated and within-person indirect effect models revealed associations consistent with existing theories of close relationships and health. In particular, our results support Troxel et al. (2007) and Pietromonaco and Collins (2017) models, which propose that relationship quality impacts intrapersonal, psychological processes, which in turn relate to health over time. Further, partner effects revealed in the current study corroborate existing work on sleep as a dyadic process, and support well-established benefits of positive event disclosure and capitalization support for individual *and* partner well-being (e.g., Gable et al., 2004). Our directional interpretation of the effects observed in the current study is bolstered by the examination of over-time indirect effects. Yet, we urge caution in interpreting these indirect over-time relationships, which we describe as preliminary, as a well-validated procedure for testing these effects within the over-time actor-partner model (with non-linear outcomes) is not yet available. We urge future research to replicate these findings, with the goal of better establishing temporal precedence. Further, it should be acknowledged that these relationships are correlational in nature, and theory specifies bidirectional effects between sleep and relationships. This concern is partially assuaged by controlling for previous day's sleep. Future research should continue exploring sleep as a dyadic process, and how links among capitalization support and sleep impact individual and partner health over time.

Interestingly, across multiple levels of analysis, we found little evidence for a direct association among capitalization support and sleep. These findings are consistent with previous literature suggesting an indirect link between relationship functioning and health via intrapersonal, psychological mechanisms (e.g., Pietromonaco & Collins, 2017; Troxel et al., 2007). We argue that the dearth of direct associations among capitalization support and sleep in the current study does not undercut this potential association, but rather leave room for research

to continue exploring mechanisms through which capitalization support may impact sleep, both within-day and aggregated over-time. Indeed, results of actor-partner indirect effects in the current study (aggregate and over-time) provide preliminary insight into the role of intrapersonal mechanisms in capitalization-sleep associations.

Overall, lagged actor-partner models revealed actor and partner effects at the daily level consistent with those revealed in the aggregate. For example, in aggregated and over-time analyses, capitalization support related to greater intimacy (veterans and spouses), and less loneliness (spouses). Further, veteran loneliness related to greater difficulty falling asleep, and veteran intimacy related to greater sleep quality. Interestingly, one partner effect was consistent across aggregated and over-time dyadic models: greater capitalization support among veterans related to greater spouse intimacy (partner effect). Further, across all analyses, regardless of predictor or outcome, partner effects were largely directed from veterans to spouses. While we acknowledge this pattern of partner effects is preliminary, these results are consistent with previous research exploring gender differences in support provision (Pietromonaco, Uchino, & Schetter, 2013), as the majority of spouses were women and the majority of veterans were men. Future work should consider replicating these partner effects within military couples that oversample female veterans, to allow for formal gender testing.

Similarities across direct effects revealed in aggregate and daily analyses demonstrate how the processes examined in the current study are similar in how they unfold day-to-day, as well as on average over time. Yet, it is important to examine both aggregated and over-time models to fully understand actor and partner effects of responsiveness on sleep, as they each address important but distinct questions. Whereas aggregated models demonstrate cumulative effects of responsiveness on sleep, over-time actor-partner effects reveal the fluctuation in these

associations across time. This distinctiveness is highlighted in differences we observed among actor and partner effects within aggregated and over-time actor-partner models. For example, whereas veteran capitalization support predicted less veteran loneliness at the aggregate level, this actor effect did not emerge in our daily analyses. Similarly, spouse loneliness predicted aggregated sleep duration, yet only veteran intimacy predicted sleep duration at the daily level. An additional difference was revealed in a partner effect from over-time analyses, wherein daily loneliness among veterans related to spouse sleep quality; less loneliness among veterans related to poorer sleep among spouses. This effect did not emerge in aggregated APIMeM models.

Whereas veteran loneliness predicted spouse sleep quality (less loneliness among veterans related to poorer sleep among spouses) only at the daily level, a similar, unexpected partner effect emerged at the aggregate level: over the 32-day study, veteran perceived capitalization support related to *poorer* sleep quality among spouses. Though these partner effects were in opposite directions than originally predicted, they may be suggestive of support fatigue among spouses. Recent evidence suggests that providing support may deplete cognitive/behavioral resources among support providers (Gosnell & Gable, 2017). To explore this pattern of partner effects, we conducted a post hoc test for the direct effect of veteran capitalization support on spouse sleep quality; this partner effect was no longer significant when intimacy and loneliness (mechanisms) were excluded. We feel these results do not so much undercut the possibility of support fatigue, but rather suggest some other unidentified mechanisms which may be at play. Similarly, an actor effect revealed that greater daily capitalization support related to *greater* sleep difficulty among veterans. This effect may be similarly due to unidentified mechanisms, such as high arousal positive affectivity (e.g., excitement, confidence) which may occur as a result of celebrating positive news with one's

partner. Research should continue to consider the benefits and consequences of support provision and receipt within military relationships, exploring underlying mechanisms for these effects.

Study Contributions and Limitations

Study strengths include the study of relationship processes in the context of sleep using a longitudinal dyadic design, among a sample of military veterans and their spouses. Previous work suggests that perceived responsiveness effects sleep and health more generally via the downregulation of stress and anxiety. Our results corroborate this process in revealing loneliness as an additional explanatory mechanism, particularly in the context of capitalization support. We also demonstrate that capitalization support may influence sleep via an upward spiral of positivity via intimacy. McHale, King, and Buxton (2017) call for research to explore and identify novel targets of prevention and intervention among groups at risk for sleep problems, such as military-connected couples. Capitalization and perceived capitalization support may be avenues through which military couples can overcome the challenges and stressors of reintegration. Results of the current study provide insight into potential points for intervention among military couples, who may experience positivity deficits within their relationships. That is, couples could practice providing more active constructive responses to their partners' disclosures, and perhaps more actively seek opportunities to capitalize and celebrate positive events with one another.

Despite the strengths and contributions noted above, this study has limitations. Of note is the measurement of study constructs via self-report, which creates potential concerns about measurement overlap. Yet, our methods helped to limit the bias in self-reports by measuring capitalization support, loneliness and intimacy on a separate reporting day from sleep. We encourage additional research to replicate our results using objective sleep measures (e.g.,

actigraphy). Of additional concern is the confounding of gender with the distinguishing variable of veteran military status. Though we control for gender, we are not able to examine potential gender effects independent of military status. However, previous research has not revealed strong evidence for gender differences in capitalization processes (e.g, Pagani, Donato, & Iafrate, 2013). Further, this study was unique in examining responsiveness and sleep in a sample of separated active duty service members and reservists. Yet, our results are largely consistent with the findings from the civilian literature. This is not surprising, as most of our sample was separated from military service for about 6 years and were recruited from a civilian workplace context. We encourage additional research with a sample of civilians and including veterans with more diverse backgrounds to fully assess how military status may moderate associations under investigation here.

Conclusion

In sum, using daily dyadic methodology, this investigation examined associations among capitalization support, intimacy, loneliness, and sleep. Importantly, the current study built on existing research demonstrating links among responsiveness and health by examining associations among perceived responsiveness to specific capitalization attempts over time. Results provide unique insight into the more distal health benefits of capitalization support in relation to sleep. This study also afforded an initial look at an important positive relationship process in the context of military relationships; such processes may function to improve the individual health of veterans and their partners as well as the health of the relationship over time.

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Table 1.0. Within-Veteran, Within-Spouse, and Interpartner Correlations among study variables.

					Veteran						
Spouse	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. CS	**.12**	-.28**	.40**	.29**	-.16†	.08	.18†	.03	.12	-.13	-.21*
2. Lonely	-.34**	**.42****	-.40**	-.32**	.43**	-.28**	.00	-.07	-.07	.41***	.44**
3. Intimacy	.37**	-.46**	**.60****	.38**	-.19**	.25**	.16†	-.05	-.05	-.10	-.29***
4. SlpQual.	.24**	-.36**	.38**	**.21****	-.57**	.54**	.14	.16*	-.11	-.52***	-.56**
5. SlpDiff.	-.17*	.35**	-.27**	-.44**	**.10**	-.39**	-.03	-.11	-.09	.42***	.48**
6. Slp Dur.	.09	-.22**	.22**	.50**	-.36**	**.31****	.10	.06	.03	-.29***	-.34**
7. Gender	-.08	.00	-.12	.08	-.02	.06	**-.97****	-.15†	-.21*	-.09	-.08
8. RltsLen.	-.07	-.05	-.12	.09	-.05	-.01	.12	**.99****	.00	-.21**	-.16*
9. vDeploy	-.00	.04	-.12	-.06	-.00	-.11	.22**	.00	**1.00****	.16*	.11
10. vPTSS	-.11	.25**	-.04	-.08	.06	-.13	.08	-.21**	.16*	**1.00****	.72**
11. PsyDist	-.28**	.55**	-.30**	-.37**	.42**	-.27**	.00	-.18*	.07	.18*	**.21****

Descriptive Statistics

Mean (SD)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Veteran	.06	4.02	3.36	2.73	.25	6.58	.13	12.07	.85	1.90	1.79
	(1.11)	(1.58)	(.92)	(.39)	(.27)	(.93)	(.34)	(8.59)	(.36)	(1.02)	(.68)
Spouse	-.05	3.93	3.28	2.77	.25	6.96	.88	11.74	.85	1.90	1.67
	(1.21)	(1.95)	(.93)	(.46)	(.26)	(1.00)	(.33)	(8.61)	(.36)	(1.02)	(.64)

Note: CS = Capitalization Support; SlpQual = Sleep Quality; SlpDiff= Sleep Difficulty; SlpDur = Sleep Duration; RltsLen = Relationship Length; Deploy = Deployment Status; PTSS = Post-Traumatic Stress Symptoms; PsyDist = Psychological Distress; interpartner correlations in bold, within-veteran correlations presented above the diagonal, within-spouse correlations presented below diagonal; for sleep quality/duration/difficulty, higher scores = greater quality/duration/difficulty. †$p < .10$; *$p < .05$; **$p \leq .01$.

Table 2.0. Actor and partner effects for specific pathways of aggregated APIMeM models (unstandardized estimates).

	VSleep		SpSleep		VLonely		SpLonely		*VIntimacy*		*SpIntimacy*	
Predictor	*b*	*SE*	*b*	*SE*	*b*	*SE*	*b*	*SE*	*b*	*SE*	*b*	*SE*
Sleep Quality												
V CS	0.04 *(0.01)*	0.03 *(0.03)*	-.06 *(**-.08***)*	0.04 *(0.04)*	**-0.41****	0.07	**-0.48****	0.12	**0.36****	0.07	**0.22****	0.07
SP CS	0.01 *(0.01)*	0.03 *(0.02)*	**.07*** *(.06†)*	0.03 *(0.03)*	-0.01	0.08	**-0.22***	0.11	0.09	0.06	**0.22****	0.06
V Lonely	0.02	0.03	-0.03	0.04	--	--	--	--	--	--	--	--
SP Lonely	0.01	0.02	**-0.10****	0.03	--	--	--	--	--	--	--	--
V Intimacy	0.07†	0.04	0.07	0.05	--	--	--	--	--	--	--	--
SP Intimacy	0.03	0.04	**0.17****	0.05	--	--	--	--	--	--	--	--
Sleep Duration												
V CS	0.00 *(-0.03)*	0.07 *(0.08)*	0.10 *(0.08)*	0.09 *(0.10)*	**-0.40****	0.08	**-.41****	0.14	**0.36****	0.07	**0.22****	0.07
SP CS	-0.02 *(0.01)*	0.06 *(0.06)*	0.02 *(0.02)*	0.07 *(0.07)*	-0.02	0.08	**-0.25***	0.11	0.09	0.06	**0.22****	0.06
V Lonely	0.01	0.08	0.03	0.09	--	--	--	--	--	--	--	--
SP Lonely	-0.03	0.06	**-0.21****	0.06	--	--	--	--	--	--	--	--
V Intimacy	*0.11*	*0.10*	*0.04*	*0.11*	--	--	--	--	--	--	--	--
SP Intimacy	*-0.05*	*0.10*	*0.17*	*0.11*	--	--	--	--	--	--	--	--
Sleep Difficulty												
V CS	-0.01 *(-0.03)*	0.02 *(0.03)*	0.02 *(0.02)*	0.02 *(0.02)*	**-0.41****	0.10	**-0.46****	0.12	**0.36****	0.07	**0.22****	0.07
SP CS	0.02 *(0.03)*	0.02 *(0.02)*	-0.01*(-0.02)*	0.02 *(0.02)*	-0.00	0.09	**-0.23***	0.11	0.08	0.08	**0.21****	0.07
V Lonely	**0.06****	0.03	0.01	0.02	--	--	--	--	--	--	--	--
SP Lonely	-0.02	0.02	**0.06****	0.02	--	--	--	--	--	--	--	--
V Intimacy	*0.03*	*0.03*	*-0.01*	*0.03*	--	--	--	--	--	--	--	--
SP Intimacy	*-0.05*†	*0.03*	*-0.04*	*0.04*	--	--	--	--	--	--	--	--

Note: V= veteran; SP = spouse; CS = cap support; $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}\leq .01$; italicized coefficients = intimacy indirect effect models.

Table 3.0. Multilevel regression coefficients predicting sleep, loneliness, and intimacy.

	Vet Sleep Quality		**Sp Sleep Quality**		**Vet Sleep Difficulty***		**Sp Sleep Difficulty***		**Vet Sleep Duration**		**Sp Sleep Duration**	
Predictor	*b*	*SE*	*b*	*SE*	*b*	*SE*	*b*	*SE*	*b*	*SE*	*b*	*SE*
Vet CS	-0.04	0.07	-0.01	0.07	**0.82****	0.35	0.06	0.40	-0.05	0.13	0.06	0.12
SP CS	0.08	0.07	-0.02	0.07	0.47	0.54	-0.18	0.30	0.15	0.13	0.02	0.13
Vet Lonely	0.01	0.01	**0.02***	0.01	**0.17****	0.03	-0.06†	0.04	-0.03	0.02	0.02	0.02
Sp Lonely	-0.00	0.01	-0.00	0.01	0-.05	0.03	**0.16****	0.03	-0.02	0.02	-0.02	0.02
Vet Intimacy	**0.07****	0.02	0.00	0.02	-0.09†	0.05	-0.05	0.05	**0.08****	0.03	0.06	0.03
SP Intimacy	-0.02	0.02	0.03	0.02	-0.00	0.05	**-0.13****	0.05	0.02	0.03	0.03	0.03

	Vet Lonely		**Sp Lonely**		***Vet Intimacy***		***Sp Intimacy***	
	b	*SE*	*b*	*SE*	*b*	*SE*	*B*	*SE*
Vet CS	-0.02	0.13	-0.12	0.14	**0.20***	0.08	**0.26****	0.08
SP CS	0.14	0.12	**-0.30***	0.13	0.06	0.07	**0.20****	0.07

Note: Vet= veteran; SP = spouse; CS = capitalization support; table reports unstandardized coefficients; *coefficients for sleep difficulty represent log odds ratio of indicating having a difficult time falling asleep on a given night; coefficients in lower half of the table derived from models predicting loneliness and intimacy from capitalization support; $^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p \leq .01$.