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Exposure to Stressors and Trajectories of Perceived Stress Among Older Adults

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Objectives. Models of stress incorporate both the environmental demands experienced by individuals (stressors) and the appraisal of these life events (perceptions). Because little is known about the extent to which experience and perceptions are related, we examine this relationship in a nationally representative population of older Taiwanese adults.

Method. Using growth models applied to data from 3 waves (1999, 2003, and 2007) of the Taiwan Longitudinal Study of Aging, we (a) investigate patterns of change in perceived stress in later adulthood and (b) examine how experienced stressors influence perceived stress. Participants were asked to report the presence of, and in some cases the degree of, exposure to stressors including total number of medical conditions, difficulty with activities of daily living, difficulty with mobility functions, being financially worse off compared with the prior wave, experiencing the death of a child, and experiencing a marital disruption. Items reflecting perceived stress included concerns about various domains pertaining to the respondent and his/her family member.

Results. Our results indicate that exposure to stressors increases, whereas perceived stress decreases, over time. Change in exposure to stressors is not generally associated with change in perceptions of stress, with the exception of a summary measure of health-related exposure to stressors. An increase in poor health over time is related to an increase in perceived stress in all domains.

Discussion. The results underscore the importance of distinguishing between perceptions of stress and exposure to stressors when studying the links between stress and health among older adults. Furthermore, the diminishing linkage between experienced stressors and perceptions of stress suggests that older adults' appraisal may be an adaptive coping strategy that emerges to buffer some of the difficulties that are inevitable in later life.

Key Words: Health—Perceived stress—Stressors—Stress trajectories.

THE relationship between stress and health is well documented, with exposure to stressful events linked to depression (Hammen, 2005; Mazure, 1998; Monroe & Simons, 1991), cardiovascular disease (Dong et al., 2004; Kristensen, 1996; Rasul, Stansfeld, Hart, & Davey Smith, 2005; Stansfeld, Fuhrer, Shipley, & Marmot, 2002), delayed wound healing (Kiecolt-Glaser, Marucha, Malarkey, Mercado, & Glaser, 1995), the progression of immune conditions (Leserman et al., 2002; Pereira et al., 2003; Vedhara & Irwin, 2005), and numerous other health outcomes, including mortality. The precise mechanisms through which stress operates to affect health, however, remain unclear, and the relationship between life-course patterns in both stress and health is an ongoing area of investigation. The personal appraisal of stress is the first, and perhaps most important, mediator in the relationship between stressors and health, but little is known about how stress appraisal may change across later life. In this study, we investigate trajectories of perceived stress among older adults as they age into late adulthood. In particular, we evaluate whether there is a general decline in perceived stress across late adulthood and whether perceived stress is related to actual, experienced stressors.

Background

Early studies of stress and health tended to involve short-term, even cross-sectional data utilizing simple associations between the quantity of stressors experienced in some specified prior time period and current measures of health (Kugelmass & Lynch, 2014). Since the 1980s, research on the relationship between stress and health has evolved in two major directions (Cohen, Kessler, & Gordon, 1997; Pearlin, 2010). First, research has increasingly broken the stress experience into a complex process involving the experience of objectively measurable events or situations, the individual's appraisal of the events as "stressful" or demanding, the individual's ability to cope, that is, to actively mitigate the impact of the stressor on his/her well-being, and the health consequences of unmitigated, residual stress. Each of these stages has been investigated extensively, including the role of social factors in the linkage between the experience of events and their appraisal, the role of social factors,

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interpersonal factors, and personality characteristics in coping, and in the physiological mechanisms at work translating residual stress into larger health outcomes.

Second, research over especially the last two decades has begun to use panel data to evaluate long-term patterns in both stress and health and in their interrelationship. Patterns in stress—in particular, exposures to objective events—have been investigated in life stages ranging from adolescence (Ge, Lorenz, Conger, Elder, & Simons, 1994) to late adulthood (Lynch & George, 2002). Although exposure to stressors appears to increase across adolescence, research among older adults is mixed. Some research has shown that older adults are exposed to fewer stressors than younger persons, whereas some has found that, at least for certain types of stressors, older adults generally experience an increase across age. In particular, events involving death and illness of spouses, children, and peers occur with increasing frequency, as one might expect because of loss-related events associated with aging (Lynch & George, 2002). Other events that could be considered stressors or precursors to stressors may also increase in frequency, such as increases in the individual's own health limitations or difficulties with finances. At the same time, other types of events may stabilize or even decrease—for example, the risk of job loss or divorce.

Although some events occur with increasing frequency, they are often not unexpected at older ages. Thus, we might expect that, as a person ages, s/he becomes better at appraising such events as less salient or less significantly life altering compared with younger persons. Yet little is known about how older adults' appraisal of events changes as they age. Part of the reason for the lack of knowledge is that the two directions of contemporary research on stress described earlier are only beginning to become integrated. To be sure, Pearlin (2010) and Pearlin and Skaff (1996) have written extensively on the theory of stress and its relationship with health across the life course. For example, the concept of stress proliferation shows how some acute stressors may "spill over" into other domains and become chronic stressors affecting long-term mental health. Pearlin has written more generally on the stress process—as a life-course process, covering the entirety of the pathways discussed earlier. However, research using longitudinal data has generally limited its focus to two waves of investigation and often just the end points of the process: the experience of objective stressors and their eventual health outcomes.

Most research in sociology has shied away from investigating stress appraisal, perhaps in part because of the confounding of stress and coping (Folkman, Lazarus, Pimley, & Novacek, 1987)—a predominantly psychological venue of research—and in part because of the endogeneity of appraisal with respect to health outcomes. That is, if a researcher asks a respondent, usually months after the experience of an objective event, to assess whether the event was stressful, the respondent is almost certain to base that appraisal on any outcome that the event may have precipitated. For example, if widowhood was expected, and financial, living, and other arrangements were made prior to the death of the spouse, the surviving spouse may not suffer a significant negative health outcome and may therefore appraise the event as not particularly stressful. In this scenario, a model linking appraised stress with health outcomes would overestimate the relationship, especially compared with a model linking the mere experience of the event with health outcomes.

In this article, we focus not on the health outcomes of the stress process, but rather on how the process of appraising stress changes in later life, and how/whether experienced stressors—as measured via usual, objective, measures—are linked to the appraisal of them. If the process of appraisal becomes increasingly disconnected from the experience of the event itself, then the impact of experienced stressors on health may be minimal. Put another way, the relationship between stress exposure as measured via objective measures and health may, in fact, be stronger in later life than is often thought but may be masked by differences in how people appraise events at later versus earlier ages.

We expect objective events to be appraised differently by persons of different ages for several reasons. First, as suggested earlier, certain types of events are both more frequent among older adults and more expected, perhaps in part because they are more frequent. The anticipation of events almost certainly affects their appraisal, most likely reducing their significance (see Pearlin, 1980). Second, older adults focus more on positive over negative stimuli relative to younger adults, suggesting that negative affect decreases in late life (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000). Third, with increasing age, individuals build a repertoire of experience that serves two purposes in the face of a new stressor. First, experience enables an older adult to assess the stressor in the context of many others that have occurred before—that is, essentially to "rank" it among prior experiences. By itself, this process may serve to reduce the appraised salience of the event. Second, having a base of prior experience enables an individual to assess the stressor in terms of the anticipated methods needed to mitigate its potential impact. Note that this appraisal process is distinct from coping, as it is commonly defined, because it does not involve actually mobilizing/activating any resources.

Thus, we propose the following two hypotheses:

H1: Older adults will report stable or declining levels of perceived stress, on average, across age. This pattern will be apparent for all measures of perceived stress, including a global perceived stress measure and measures pertaining to perceived stress about the respondent's health, finances, and work.

H2: Exposure to objectively defined stressors will not correspond to perceived stress.

Method

Study Participants

The data are from three waves of the Taiwan Longitudinal Study of Aging (TLSA 1999, 2003, and 2007), a nationally representative study of adults aged 60 and older in 1989 (Hermalin, Lian, & Chiang, 1989), with younger refresher cohorts added in 1996 and 2003. Of 4,440 persons interviewed in 1999, 2,813 (63.6%) were interviewed at all three waves, 1,324 (29.8%) died over the study period, and 303 (6.8%) were lost to follow-up (LFU) for at least one wave. At each survey wave, efforts were made to contact and interview all participants from the original cohorts, even if they were LFU in a previous wave. Thus, an individual may be LFU in one survey wave but interviewed in subsequent waves. Persons who were LFU for a given wave did not contribute data for the period but did contribute data for the periods in which they were observed. Those who died were included for exposure until death. For example, if a participant was interviewed in 1999, LFU in 2003, and interviewed in 2007, the person would have contributed data for the 1999 and 2007 waves. Supplementary Figure 1 categorizes TLSA study participants included in the current study.

We compared sociodemographic characteristics of respondents who died and were LFU relative to those who were interviewed at all three waves. Those who died during our study period were significantly ($p < .001$) older and had fewer years of education at baseline than participants with complete data. Compared with persons who were interviewed in all three waves, participants who were LFU were significantly older and tended to live in urban areas, as opposed to rural areas, at baseline.

Measures

Stress exposure.—At each survey wave, participants were asked about currently having (a) particular medical conditions, (b) difficulty with activities of daily living (ADLs), and (c) difficulty with a set of mobility-related activities. We summed the number of reported current medical conditions (out of seven serious conditions), including hypertension, diabetes, heart disease, stroke, kidney disease, liver disease, and cancer (all of which are among the top 10 leading causes of death in Taiwan; Department of Health, 2011). Next, we summed the number of ADLs (0–6) that the respondent reported difficulty performing, including eating, bathing, toileting, dressing, moving about the house, and getting out of bed or standing up from or sitting in a chair. We considered a dichotomous variable in which respondents reported difficulty with any ADL or no difficulty with any ADLs (91% in 1999, 87% in 2003, 84% in 2007). Similarly, we summed the number of mobility tasks (0–8) that the respondent reported difficulty performing, including squatting, standing for 15 min, grasping with fingers, reaching over one's head, walking 200–300 m, running 20–30 m, climbing 2–3 flights of stairs, and lifting/carrying 11–12 kg (Collins, Goldman, & Rodríguez, 2008; Nagi, 1969, 1976). Finally, we computed a summary health measure (health-related exposure to stressors) by summing the presence of any of the following three conditions: difficulty performing at least one ADL, having at least one mobility limitation, and the presence of at least one of seven medical conditions (range: 0–3). We also considered an alternate summary health score that summed the total number of ADL difficulties, mobility limitations, and medical conditions. This alternate summary health measure did not alter our substantive conclusions.

In addition to the above measure of health-related exposure to stressors, respondents were asked about other stressors. At each wave, participants were asked to compare their current financial situation with their situation in the prior wave (responses in 1999 corresponded to their financial situation in 1996). We constructed a dichotomous variable indicating that the respondent had a worse or much worse financial situation now than previously. Respondents were also asked whether a child had died since the last interview; whether they had experienced divorce, separation, and death of a spouse; and whether they had changed residence since the last wave. We constructed indicators for each of these measures as well as a global exposure to stressors measure by summing the following: presence of any medical condition, difficulty with any ADL, difficulty with any mobility activity, being worse off financially than in the prior wave, experiencing the death of a child since the last interview, experiencing a marital disruption, and experiencing a change of residence since the prior wave (range: 0–7).

Perceived stress.—In each survey year, participants were asked about the presence of stress/anxiety in the following domains: (a) the participant's own health, (b) his/her own financial situation, (c) his/her own job, (d) his/her relationship with family members, (e) his/her family member's health, financial situation, job, or marriage, and (f) any other situation. The structure and wording of the perceived stress questions and the response categories were identical across the three waves. The total number of domains with reported stress (dichotomized as any or none) was summed to create a global perceived stress measure (range: 0–6, with higher scores indicating a greater number of domains with perceived stress). We also examined three dichotomous measures of perceived stress (derived from the same questions) regarding the individual's own (a) health, (b) finances, and (c) work.

Overall, then, for each of the three waves of the study, we had two general measures of exposure to stressors—health-related and global exposure to stressors—and four measures of perceived stress, including global perceived stress, perceived stress regarding health, perceived stress about finances, and perceived stress about work (in wave 1, 78% of the sample was not currently working and was coded

as having no perceived work-related stress). In addition to these measures, we controlled for several background variables in our models, including age (in years) at baseline, sex, education (years of schooling), rural versus urban residence at baseline, and being married at baseline. These covariates were centered at their means to enhance interpretability of the growth model intercept and slope means, as discussed later.

Data Analysis

We modeled change in domains of perceived stress using a structural equation modeling (SEM) approach to growth modeling (see Bollen & Curran, 2006). Growth modeling assumes that repeated measures of an outcome *y* on an individual are, at least in part, reflections of an underlying life-course process—a trajectory. Under usual growth modeling assumptions, trajectories are assumed to follow a common shape for everyone (e.g., linear), but both the starting level of the trajectory (α) and its rate of change (β) may vary between individuals. Time-specific measures of *y* are then the product of two factors: time-varying factors that influence *y* at a specific time but do not fundamentally alter the underlying trajectory of *y* (which we call "Level 1 factors"), and time-invariant factors that influence the overall starting level and rate of change of the individual's trajectory (which we call "Level 2 factors").

Our primary goal is to understand trajectories of perceived stress in later adulthood and the role that experienced stressors plays in influencing these trajectories. As suggested earlier, there are two ways in which experienced stressors may influence perceptions of stress. As prior research has shown (Lynch & George, 2002), certain types of experienced stressors have evidence of growth in later adulthood. Thus, we first consider how *trajectories* of experienced stressors are related to trajectories of perceived stress. Specifically, do persons who experience growth (or decline) in experienced stressors also experience growth (or decline) in perceived stress, or are such patterns unrelated? We call these "Level 2 models," because the relationship between experienced stressors and perceived stress is modeled at the trajectory level.

Experienced stressors as measured here may not evidence a clear pattern, however. For example, widowhood is usually a one-time event. Thus, trajectories of experienced stressors may not correlate with trajectories of perceived stress because experienced stressors may not follow a standard shape across age at the individual level. Yet, perceived stress may follow a clear pattern, and the level of experienced stressors at particular time points may serve simply to temporarily interrupt an individual's longer term pattern in perceived stress. That is, experienced stressors may "bump" *y* off its trajectory temporarily—it may act as a shock. We therefore also estimate models with time-specific measures of exposure to stress allowed to directly affect time-specific measures of perceived stress, while simultaneously estimating trajectories of perceived stress. We call these "Level 1 models" because of the way in which stress exposure is allowed to predict perception.

Figure 1a and b present graphic depictions of these models using standard SEM representation (see Bollen, 1989; Bollen & Curran, 2006). Figure 1a represents a "Level 1 model" for stress exposure in showing time-specific measures of stress exposure predicting time-specific measures of perceived stress in addition to the (latent) parameters α and β capturing the underlying trajectory of perceived stress. Figure 1b represents a "Level 2 model" for stress exposure in showing a growth model for exposure in which the latent parameters of its trajectory predicts the latent parameters of a trajectory of perceived stress, with fixed covariates like sex and race predicting the latent parameters of each growth process (see Lynch & George, 2002, for an application similar to that presented here). Note that all error variances as well as all covariances between exogenous variables and between endogenous latent variables (alpha and beta) are included in the models but omitted from the figure for the sake of simplicity (again, see Bollen & Curran, 2006, for additional explanation of growth modeling in an SEM framework).

The simultaneous modeling of multiple trajectories is an advantage of the SEM approach over hierarchical linear modeling (HLM) or the mixed modeling approach followed in general software packages like Stata and SAS. HLM/mixed modeling approaches are not multivariate; they can only handle a single growth curve and not interrelationships between two or more growth curves for different phenomena.

Note that in Figure 1a and b the factor loadings (representing the "loadings" of the measured items on the latent intercepts and slopes) were fixed at 1 for the latent intercept and 0, 1, and 2 for the latent slope. This specification is for modeling linear trajectories and reflects a constant (1) plus a contribution of scaled time since baseline. This approach implies a wave-based, rather than age-based, specification for time. That is, we modeled change across *waves* of the study rather than across *age* of respondents (see Mehta & West, 2000). The majority of the respondents are clustered toward the young end of the age distribution at baseline, so the distinction between wave-based and age-based specifications is minimal. The distinction is negligible for two additional reasons: First because we control for the influence of age on our latent intercepts; and second because there is considerable variation in the ages at which stress exposures of the type measured begin to increase across people even in the same birth cohort because of differences in age of marriage, child bearing, and age of siblings. As a sensitivity test, we also estimated models on a sample with a restricted baseline age range (53–75); results of those models yielded similar substantive conclusions to those we report here using the full sample.

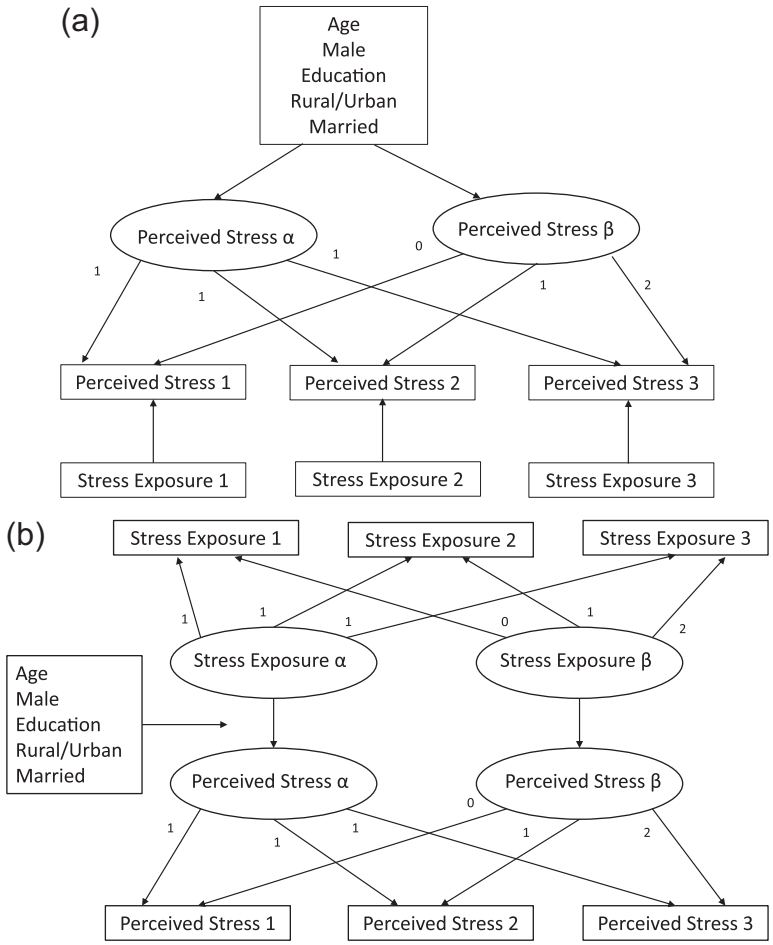

Figure 1. (a) Growth curve model of perceived stress growth with exposure to stress modeled as a Level 1 predictor. (b) Full growth curve model (Level 2) of stress exposure growth predicting perceived stress growth. The univariate growth curve model for stress exposure is the the upper portion of Figure 1b. The univariate growth curve for perceived stress is the lower portion of Figure 1b. Baseline covariates affect all latent parameters (growth curve intercepts and slopes) in the model. For simplicity, not all paths are shown, and measurement errors and covariances are not displayed.

We used MPlus version 5 for our analyses. All available data from survivors, those who were LFU, and those who died during the three waves were included in all models by using MPlus's full information maximum likelihood (FIML; also called direct ML) estimator (Muthen and Muthen, 1998–2010). We also estimated models using complete cases (those interviewed in all three waves) only; those results were substantively similar to those we report here.

Results

Table 1 reports the sociodemographic characteristics and aggregate means for stress exposure and perceived stress measures at each wave. There were slightly more men (53%) than women (47%), and the participants had an average of 4.7 years of education. At baseline, the average age was nearly 70 years (range: 53–98), 69% were married and 40% lived in a rural area. The aggregate means for global exposure to stressors and health-related exposure to stressors increased from wave 1 (1.95 and 1.26, respectively) to wave 3 (2.60 and 1.53, respectively). In contrast, perceived stress declined over the three waves. Mean global perceived stress decreased from 1.29 units at wave 1 to 1.11 units by wave 3. Perceived stress about health was reported among 36% of the sample in the first wave and decreased to 33% in the final wave. A similar decline was observed for perceived stress about finances (31% in wave 1, 30% in wave 2, and 25% in wave 3) and perceived stress about work (12% in wave 1, 9% in wave 2, and 7% in wave 3).

Tables 2–4 present the results of univariate growth models for the four measures of perceived stress from a total of 12 models. Table 2 shows results of growth models for each perceived stress measure controlling for age, sex, education, region of residence, and marital status (effects of control variables are not shown but available upon request). Tables 3 and 4 show results of growth models for each perceived stress measure controlling for the background variables as well as the global measure of exposure to stressors and the health-related exposure to stressors measure (respectively) treated as predictors at Level 1.

Table 1. Aggregate Means and Standard Deviations for (or Percentages of) Background Variables, Measures of Exposure to Stressors, and Perceived Stress Measures at Each Wave

	Wave 1 (n = 4,440)		Wave 2 (n = 3,536)		Wave 3 (n = 2,915)	
	Mean (or %)	*SD*	Mean (or %)	*SD*	Mean (or %)	*SD*
Age (years)	69.47	9.16				
Male (%)	53					
Education (years)	4.67	4.58				
Rural (vs. urban, %)	40					
Married (%)	69					
Exposure to stressors						
Global exposure to stressors (range: 0–7)	1.95	1.79	2.59	2.01	2.60	2.22
Health-related stress (range: 0–3)	1.26	0.89	1.44	0.88	1.53	0.90
Perceived stress						
Global perceived stress (range: 0–6)	1.29	1.43	1.19	1.32	1.11	1.29
About health (%)	36		33		33	
About finances (%)	31		30		25	
About work (%)	12		9		7	

Table 2. Results of Growth Curve Models for Global Perceived Stress and Perceived Stress About the Respondent's Own Health, Finances, and Work (n = 4,440)

(Predictor)→	(No stress exposure predictors included)[a]			
Perceived stress (outcome)↓	α	β	E→P	RMSEA/CFI
Global perceived stress	1.28***	−0.13***	_	0.022/0.991
Perceived stress about health	0.36***	−0.02**	_	0.020/0.984
Perceived stress about finances	0.32***	−0.04***	_	0.021/0.989
Perceived stress about work	0.12***	−0.03***	_	0.016/0.990

Notes. E = exposure to stressors; P = perceived stress; RMSEA = root mean square error of approximation; CFI = comparative fit index.
[a]Adjusted for age, sex, education, rural/urban status, and marital status (results not shown, but available upon request). Not adjusted for any indicators of exposure to stressors.
**p < .01. ***p < .001.

The models presented in Table 2 fit the data well, according to the measures of overall model fit. All values of the root mean square error of approximation (RMSEA) were below 0.05 and the comparative fit indices (CFIs) were above 0.95. Substantively, the results show that perceived stress tends to decline across waves regardless of which measure is considered. Note that, because the covariates were centered on their means, the means for alpha and beta are directly interpretable: they represent the average value of the perceived stress measure at baseline and the rate of change in the perceived stress measure across waves. Latent baseline global perceived stress, for example, had a predicted mean of 1.28 units (actual mean, from Table 1 was 1.29), and the mean growth rate was −0.13 units per study wave (actual rate, from Table 1 was −0.09: mean perceived stress fell from 1.29 to 1.11 across waves). The means for all Table 2 growth rates were negative and significant.

The models presented in Table 3 fit the data well, with one exception. All four models had RMSEAs below 0.05, but the CFI was substantially below 0.95 for the model for perceived stress about health. In each model, as in the models presented in Table 2, the pattern for perceived stress was one of decline: all four perceived stress measures had negative mean growth rates even after controlling for global exposure to stressors. The effect of exposure to stressors [E] on perceived stress [P], which is forced to be the same for each of the three waves, is positive and significant in all Table 3 models (e.g., E→P for the global perceived stress model is 0.05). In short, although global exposure to stressors temporarily increases perceived stress, the long-term pattern in perceived stress across age is negative.

The models presented in Table 4—in which health-related stress predicts growth curves for the four measures of perceived stress—fit the data well in general, based on RMSEA and CFI fit indices, and revealed the same pattern as the models in Tables 2 and 3. On average, perceived stress tends to decline over time, net of stress exposure. With the exception of perceived work stress, the effect of exposure to stressors on perceived stress was positive and significant for all models in Table 4. In other words, in both Tables 3 and 4 time-specific experience of stress exposure temporarily increases perceived stress, but the long-term pattern for perceived stress—no matter how it is measured—is one of decline.

Table 5 shows results of bivariate growth models in which *trajectories* of exposure to stressors predict trajectories of perceived stress. The table shows the results of eight models. The first set of columns (Model group I) shows results for models in which trajectories of global exposure to stressors predict trajectories of each of the four measures of perceived stress; the second set of columns (Model group II) shows results for models in which trajectories of

Table 3. Results of Growth Curve Models for Global Perceived Stress and Perceived Stress About the Respondent's Own Health, Finances, and Work With Time-Specific Global Stress Exposure Measures as Predictors at Level 1 (n = 4,440)

(Predictor)→	Global exposure to stressors[a]			
Perceived stress (outcome)↓	α	β	E→P	RMSEA/CFI
Global perceived stress	1.17***	−0.15***	0.05***	0.040/0.937
Perceived stress about health	0.30***	−0.03***	0.03***	0.044/0.869
Perceived stress about finances	0.28***	−0.05***	0.02***	0.029/0.957
Perceived stress about work	0.11***	−0.03***	0.01**	0.013/0.987

Notes. All covariates are mean centered. E = exposure to stressors; P = perceived stress; RMSEA = root mean square error of approximation; CFI = comparative fit index.
[a]Adjusted for covariates in Table 2 (results not shown, but available upon request) in addition to global exposure to stressors (E→P).
*p < .05. **p < .01. ***p < .001.

Table 4. Results of Growth Curve Models for Global Perceived Stress and Perceived Stress about the Respondent's Own Health, Finances, and Work With Time-Specific Measures of Health-Related Exposure to Stressors as Predictors at Level 1 (n = 4,440)

(Predictor)→	Health-related exposure to stressors[a]			
Perceived stress (outcome)↓	α	β	E→P	RMSEA/CFI
Global perceived stress	1.04***	−0.17***	0.19***	0.027/0.971
Perceived stress about health	0.19***	−0.04***	0.13***	0.039/0.925
Perceived stress about finances	0.27***	−0.05***	0.04***	0.016/0.987
Perceived stress about work	0.12***	−0.03***	0.00	0.021/0.965

Notes. All covariates are mean centered. E = exposure to stressors; P = perceived stress; RMSEA = root mean square error of approximation; CFI = comparative fit index.
[a]Adjusted for covariates in Table 2 (results not shown, but available upon request) in addition to health-related exposure to stressors (E→P).
***p < .001.

Table 5. Results of Growth Models in Which Trajectories of Exposure to Stressors Predict Trajectories of Perceived Stress (i.e., Level 2 models; n = 4,440)

Exposure to stressors (predictor)→	Model group I: Global exposure to stressors			Model group II: Health-related exposure to stressors		
Perceived stress (outcome)↓	(α→α)	(β→β)	RMSEA/CFI	(α→α)	(β→β)	RMSEA/CFI
Global perceived stress	0.20***	−0.04	0.057/0.939	0.35***	0.32***	0.027/0.989
Perceived stress about health	0.09***	−0.02	0.057/0.926	0.21***	0.19***	0.035/0.979
Perceived stress about finances	0.06***	0.01	0.055/0.939	0.07***	0.07**	0.019/0.994
Perceived stress about work	0.01*	0.01	0.054/0.932	−0.01	0.04*	0.022/0.991

Notes. All models adjusted for age, sex, education, rural/urban status, and marital status. All covariates are mean centered. CFI = comparative fit index; RMSEA = root mean square error of approximation; CFI = comparative fit index.
***p < .001.

health-related exposure to stressors predict trajectories of perceived stress. The table reports overall model fit statistics, the influence of latent intercepts for exposure on latent intercepts for perceptions, and the influence of latent growth rates for exposure on latent growth rates for perceptions.

Overall, the models in which trajectories of global exposure to stressors predict perceived stress trajectories (Model group I) have acceptable fit. The RMSEAs for each model are above 0.05, but only slightly, and the CFIs are below 0.95, but only slightly. In terms of the key model parameters, those experiencing greater global exposure to stressors at baseline also evidenced greater perceived stress at baseline: the relationship between latent intercepts was positive and statistically significant in all cases. However, there was no relationship between rates of change in global stress exposure and rates of change in perceived stress.

These results stand in contrast to those found in the Model group II in which trajectories of health-related exposure to stressors generally predict trajectories of perceived stress. In general, those models fit the data very well, with RMSEA values below 0.05 and CFI values well above 0.95. With the exception of perceived work stress, those with greater health-related exposure to stressors at baseline tended to have greater perceived stress at baseline, and the relationship between latent growth rates for exposure and perception was positive and statistically significant. In other words, those who experience increases (or decreases) in health-related stressors over the duration of the study tended to also experience increases (or decreases) in *all* domains of perceived stress.

Discussion

The purpose of this article was to examine patterns of perceived stress in later life and to investigate the role of stress exposure in shaping these patterns. Our findings

indicated that (a) perceived stress tended to decrease over time; (b) stress exposure in general elevates perceived stress but does not change the fundamental decline in any domain of perceived stress over age, even when exposure itself is modeled as a process; and (c) change in health-related exposure to stressors does affect change in almost every domain of perceived stress. In short, it appears that exposure and perception were only weakly associated across age in later life. Only health-related stress exposures appeared to predict trajectories of perceived stress, and although exposures predicted perceived stress in any given wave, the general pattern of perceived stress was one of decline across age.

To our knowledge, this study is the first to investigate trajectories of perceived stress over time among an older adult population. Our observation of a decline in perceived stress with time corresponds to the findings that negative affect decreases during late life (Carstensen et al., 2000; Charles, Reynolds, & Gatz, 2001; Mroczek & Kolarz, 1998), and that older adults tend to focus on positive stimuli rather than negative stimuli relative to younger adults (the positivity effect; Mather & Carstensen, 2005). It has been hypothesized that this positivity effect is due to an increased emphasis on emotional goals among older adults, which results in their preference for positive information and avoidance of negative information in the context of attention and memory (Mather & Carstensen, 2003). Relative to younger adults, older adults report greater self-control of their emotions and have higher self-reported ratings of emotion regulation skills (Gross et al., 1997; Lawton, Kleban, Rajagopal, & Dean, 1992). For instance, when dealing with an upsetting interpersonal situation, older adults indicate that they are less likely to employ destructive behavioral responses (e.g., name calling or shouting) than younger adults (Birditt & Fingerman, 2005). This finding would support the observed decline in perceived stress trajectories that we identify in our older Taiwanese population.

The positivity effect, originally considered in the context of older adults' memory and attention (Mather & Carstensen, 2003), could also be applied to perceptions of stress in late life. The greater emphasis on emotion regulation and use of cognitive mechanisms that diminish negative and enhance positive information may also be responsible, in part, for the lack of association between change in exposure to stressors and change in perceived stress that we observed.

Changes in exposure to stressors relating to an older adult's health, however, were found to be positively associated with perceived stress in our population of older Taiwanese adults. Increases in health-related stress exposure were associated with increased perceived stress. This exception to our general observation that change in exposure to stressors was not related to change in perceived stress underscores the importance of health conditions on perceptions of stress. This result is supported by findings from a separate study (Vasunilashorn, Glei, Weinstein, & Goldman, 2013) where the association between perceived stress and mortality was no longer observed after adjusting for measures of health status. In that study, two potential reasons for this finding were suggested: (a) health mediates the effects of perceived stress on mortality (i.e., higher perceived stress results in poorer health, which in turn, results in a higher risk of dying) or (b) poor health affects both perceptions of stress and risk of dying. Both reasons are consistent with the correlation between health and perceived stress and support our finding that increases in exposure to stressors related to health are associated with increases in perceived stress in late life.

Our study had a number of strengths. This population-based sample of older Taiwanese adults included questions about stress exposures and perceived stress that were asked consistently at three consecutive survey waves over an 8-year period within a substantially large and nationally representative sample of older adults. Furthermore, our application of latent growth curve analysis allowed us to examine relationships between stress exposure and perception in both the shorter and longer terms, something few studies have done.

We also note limitations of our study. Because our sample included only older adults residing in Taiwan, replications with samples from other geographic areas and age groups are needed. The age restriction of TLSA may be especially important because trajectories of stress exposures and perceived stress are likely to differ between older and middle-aged adults; the latter group may be experiencing multiple stressors related to the challenges of mid-life (e.g., individuals who care for their aging parents while supporting their own children). Another drawback is the availability of data for three observation periods, which permitted only a cursory investigation of nonlinearity in trajectories of exposure and perception.

Models of stress have long indicated a relationship between exposure to stressors and an individual's appraisal of stress. Our study has provided empirical evidence suggesting that changes in stress exposure and perceived stress are not associated, with the exception of health-related stress exposure, in later life. Future studies that examine the relationship between perceived stress and stress exposure in other age groups are especially important and will provide a better understanding of this relationship across the life course. Additionally, studies that examine the links between trajectories of exposure to stressors, perceived stress, and physiological response to stress (e.g., cortisol levels) that is not available for this data set would provide further insight into the links between stress and health in late life.

Supplementary Material

Supplementary material can be found at: http://psychsocgerontology.oxfordjournals.org/.

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