Relationship and sexual satisfaction: A developmental perspective on bidirectionality

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Abstract

Researchers have investigated the directionality between relationship and sexual satisfaction; however, there remains no definitive conclusion. Previous longitudinal studies have not conceptualized relationship and sexual satisfaction as systematic developmental processes and have focused on predicting scores at later time points. Instead, researchers should be concerned with understanding how relationship and sexual satisfaction change together over time. The objective of this study was to use longitudinal data from midlife American marriages to test the directionality of the association between relationship satisfaction and sexual satisfaction. Multivariate latent growth curve modeling of 1,456 midlife Americans married for 20 years from the Midlife in the United States study was used to compare directionality models. Findings support that long-term, stable marriages of midlife Americans at the sample level were characterized by a linear increase in relationship satisfaction over 20 years and a linear decline in sexual satisfaction during the same time frame. A co-change model, wherein relationship and sexual satisfaction changed together over time, fit the data best. Trajectory correlations showed that changes in relationship and sexual satisfaction were strongly interconnected. High initial levels of sexual satisfaction protected against declines in relationship satisfaction over 20 years. Results support that relationship and sexual satisfaction change together over time and highlight that the longitudinal association between these outcomes is dynamic rather than static.

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Scholars investigating sexual and romantic relationships research have historically operated within two separate traditions with limited overlap (Diamond, 2013; Impett, Muise, & Peragine, 2014). Perhaps as a result, the nature of the connection between relationship and sexual satisfaction has remained unclear (Byers, 2005; McNulty, Wenner, & Fisher, 2016). Different theoretical perspectives have proposed that sexual satisfaction influences relationship satisfaction (Thibaut & Kelley, 1959), that relationship satisfaction influences sexual satisfaction (Byers, 2005), and that they are connected bidirectionally (McNulty et al., 2016). Additionally, it is possible that the association between relationship and sexual satisfaction depends on other variables (e.g., Byers, 2005). The current study presents empirical evidence for the bidirectional longitudinal association between relationship and sexual satisfaction.

The construct of relationship satisfaction has been central to relationship research and applied practice as it is often used to gauge the effectiveness of therapy and other treatments (e.g., Wood, Crane, Schaalje, & Law, 2005). Likewise, sexual satisfaction has increasingly been used as a guide and measure for the effectiveness of clinical interventions (McClelland, 2011). Notwithstanding limitations to using subjective satisfaction levels as the sole gauges for relationship and sexual therapy outcomes (e.g., McClelland, 2011), the immense attention that has been paid to these constructs underscores the importance of relationship and sexual satisfaction to their respective fields. But in long-term relationships, the relational and sexual elements, and the degree to which individuals are satisfied in these domains, are not in isolation from one another. Models such as the interpersonal exchange model of sexual satisfaction (Lawrance & Byers, 1995) have suggested that nonsexual variables, such as relationship satisfaction, are critical components contributing to sexual satisfaction by altering the cost/rewards ratio within the relationship. In contrast, interdependence theory (Thibaut & Kelley, 1959) suggests that sexual activity is an interaction that may have costs or benefits to the overall relationship (Arriaga, 2013), thus conceptualizing sexual satisfaction as affecting relationship satisfaction by contributing to this cost/benefit equilibrium. The theories researchers choose to take up have important implications for how their research is structured and for how research questions are tested statistically. In contrast, therapists see relationship and sexual satisfaction as linked in complex and bidirectional ways (Wincze & Carey, 2001).

Research supports the positive cross-sectional association between relationship and sexual satisfaction (Impett et al., 2014; Sprecher & Cate, 2004); however, inferences about directionality are difficult to obtain from such data. Although longitudinal studies can provide answers to questions of directionality between relationship and sexual satisfaction, such studies are few and results have been inconsistent. There is mixed evidence for any directional effect (i.e., Byers, 2005), with some researchers finding evidence for contradictory unidirectional effects (i.e., Cao, Zhou, Fine, Li, & Fang,

2018; Fallis, Rehman, Woody, & Purdon, 2016; Henderson-King & Veroff, 1994; Sprecher, 2002; Vowels & Mark, 2018; Yeh, Lorenz, Wickrama, Conger, & Elder, 2006) and some have identified preliminary evidence for a bidirectional relationship (McNulty et al., 2016). McNulty et al. (2016) tested a bidirectional model and found both that earlier levels of relationship satisfaction predicted later levels of sexual satisfaction and that earlier levels of sexual satisfaction predicted later levels of relationship satisfaction in a sample of new marriages.

Inconsistent results across previous studies are perhaps due to their sole focus on whether earlier levels of relationship or sexual satisfaction predicted subsequent scores on each other over time (through use of longitudinal panel models), promoting a view that relationship and sexual satisfaction are static outcomes that do not continuously change together over time as part of an ongoing developmental relationship process (Karney & Bradbury, 1995a, 1995b).

Developmental perspectives in the relationship and marital literature are commonplace (Fincham, Rogge, & Beach, 2018; Finkel, Simpson, & Eastwick, 2017; Karney & Bradbury, 1995a, 1995b). That relationships continue to exist and evolve over long periods of time is a defining feature separating romantic relationships and marriages from other forms of shorter term social relationships (Duck & Sants, 1983; Finkel et al., 2017). Considering a developmental perspective necessitates the examination of relationships high in longevity, such as midlife marriages. For example, long-term (i.e., 40 years) data from Vaillant and Vaillant's (1993) study have suggested that relationship satisfaction may stabilize in the middle and late years, highlighting the need for research that examines these midlife relationships from the perspective of relationship development. This conceptualization recognizes that individuals in relationships may follow discrete developmental trajectories; as such understanding the interindividual differences in trajectories is critical to understanding relationships (Karney & Bradbury, 1995a).

Conversely, sexuality research has lacked theoretical underpinnings compared to relationship research (Muise, Maxwell, & Impett, 2018). Although sexuality research has adopted a developmental approach, it is typically focused on change through adolescence and early adulthood (see Tolman & McClelland, 2011, for review). Researchers infrequently take a developmental perspective when considering sexuality beyond early adulthood despite evidence supporting this viewpoint (DeLamater & Hyde, 2004). For instance, research has shown that significant personal events during adulthood such as marriage (Christopher & Sprecher, 2000), childbirth, child caretaking (Ahlborg, Rudeblad, Linnér, & Linton, 2008; Hansson & Ahlborg, 2012), and retirement (Bach, Mortimer, VandeWeerd, & Corvin, 2013) are associated with long-term, systematic changes in sexual behaviors/inactivity, sexual satisfaction, and sexual functioning. Cross-sectional (e.g., Laumann, Paik, & Rosen, 1999) and longitudinal research on sexual satisfaction have shown that it decreases over time in relationships (McNulty et al., 2016; Schmiedeberg & Schröder, 2016), after an increase during the first year of the relationship (Schmiedeberg & Schröder, 2016). These findings suggest that there are identifiable longitudinal trajectories for sexual satisfaction in adult relationships which have not often been the focus of previous research.

Limitations of previous studies

Although previous longitudinal studies have expanded greatly upon the ways in which relationship and sexual satisfaction are associated, these studies are limited in several ways. First, research in this area has been limited due to small samples measured within a relatively narrow time frame, often of new relationships or new marriages, and thus restricts findings to the developmental course of shorter and newer relationships. Narrower time spans may not allow enough time for the underlying co-development process to occur.

Furthermore, previous research has focused on predicting scores (or difference scores as in Sprecher, 2002) at a later time point as evidence for directionality/bidirectionality, effectively ignoring relationship and sexual satisfaction as ongoing developmental processes characterized by interindividual differences in change (Karney & Bradbury, 1995a, 1995b). Scores obtained at these subsequent time points are limited because they do not represent a true end point; the relationship is ongoing and will continue to change over time. When these final or subsequent time points do not coincide with a significant event for the participant related to that outcome (e.g., divorce, onset of marriage, birthing a child, beginning couples' therapy), then there may not be anything useful or note-worthy about ratings from that assessment as an "outcome" (Grimm, Ram, & Estabrook, 2016; Little, 2013). This is compounded by empirical evidence from daily diary studies showing that there are fine grained, day-to-day fluctuations in both sexual (e.g., Day, Muise, Joel, & Impett, 2015; Rubin & Campbell, 2012) and relationship satisfaction (e.g., Laurenceau, Barrett, & Rovine, 2005). By focusing on predicting static relationship outcomes instead of explaining the long-term trajectories of individual change over time, previous studies have perpetuated a static viewpoint of relationships that was the subject of Karney and Bradbury's (1995a, 1995b, 1997) studies. This critique was levied at the restrictive practice of studying solely the associations between initial measurements and final outcomes because this produces only a static snapshot of change over time in marriages that is not attentive to interindividual differences in change (Karney & Bradbury, 1995a).

Overview of the current study

A multivariate latent growth curve modeling (MLGCM) approach can address the conceptual and methodological limitations of prior research. Although some relationships researchers (Arriaga, 2001; Karney & Bradbury, 1995b, 1997, 2000) have rec-ommended, and made frequent use of, univariate growth curve models (i.e., growth models of a single variable over time) with relationship outcomes, a multivariate application (i.e., modeling two or more growth curves simultaneously) has been far less common in both relationships and sexuality research (see Lavner, Karney, & Bradbury, 2014; Mitchell, Beals, & Kaufman, 2006).

This study conceptualized relationship satisfaction and sexual satisfaction as systematic codeveloping processes, and used MLGCM to answer two research questions (RQ) using a large ($N = 1,456$) sample of midlife, married American adults who

participated across three waves of the Midlife in the United States (MIDUS) longitudinal study spanning 20 years:

> **RQ1:** What are the trajectories of relationship satisfaction and sexual satisfaction?
>
> **RQ2:** Which directionality assumption, if any, is supported between relationship and sexual satisfaction?

Method

Participants and procedure

Data from the MIDUS longitudinal study were used for the current investigation. The study consisted of three data collection stages over 20 years with approximately 10 years between data collection phases. MIDUS 1 (Brim et al., 1995–1996), collected in 1995/1996, was a baseline sample consisting of a national probability sample ($n = 3,487$). The national probability sample was sampled from nationally representative working telephone banks in the U.S. using a random-digit-dialing of noninstitutionalized, English-speaking adults between the ages of 25 and 74. For longitudinal follow-up, each living participant was recontacted. MIDUS 2 (Ryff et al., 2004–2006) was conducted in 2004–2006. MIDUS 3 (Ryff et al., 2013–2014) was a third wave, with data collected between 2013 and 2014. In all waves, respondents participated in a phone interview (approximately 30 min in length) and optionally completed self-administered questionnaires. To isolate individuals who were in the same relationship for the entire study, cases were selected based on the following conditions: (1) they reported in MIDUS 1 that they were married (and implicitly that their spouse was still alive) and that this was their first marriage, and (2) they reported that they were still married and still in their first marriage across both MIDUS 2 and MIDUS 3. This reduced the sample to 1,456 individuals who were in their first marriages and remained married to the same person for at least the entire duration of the study (at least 20 years). Following ethics board approval from the University (of Guelph) for secondary data analysis, data were obtained through the Inter-University Consortium for Political and Social Research (data are available through their website).

Sample. There were 747 (51%) men in the sample and 703 (49%) women. The average age of the sample at time 1 was 45.36—the youngest was 25 and the oldest was 74 at the onset of the study. Almost all participants were heterosexual ($n = 1,385$; 95%), with a smaller proportion reporting that they were homosexual ($n = 2$; 0.1%) and bisexual ($n = 4$; 0.3%) and the remaining either chose not to respond ($n = 22$; 2%) or were missing data ($n = 43$; 3%). Participants were mostly U.S. citizens ($n = 1,385$; 95%) though a small number were not ($n = 2$; 0.14%), with 22 (2%) refusing to answer and 43 (2.9%) with missing data. Most were "White" ($n = 1,334$; 92%), and smaller numbers identifying as "Black and/or African American" ($n = 27$; 2%), and "Other" ($n = 17$; 1%), and far fewer identifying as "Native American or Aleutian Islander/Eskimo" ($n = 6$; 0.4%), "Asian or Pacific Islander" ($n = 7$; 0.5%), "Multiracial" ($n = 9$; 6%), and the remainder responded

as "Don't Know" ($n = 13$; 0.9%) or missing ($n = 43$; 3%). On average, individuals had been married 22 ($SD = 11.96$) years at the beginning of the study.

Measures

Demographic variables. To identify the marital status of individuals, participants were asked "Are you married, separated, divorced, or never married?" Biological sex was assessed by asking participants to select one of the following response options: "male," female," or "don't know." No individuals in the current sample responded with "don't know;" male was coded as 1, and female was coded as 2. Sexual orientation was assessed by asking participants "How would you describe your sexual orientation? Would you say you are heterosexual (sexually attracted only to the opposite sex), homosexual (sexually attracted only to your own sex), or bisexual (sexually attracted to both men and women)?" and the response options were heterosexual, homosexual, or bisexual.

Relationship satisfaction. Participants who had indicated that they were in a "marriage-like" relationship were asked: "Using a scale from 0 to 10, where 0 means 'the worst possible marriage or close relationship' and 10 means 'the best possible marriage or close relationship', how would you rate your marriage or close relationship these days?" Participants were asked this identical question at each time point.

Sexual satisfaction. Sexual satisfaction was rated with a single item on an 11-point scale. Participants were prompted: "Using a scale from 0 to 10 where 0 means 'the worst possible situation' and 10 means 'the best possible situation', how would you rate the sexual aspect of your life these days?" Participants were asked this identical question at each time point.

Data analysis. Analyses were performed using the R *lavaan* package (Rosseel, 2012). Growth curves estimate the interindividual variability of intraindividual patterns of change over time (Bollen & Curran, 2006). In the current study, the intercepts represented the average initial score (at time 1) for relationship and sexual satisfaction. Only linear growth curves were tested—latent slopes were coded as 0, 1, and 2 for each growth curve. The slope coefficient thus represented the average linear change in the outcome between time points (Bollen & Curran, 2006). Intercepts and slopes were free to vary as random effects. The analyses presented in the current study proceeded in two broad stages: the first was the within-subjects analysis and involved estimation of the change trajectory for relationship and sexual satisfaction (the level 1 equation); the second was the between-subjects portion (the level 2 equation), where the latent growth factors (slope and intercepts) representing the interindividual differences in trajectories were variables to be explained. Each univariate model is tested with and without stationarity of indicator residuals (Little, 2013). Stationarity is the idea that the residuals of the indicators do not vary over time—which represents that the purported processes (i.e., change over time) underlying the variables are consistent across the time points (Little, 2013). The sample exceeds standards from simulation studies ($N > 500$ for studies with less than 10 time points) for statistical power established in the MLGCM literature to detect growth parameter associations (Hertzog, Lindenberger, Ghisletta, & von Oertzen,

Table 1. Summary of means, *SD*, and missing values for each observed variable (*N* = 1,456).

Variable	*N*	*M*	*SD*	Missing *n*	Missing %	Skew	Kurtosis
MIDUS 1 RS	1404	8.38	1.58	52	4	−1.44	2.78
MIDUS 2 RS	1276	7.98	1.70	180	12	−.98	1.16
MIDUS 3 RS	1175	8.55	1.68	283	19	−1.83	4.22
MIDUS 1 SS	1387	6.43	2.46	69	5	−.71	−.09
MIDUS 2 SS	1244	5.74	2.62	212	15	−.47	−.58
MIDUS 3 SS	1142	5.04	2.89	314	22	−.22	−.93
M1 Age	1456	45.36	10.60	0	0	.29	−.64
M2 Age	1456	54.23	10.57	0	0	.29	−.63
M3 Age	1456	63.36	10.58	0	0	.29	−.64

Note. RS = relationship satisfaction; SS = sexual satisfaction. MIDUS 1 marital duration correlated with MIDUS 1 RS: *r* = .06, *p* = .03; MIDUS 1 SS: *r* = .10, *p* < .001.

2006). The current sample also exceeds the most conservative sample size requirements to detect small effect sizes (*N* > 800; Lee & Whittaker, 2018).

Normality. Univariate normality assessment based on skewness and kurtosis values (see Table 1) suggested that sexual satisfaction across the three time points was normally distributed and normal based on visual inspection of P-P plots and histograms. Relationship satisfaction did not appear normally distributed at any time point based on the same indices. At each time point, it appeared highly negatively skewed, with a large cluster of points in the higher ends of relationship satisfaction. Multivariate normality was tested using Mardia's test with the *MVN* package for R (Korkmaz, Goksuluk, & Zararsiz, 2014). Mardia's multivariate skewness and kurtosis statistic *p*-values were <.05 for all variables, suggesting that none were multivariate normal. Based on these assessments, all Structural Equation Models (SEM) were estimated using robust maximum likelihood which is robust to violations of multivariate normality (Yuan, Chan, & Bentler, 2000).

Missing data. The prevalence of missing data was assessed for each time point. As expected, the percentage of missing data overall increased toward later time points (Table 1). Inspection of the missing value patterns of relationship and sexual satisfaction showed that the most common pattern was that of no missing data (70% of the cases fit this pattern), and the patterns appeared monotonic in nature. Missing data in all growth models were handled using the full information maximum likelihood estimation option in R *lavaan*. Maximum likelihood is considered a state-of-the-art missing data technique relative to other methods (Enders, 2010).

Results

The longitudinal trajectories of relationship and sexual satisfaction (RQ1)

Relationship satisfaction. Two linear growth curve models of relationship satisfaction were estimated—the only difference between these two models was that one applied equality

Table 2. Fit indices for relationship satisfaction and sexual satisfaction LGCMs.

Model	χ^2 (p-value)	df	p	RMSEA (90% CI)	SRMR	CFI	AIC	BIC	Pass
Relationship satisfaction									
Model 1: Residuals constrained equal	3.01	3	.39	.00 (.00, .06)	.01	1.00	13,672.35	13,703.96	Y
Model 2: Fully unconstrained	5.08	1	.02	.05 (.02, .10)	.01	1.00	13,676.14	13,718.29	Y
Sexual satisfaction									
Model 4: Residuals constrained equal	6.38	3	.09	.03 (.00, .06)	.02	1.00	17,156.27	17,187.87	Y
Model 5: Fully unconstrained	.00	1	.98	.00 (.00, .00)	.00	1.00	17,153.34	17,195.48	N

Note. CI = confidence interval; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; CFI = Comparative Fit Index; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion.

Table 3. Fixed effects and variance estimates for univariate LGCMs of relationship satisfaction and sexual satisfaction.

	Estimate [95% CI]	SE	p-value
Relationship satisfaction			
Fixed effects			
Intercept	8.35 [8.27, 8.44]	.04	<.001
Slope	.07 [.02, .12]	.03	.01
Random effects			
Intercept	1.56 [1.29, 1.82]	.14	<.001
Slope	.28 [.16, .40]	.06	<.001
Sexual satisfaction			
Fixed effects			
Intercept	6.42 [6.30, 6.55]	.07	<.001
Slope	−.71 [−.79, −.63]	.04	<.001
Random effects			
Intercept	3.46 [2.96, 3.95]	.25	<.001
Slope	.60 [.38, .82]	.11	<.001

Note. LGCM = latent growth curve modeling; CI = confidence interval; SE: standard error. Estimates are unstandardized.

constraints to the indicator residuals (stationarity) and one did not (Table 2). Both models had excellent model fit by all indices. Model 1, which had stationarity applied, was retained as it fit the data best as evidenced by a nonsignificant χ^2, and the lowest Bayesian Information Criterion (BIC) and Akaike information criterion (AIC) values compared to Model 2. The fixed effects and random effects estimates of Model 1 are shown in Table 3. Individuals on average began the study close to the higher end of the
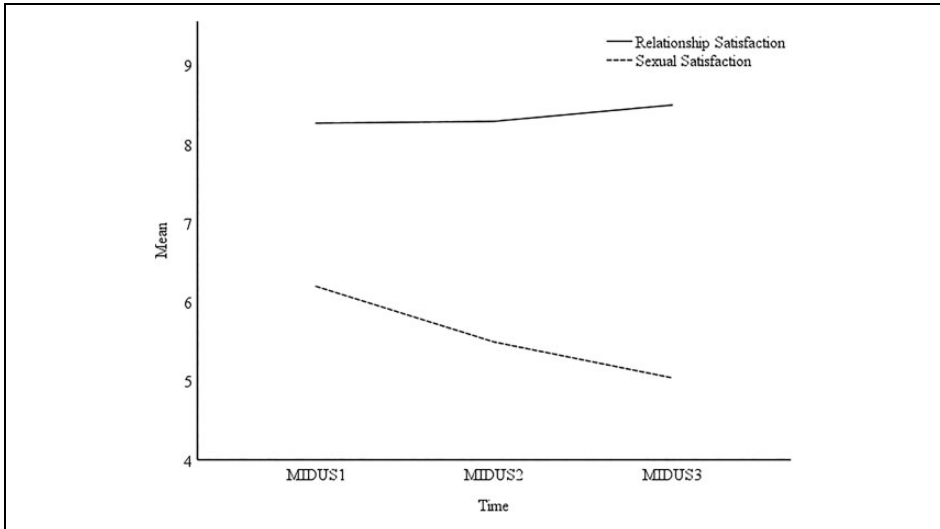
Figure 1. Observed means of relationship and sexual satisfaction.

possible range of scores (0–10) for relationship satisfaction. The slope was statistically significant and positive, indicating that individual relationship satisfaction on average increased by .07 between each measurement occasion. Statistically significant random effects for the intercept and slope suggested interindividual differences in trajectories over time—there was substantial variability in the starting points and trajectories between participants. Observed means are plotted in Figure 1. In summary, relationship satisfaction increased over time, though there was substantial interindividual variation in both the starting points and trajectories.

Sexual satisfaction. Similarly, two linear growth curve models of sexual satisfaction were estimated—one with stationarity and one without stationarity (Table 2). Model 4 which had stationarity was retained. Model 5 without stationarity did not estimate properly—fit indices were out of bounds. Note that the matrix was positive definite, and all variances were positive. Little (2013) indicates that growth models with single indicators frequently encounter estimation difficulties without stationarity constraints applied and this was likely the case here. The fixed effects and random effects estimates are shown in Table 3. Results showed that, on average, individuals began the study with scores on sexual satisfaction near the middle of the possible range of scores (0–10). There was a statistically significant decline in sexual satisfaction over time, showing that on average, individuals decreased by .71 between each measurement occasion. Random effects were statistically significant, suggesting interindividual differences in these intercept and slope estimates—there was substantial variability in the starting points and trajectories between-participants. Observed means are plotted in Figure 1. In summary, individuals overall became less sexually satisfied over time, although there was interindividual variability in the starting points and trajectories.

Table 4. Fit indices for multivariate growth curve models.

	χ^2	df	p	RMSEA [90% CI]	SRMR	CFI	AIC	BIC	Pass
Unidirectional models									
Model 1: SS. Int. → RS. Int.	10.33	7	.17	.02 [.00, .05]	.01	1.00	30,060.96	30,166.36	Y
Model 2: RS. Int. → SS. Int.	10.33	7	.17	.02 [.00, .05]	.01	1.00	30,060.96	30,166.36	Y
Model 3: RS. Int. + RS. Slope → SS. Slope	8.86	6	.18	.02 [.00, .06]	.01	1.00	30,062.96	30,173.63	Y
Model 4: SS. Int. + SS. Slope → RS. Slope	8.86	6	.18	.02 [.00, .06]	.01	1.00	30,062.96	30,173.63	Y
Model 5: RS. Slope → SS. Slope	10.33	7	.17	.02 [.00, .05]	.01	1.00	30,060.96	30,166.36	Y
Model 6: SS. Slope → RS. Slope	10.33	7	.17	.02 [.00, .05]	.01	1.00	30,060.96	30,166.36	Y
Bidirectional models									
Model 7: Correlated bivariate model	11.81	8	.16	.02 [.00, .05]	.01	1.00	30,058.96	30,159.09	Y
Model 8: Regressive Bidirectional Model	11.81	8	.16	.02 [.00, .05]	.01	1.00	30,058.96	30,159.09	Y
Bidirectional model with covariates									
Model 9: Correlated bivariate model with covariates	12.94	10	.23	.02 [.00, .04]	.01	1.00	29,742.77	29,959.22	Y

Note. CI = confidence interval; SS. Int. = Sexual Satisfaction Intercept; SS. Slope = Sexual Satisfaction Slope; RS. Int. = Relationship Satisfaction Intercept; RS. Slope = Relationship Satisfaction Slope. Arrows represent regressive paths. All models assume stationarity (indicator residuals for each construct set to equality). Cross-construct indicator residuals are free to covary within each time point.

Parallel process models of sexual and relational satisfaction (RQ2)

Based on acceptable model fit indices from the single-construct linear LGCMs, parallel process models with differently specified relations between intercept and slope estimates were modeled. Models 1 and 2 were unidirectional models with the intercept of sexual satisfaction predicting the intercept of relationship satisfaction and vice versa (Table 4). Model 3 estimated the intercept and slope of relationship satisfaction as predictors of the slope of sexual satisfaction, and model 4 estimated the intercept and slope of sexual satisfaction as predictors of the slope of relationship satisfaction (nonregressed growth factors were free to covary). Models 5 and 6 estimated the slope of relationship satisfaction as a predictor for the slope of sexual satisfaction (model 5) and vice versa (model 6) without the inclusion of intercepts as predictors.

These models fit very well by all indices (see Models 1 through 6 in Table 4), but each pair of models with reversed directionality were mathematically equivalent—thus they can only be distinguished by their substantive and theoretical interpretations, not by their fit indices (MacCallum, Wegener, Uchino, & Fabrigar, 1993). Therefore, it is

not possible to use fit indices to determine which unidirectional assumption fits the data better between any two competing models. Next, parallel process models testing bidirectional relationships were estimated to identify whether these models fit better than all the unidirectional models according to non-nested fit indices. In total, two models testing different bidirectional assumptions were estimated. Model 7 was a parallel process model with all growth factors free to covary together (see Figure 2). Model 8 was a bidirectional regressive model where the intercept of relationship satisfaction predicted the slope of sexual satisfaction, and the intercept of sexual satisfaction predicted the slope of relationship satisfaction. In Model 8, intercepts were free to covary, as were slope residuals.

Models 7 and 8 were again equivalent models, and their fit indices showed that these two models fit the data very well. AIC and BIC values of the bidirectional models were lower than the unidirectional models, suggesting that the bidirectional models were a better fit (Vrieze, 2012) than the unidirectional models. Furthermore, the statistical superiority of the bidirectional models over the unidirectional models is substantive when considered alongside the inconsistent results of prior unidirectional studies (e.g., Yeh et al., 2006) and emerging bidirectional theorizing and evidence (Byers, 2005; McNulty et al., 2016). Because of the AIC and BIC values and theoretical rationale, the bidirectional models were retained over the unidirectional models.

To distinguish these two mathematically equivalent bidirectional models, several theoretical considerations were made. Firstly, Grimm, Ram, and Estabrook (2016) suggested that in most cases there is minimal value to modeling intercepts as direct predictors of slopes unless the intercept corresponds to a meaningful start point. Given that MIDUS 1 began at an arbitrary point (i.e., not at the onset of marriage for these participants), there was no substantive meaning to the intercept in this study aside from it being the onset of the study, and therefore there was minimal rationale for its use as a direct predictor of slopes. Secondly, the regressive model (with intercepts predicting slopes) specified stronger hypotheses than a correlated model (Kline, 2015) and, combined with minimal a priori rationale for its stronger assumptions, had less appeal due to its stronger assumptions. Therefore, the correlated model, which made weaker assumptions and was more substantive, was retained for further analyses. Fixed and random effect estimates and their interpretation for the correlated model (model 7) are identical to those shown in Table 3.

Summary of correlated model (Model 7). The slopes of relationship and sexual satisfaction showed that over time, individuals' relationship and sexual satisfaction tended to change in the same direction (see Table 5)—individuals who increased in relationship satisfaction over time also increased in sexual satisfaction over time. The inverse interpretation was also true—individuals who decreased in relationship satisfaction over time also decreased in sexual satisfaction over time. The large effect size suggested that changes in relationship and sexual satisfaction were strongly connected over time.

The significant correlation between the intercept of sexual satisfaction and the slope of relationship satisfaction indicated that individuals who began the study higher in sexual satisfaction declined slower in relationship satisfaction over time compared to those who began lower in sexual satisfaction. Therefore, higher initial levels of sexual
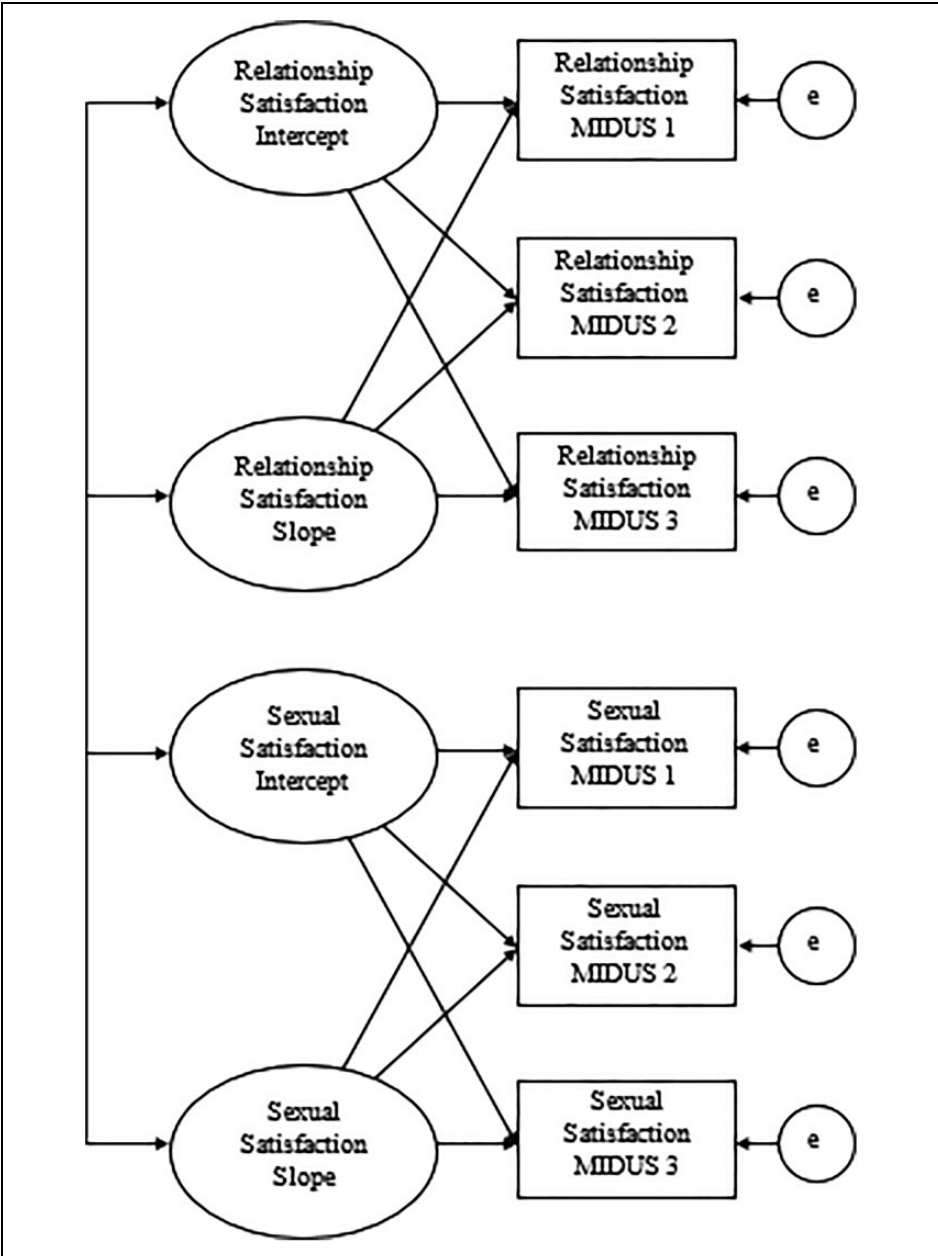
Figure 2. SEM path diagram of Model 7, showing the parallel process growth curve model with correlations between intercepts and slopes of relationship and sexual satisfaction. Note that indicator residuals were constrained to equality separately for relationship and sexual satisfaction and that cross-construct indicator residuals within the same time point were free to covary (e.g., relationship and sexual satisfaction residuals at Time 1 were free to covary).

Table 5. Summary of growth parameter estimate correlations for model without covariates (Model 7).

	RS. Int.	RS. Slope	SS. Int.
RS. Slope	−.26*	—	
SS. Int.	.66***	−.23*	—
SS. Slope	−.16	.51**	−.06

Note. SS. Int. = sexual satisfaction intercept; SS. Slope = sexual satisfaction slope; RS. Int. = relationship satisfaction intercept; RS. Slope = relationship satisfaction slope.

satisfaction were a protective factor against declines in relationship satisfaction, and lower initial levels of sexual satisfaction were a risk factor for more pronounced declines in relationship satisfaction over time.

The correlation between the intercept of relationship satisfaction and the slope of relationship satisfaction indicated that individuals who began the study higher in relationship satisfaction declined slower in relationship satisfaction over time compared to those who began lower in relationship satisfaction. The correlation between the intercept of sexual satisfaction and the slope of sexual satisfaction was not statistically significant, suggesting that starting points and trajectories of sexual satisfaction were not related.

The correlation between the intercepts of sexual and relationship satisfaction showed that individuals who were higher in relationship satisfaction initial scores also had higher initial scores on sexual satisfaction at MIDUS 1. The correlation between the intercept of relationship satisfaction and the slope of sexual satisfaction was not statistically significant.

Summary of model with covariates. Covariates were then applied to the model, and model fit of the covariate model was excellent (Table 4). See Online Supplementary Material for models controlling for marital duration. After including age and sex, all fixed effects and random effects remained statistically significant and in the same directions (see Table 6). Statistically significant random effects demonstrate that there was substantial variability that remained unaccounted for by age and sex. The significance levels of intercorrelations between growth parameter estimates did not change after including the covariates (see Table 7).

Effect of covariates. Sex was modeled as a time-invariant covariate and results showed that women decreased less in relationship satisfaction over time than men (see Table 8). No other sex effects were statistically significant.

Age was modeled as a time-varying covariate (Table 9). Note that age was mean-centered prior to analysis. Age was a statistically significant predictor of relationship and sexual satisfaction at each time point. Older individuals were more relationally satisfied at each time point; however, individuals higher in age were lower in sexual satisfaction at each time point.

Table 6. Fixed and random effects estimates of correlated bidirectional model with demographic covariates.

	Estimate [95% CI]	SE	*p*-value
Relationship satisfaction			
Fixed effects			
Intercept	8.41 [8.17, 8.66]	.13	<.001
Slope	.22 [.07, .37]	.08	<.01
Random effects			
Intercept	1.52 [1.26, 1.78]	.13	<.001
Slope	.25 [.14, .37]	.06	<.001
Sexual satisfaction			
Fixed effects			
Intercept	6.20 [5.81, 6.60]	.20	<.001
Slope	−.46 [−.70, −.22]	.12	<.001
Random effects			
Intercept	3.38 [2.89, 3.87]	.25	<.001
Slope	.59 [.37, .81]	.11	<.001

Note. Estimates are unstandardized. CI = confidence interval; *SE*: standard error.

Table 7. Summary of growth parameter estimate correlations for model with covariates (Model 9).

	RS. Int.	RS. Slope	SS. Int.
RS. Slope	−.32**	—	
SS. Int.	.69***	−.21*	—
SS. Slope	−.15	.59**	−.09

Note. SS.Int. = sexual satisfaction intercept; SS. Slope = sexual satisfaction slope; RS. Int. = relationship satisfaction intercept; RS. Slope = relationship satisfaction slope.
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 8. Summary of the effect of biological sex on intercepts and slopes of relationship and sexual satisfaction.

	Estimate [95% CI]	SE	*p*-value
Relationship satisfaction			
Intercept ($R^2 = .00$)			
Biological sex	−.04 [−.20, .12]	.08	.70
Slope ($R^2 = .01$)			
Biological sex	−.11 [−.21, −.01]	.05	.02*
Sexual satisfaction			
Intercept ($R^2 = .00$)			
Biological sex	.15 [−.11, .40]	.13	.26
Slope ($R^2 = .01$)			
Biological sex	−.16 [−.31, −.01]	.08	.05

Note. Estimates are unstandardized. Coding for biological sex is women (2) men (1). CI = confidence interval; *SE* = standard error.
*$p < .05$

Table 9. Summary of the effect of age on relationship satisfaction and sexual satisfaction at each wave.

Dependent variable	Covariate	Estimate	SE	p-value	95% CI
MIDUS 1 RS	Age	.01	.00	.00***	[.01, .02]
MIDUS 2 RS	Age	.03	.00	<.001***	[.02, .04]
MIDUS 3 RS	Age	.03	.00	<.001***	[.03, .04]
MIDUS 1 SS	Age	−.03	.01	<.001***	[−.04, −.02]
MIDUS 2 SS	Age	−.04	.01	<.001***	[−.05, −.03]
MIDUS 3 SS	Age	−.06	.01	<.000***	[−.08, −.05]

Note. Estimates are unstandardized. CI: confidence interval; SE = standard error; MIDUS = Midlife in the United States; RS = relationship satisfaction; SS = sexual satisfaction. Age was mean centered.
***p < .001

Discussion

This study presented analysis of a sample of 1,456 midlife Americans married for at least 20 years across three time points and modeled the linear growth trajectories of relationship and sexual satisfaction. Then, relationship and sexual satisfaction were modeled as parallel processes and several competing directionality models were tested (e.g., intercepts and slopes of relationship satisfaction predicting intercepts and slopes of sexual satisfaction, and vice versa). In doing so, hypothetical models of unidirectionality and bidirectionality between trajectories of relationship and sexual satisfaction were tested. Demographic variables were then added as covariates.

The longitudinal development of relationship and sexual satisfaction

Relationship satisfaction, on average, appeared to increase linearly with time. There has been considerable historical debate concerning whether relationship satisfaction linearly decreases over the course of a relationship or functions as a U-shape over time—also known as the "upturn hypothesis" (Glenn, 1998). The finding that relationship satisfaction increased slightly in the current study may support the upturn hypothesis. However, comparisons are limited because MIDUS individuals were not followed through the entirety of their marriages and thus there is not a complete picture of the trajectory. A 40-year prospective longitudinal analysis by Vaillant and Vaillant (1993) suggested that marital satisfaction remained quite stable and particularly so in midlife to late life, which complements findings of the current study. Regardless, continual assessment of the trajectory of relationship satisfaction is required using large scale data sets like that presented in the current study. Alternatively, the findings presented here may simply be idiosyncratic to this data set—a set of highly stable midlife marriages.

Concerning individual differences, individuals with higher initial levels of relationship satisfaction had less steep declines in relationship satisfaction over time. This is consistent with a maintenance hypothesis—that individuals with initially higher levels of relationship satisfaction possess a suite of social and psychological skills that protect from declines over time in relationship satisfaction (Karney & Bradbury, 1997). Such a

finding is also in line with the enduring dynamics model (Huston & Houts, 1998), where a higher initial score may reflect enduring positive relational patterns that persist over long periods of time but are in contrast to the disillusionment model, which purports that high early levels of passion might lead to decreased happiness over time (e.g., Huston, Caughlin, Houts, Smith, & George, 2001). Results related to sexual satisfaction were consistent when compared to existing longitudinal studies which have shown that sexual satisfaction typically declines over time (McNulty et al., 2016; Schmiedeberg & Schröder, 2016). Findings are also complementary to studies that show, for example, increasing age and resulting declines in health have a negative effect on one's sexual desire, arousal, and ability to orgasm (Laumann et al., 1999).

A parallel process model of relationship and sexual satisfaction

This study conceptualized relationship and sexual satisfaction as parallel developmental processes and provided support for conceptualizing them as bidirectional rather than unidirectional. Results contrast with previous studies which have found only contradictory unidirectional effects (e.g., Fallis et al., 2016; Henderson-King & Veroff, 1994) but support earlier bidirectional theorizing (e.g., Byers, 2005) and nascent bidirectional evidence (McNulty et al., 2016). Results are consistent with McNulty et al.'s (2016) findings, specifically, that the magnitude of change over time in relationship satisfaction was strongly associated with changes in the same direction of sexual satisfaction. Previous studies have been unable to provide stable evidence for a definitive bidirectional association between sexual and relationship satisfaction perhaps because they have not modeled these variables as their own trajectories. Findings in the current study suggest that bidirectionality between relationship and sexual satisfaction exists for both initial levels and for their trajectories over time. In other words, not only are relationship and sexual satisfaction statically associated, but changes in one are strongly associated with changes in the other over long periods of time. The association between each variable's rate of change highlights a strong temporal connection between relationship and sexual satisfaction trajectories that may be missed when rates of change and their interrelationships are not modeled for both variables.

Even though higher initial levels of sexual satisfaction were protective against declines in relationship satisfaction over time, the reverse was not supported—higher initial levels of relationship satisfaction were not protective against declines in sexual satisfaction. On the surface, this may suggest a unidirectional relationship and, indeed, such a finding helps illuminate why methods used in previous studies have produced inconsistent results. However, this must be considered in the context of the strong bidirectional associations between intercepts and slopes of relationship and sexual satisfaction. The existence of a one-way protective effect when considered alongside a strong shared trajectory provides evidence for a complex and nuanced relationship between these change processes—it is not necessarily evidence for unidirectionality. Regardless, this protective effect should highlight the importance of the sexual aspects for the relationship broadly.

Together with McNulty et al.'s (2016) empirical evidence and bidirectional theorizing (i.e., Byers, 2005), the current study allows researchers and practitioners to infer

that relationship and sexual satisfaction change together over time in a way that is more akin to a bidirectional developmental process than a unidirectional one. However, it expands on such theorizing by revealing that relationship and sexual satisfaction tend to change together over time and revealing that sexual satisfaction may be a protective factor against declines in relationship satisfaction over time.

Biological sex. The long-term effect of sex on marital outcomes has been a topic of much research (e.g., Lavner & Bradbury, 2010). Recent meta-analytic work has shown that wives have lower relationship satisfaction levels than husbands in aggregate; however, this effect was due to the inclusion of clinical samples (Jackson, Miller, Oka, & Henry, 2014). Analysis of nonclinical samples showed no sex or gender differences (Jackson et al., 2014). The null sex effect on intercept values of relationship and sexual satisfaction in the current study was consistent with these results. The significant effect of sex on the slope coefficient, which suggested that women had less steep declines in relationship satisfaction, does contrast with the gender similarity hypothesis, a proposition that women and men are largely similar on most psychological variables and that observed differences are largely exaggerated (Hyde, 2005). Note that given how close the *p*-value was to the alpha threshold, the statistical significance of this effect may also be due to idiosyncrasies in the sample.

Strengths

The MLGCM methodology is a key strength of this study because it allowed the examination of bidirectional associations between sexual and relationship satisfaction growth factors and allowed each outcome to be estimated as its own developmental process. Furthermore, this study is novel because it approached the question of directionality between relationship and sexual satisfaction by systematically testing competing unidirectional and bidirectional models using characteristics of change trajectories rather than static scores. This is partly buttressed by the large sample drawn from a nationally representative study that meets standards for statistical power (Hertzog et al., 2006). The 20-year longtime horizon underlying the MIDUS study has made possible inferences covering a substantial amount of time.

Limitations

Despite the noted strengths, several limitations of the study are noteworthy. This study used single indicator measurement to assess relationship and sexual satisfaction. Additionally, several limitations are introduced by having only three time points. Having three time points does not allow for the thorough testing of nonlinear or more complex trends which could be assessed using a daily diary format (e.g., Day et al., 2015). Even though the duration of the MIDUS study was long, which allowed for long-term inferences, this structure neglects the more idiosyncratic microdevelopments and microchanges that may occur on a smaller time scale (i.e., day to day, week to week, month to month, year to year).

The original MIDUS data were from a nationally representative sample obtained with random-digit dialing, but it should be noted that there may be a selection effect inherent

to the current study's inclusion criteria (participants who stayed married to the same person for the entire duration). In the current study, the regressive bidirectional model (Model 8) was discarded because the design of the MIDUS study did not contain a meaningful intercept point. Although this is true in the present analyses, in other study designs that contain substantive intercepts (i.e., studies that begin at the start of a marriage), the regressive model need not be discarded. In such a case, a more thorough assessment can be made between the correlated model and the regressive model. Another limitation concerns the wording of the sexual satisfaction question, which asked about sexual satisfaction broadly rather than specifically about the marital relationship.

Future research. A bidirectional framework is foundational to future research. For example, perhaps, interindividual variation in the growth curves parameters of sexual and relationship satisfaction depends partly on one's attachment style. Research has indicated that highly anxiously attached individuals equate sex with love and they can become preoccupied with their partner's sexual needs (e.g., Birnbaum, Reis, Mikulincer, Gillath, & Orpaz, 2006). The inclusion of a robust theoretical framework like attachment would be an obvious next step clarifying the bidirectional associations shown here. The results of the current study generalize to primarily White, midlife Americans in long (at least 20 year) and stable marriages; however, they do not generalize to unstable marriages. It is likely that less stable marriages—ones that ended in divorce and, hence, were not included in the current study—followed a different trajectory over time. Other research has focused on repartnering after divorce (e.g., Wu & Schimmele, 2005), and future research could use the MLGCM framework to identify the long-term trajectories of relationship and sexual satisfaction of individuals who divorce and repartner over time. Continued replication of the bidirectionality presented here should be pursued and, in particular, with data amenable to the examination of actor and partner effects. One finding of the current study was that higher initial levels of sexual satisfaction were protective against declines in relationship satisfaction, but higher initial levels of relationship satisfaction were not protective against declines in sexual satisfaction. Further study of this should be conducted to identify whether this is idiosyncratic to this age group or this sample (i.e., because of concurrent health-related changes and changes to sexual functioning that accompany age; Laumann et al., 1999) or whether it represents a replicable effect. Importantly, future research should recruit samples of dyads to explore dyadic partner effects. This model should also be tested with samples that include a wider array of relationship types (i.e., consensually nonmonogamous relationships) focusing on relationships of individuals from a wider range of sexual orientations, gender identities, and ethnic groups.

Conclusion

Long-term, stable marriages of midlife Americans at the sample level were characterized by a linear increase in relationship satisfaction over 20 years and a linear decline in sexual satisfaction over the same duration. A bidirectional change model was supported; intercepts and slopes of relationship and sexual satisfaction were strongly positively correlated. Stated differently, individuals who began the study high in relationship

satisfaction also tended to begin high in sexual satisfaction and vice versa. Additionally, changes over time in relationship satisfaction were associated with changes in the same direction and similar in magnitude to changes in sexual satisfaction and vice versa. Higher initial levels of sexual satisfaction were also a protective factor against steeper declines in relationship satisfaction over time.

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Open research statement

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Supplemental material

Supplemental material for this article is available online.

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