

# Do hassles and uplifts trajectories predict mortality? Longitudinal findings from the VA Normative Aging Study

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**Abstract** We examined whether longitudinal patterns of hassles and uplifts trajectories predicted mortality, using a sample of 1315 men from the VA Normative Aging Study (mean age = 65.31, SD = 7.6). In prior work, we identified different trajectory classes of hassles and uplifts exposure and intensity scores over a period of 16 years. In this study, we used the probabilities of these exposure and intensity class memberships to examine their ability to predict mortality. Men with higher probabilities of high hassle intensity trajectory class and high uplift intensity class had higher mortality risks. In a model combining the probabilities of hassle and uplift intensities, the probability of high intensity hassle class membership significantly increased the risk of mortality. This suggests that appraisals of hassles intensity are better predictors of mortality than

simple exposure measures, and that uplifts have no independent effects.

**Keywords** Aging · Hassles · Longitudinal · Mortality · Uplifts

## Introduction

Hassles and daily stressors are the ordinary problems of everyday life which are relatively frequent and cause tension or annoyance. Higher hassle levels are often associated with adverse physical health outcomes (Almeida, Piazza, Stawski, & Klein, 2011; Piazza, Charles, Sliwinski, Mogle, & Almeida, 2013; Zautra, 2003). While several studies have examined the effects of hassles or daily stressors on proximate outcomes such as self-reported health and cardiovascular disease, relatively few have considered the effects of hassles on distal outcomes, such as mortality (Piazza et al., 2013). Further, the few existing studies are conducted using two time points, overlooking possible non-linear or cumulative effects. Given the growing literature on positive *affect* and mortality (Chida & Steptoe, 2008), it would make sense that positive daily *experiences*, or uplifts, should also be associated with mortality, but little work exists in this area.

This study examined the roles of long-term trajectories of hassles and uplifts on mortality, using both measures of exposure—the number of daily events reported—and intensity, which refers to the strength of the experience. Given the lack of literature on the effects of hassles and uplifts on mortality, we reviewed more broadly the effects of stressful life events and chronic stress and positive experiences on other physical health outcomes (e.g. morbidity or self-reported health symptoms), as well as mortality.

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## Stress, health, and mortality

It is well-known that psychological stress is closely related to adverse physical health outcomes. Such adverse health outcomes include the occurrence of cardiovascular diseases, the progression and recurrence of cancer, the progression of HIV/AIDS, and self-reported health symptoms (for reviews, see Aldwin, 2007; Cohen, Janicki-Deverts, & Miller, 2007; Lovallo, 2015). Despite the well-known adverse effects of stressors on various health outcomes, less is known about their relation to mortality, and these results may vary by type of stressor. Most studies have examined stressful life events, and the results have been mixed, with some studies showing increases in mortality, others showing decreases, and many showing no effects at all (for a review see Aldwin et al., 2011).

Similarly, chronic psychosocial stress is assumed to increase the risk of mortality, but the results are mixed. For example, caregiving for loved ones with dementia has been shown to elevate the risk for mortality (Dodge & Kiecolt-Glaser, 2010; Schulz & Beach, 1999). However, Fredman, Cauley, Hochberg, Ensrud, and Doros (2010) found that low-stress caregivers had lower rates of mortality than non-caregivers or high stress caregivers. Also, the effects of both chronic work stress (Backé, Seidler, Latza, Rossnagel, & Schumann, 2012) and marital strain (Eaker, Sullivan, Kelly-Hayes, D'Agostino, & Benjamin, 2007) on mortality vary by gender and age. Unfortunately, most chronic stress studies focus on particular social roles (e.g. Turner, Wheaton, & Llyod, 1995). We were unable to locate any studies which examined general levels of chronic stress and mortality.

Most studies of daily stressors and hassles have focused on proximal outcomes. Early work on the effects of hassles examined self-reported health (e.g., DeLongis et al., 1982). However, there is some suggestion in the literature that daily stressors are related to a variety of adverse health outcomes (Piazza et al., 2013). For example, Schubert et al. (2009) found that hassles were significantly associated with decreased heart rate variability in a laboratory test of episodic versus chronic stresses. Gouin, Glaser, Malarkey, Beversdorf, and Kiecolt-Glaser (2012) found that daily stress was positively associated with inflammatory biomarkers, which, in turn, are associated with the long-term development of diseases such as Type 2 diabetes (Stringhini et al., 2013). However, Mroczek et al. (2013) did not find a significant relationship between the frequency of daily stressors and mortality, but they found that affective reactivity, especially decreases in positive affect, was related to mortality.

## Positive experiences, uplifts, and health

Uplifts are the positive daily events that individuals experience. Given that positive affect appears to have beneficial

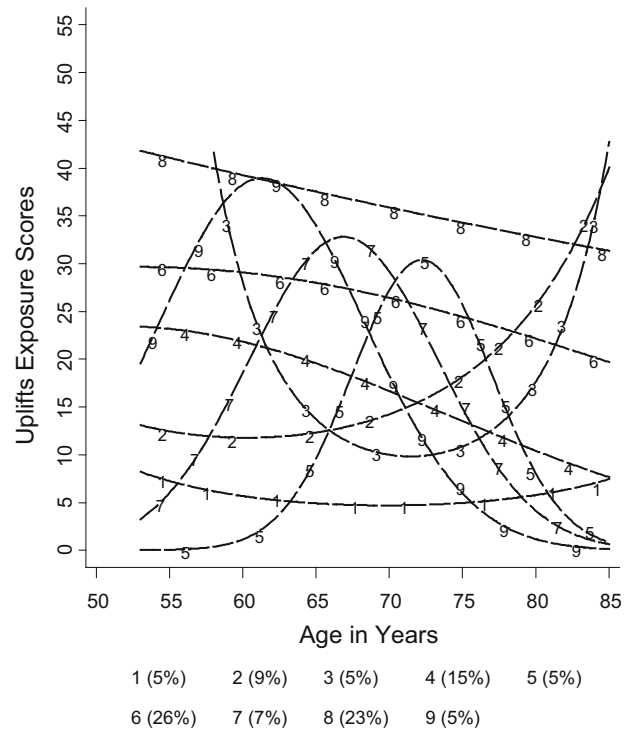
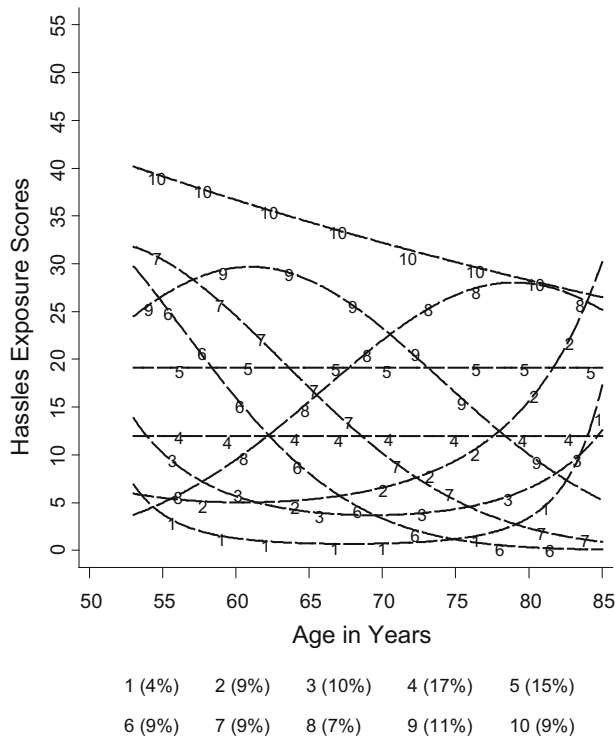
effects for health (Chida & Steptoe, 2008; Pressman & Cohen, 2005) and uplifts are associated with positive affect (Hurley & Kwon, 2013; Maybery, Jones-Ellis, Neale, & Arentz, 2006), it would be reasonable to assume that uplifts are also associated with health outcomes. However, surprisingly little research has examined this association. Moreover, findings from those studies have been inconsistent. For example, Ewedemi and Linn (1987) showed no significant relationship between uplifts and self-perceived health, while Williams, Zyzanski, and Wright (1992) found that higher uplift scores were positively correlated with the number of hospital admissions. DeLongis et al. (1982) also found a significant positive correlation between uplift frequency and numbers of somatic complaints, but the association disappeared when controlling for hassles. More recently, Sin, Graham-Engeland, Ong, and Almeida (2015) found that daily positive events were associated with lower levels of inflammatory markers.

Inconsistency in these findings may be due to the cross-sectional approach taken by many of these studies. It may be that longitudinal studies are needed to examine patterns of uplifts and their relationship with health over time (Folkman & Moskowitz, 2000; Maybery et al., 2006). To our knowledge, however, no studies have examined the extent to which long-term trajectories of uplifts are associated with physical health outcomes.

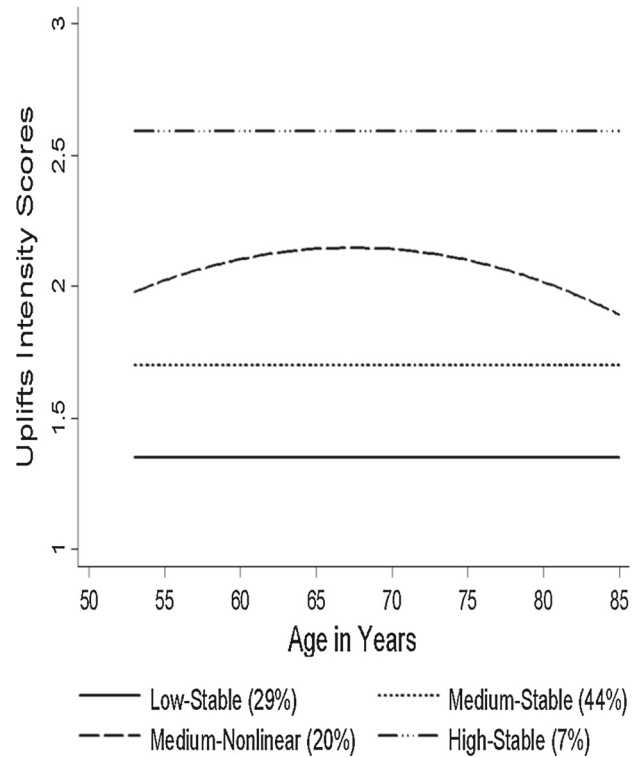
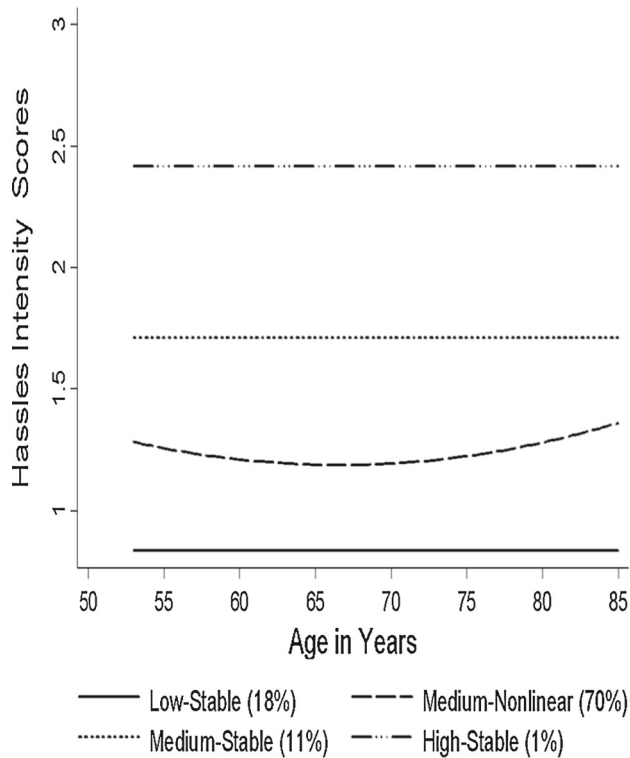
In summary, there are some major gaps in the literature with regard to the long-term health effects of experiencing hassles and uplifts. While it is unlikely that a single episode of hassles or uplifts would have long-term effects on health, it is possible that long-term patterns of hassles and uplifts may have more significant effects on mortality.

## Prior research

Using data from the Veterans Affairs (VA) Normative Aging Study, a long-term longitudinal study of aging men, our group has been actively researching both the patterns of change in stress with age, as well as their impact on health outcomes, over a span of two decades. The first study (Aldwin et al., 2011) examined patterns of long-term changes in stressful life events with age and their effects on mortality. While most patterns showed decreases over time, we identified three different trajectories of non-health-related stressful life events: consistently low, moderate, or high stress levels. Individuals in the consistently moderate and high groups had a 40–50 % higher risk of mortality compared to those in the low group, controlling for demographic characteristics and health behaviors. Interestingly, the mortality risk for those in the consistently high group was not greater in risk for those in the consistently moderate group. Thus, there were non-linear effects



(a)



(b)

**Fig. 1** Predicted trajectories for hassles and uplifts scores classes. From Aldwin et al. (2014b). **a** Predicted trajectories for hassles (left) and uplifts (right) exposure scores classes. **b** Predicted trajectories for hassles (left) and uplifts (right) intensity scores classes

of stress on mortality, supporting the analytical technique of examining classes of trajectories.

More recent work (Aldwin, Jeong, Igarashi, & Spiro, 2014b) identified different patterns of changes in hassles and uplifts over a 16-year period, using both exposure and intensity trajectories. Exposure scores are the number of hassles or uplifts events experienced (i.e., simple counts). Intensity scores are appraisals of the intensity of hassles and uplifts actually experienced (mean ratings). Not only did hassles and uplifts have different age-related trajectories, but exposure and intensity scores also were markedly different. Four patterns of hassles and uplifts intensity were found: low, medium, high, and a non-linear U shape (see Fig. 1). However, the exposure scores were far more complicated, with 10 and 9 classes for hassles and uplifts, respectively; see Fig. 1.

Preliminary analyses contrasted the effects of the hassles intensity classes and the stressful life event classes on mortality (Aldwin, Jeong, Igarashi, Choun, & Spiro, 2014a). We had expected that hassles intensity classes would mediate the effect of life events on mortality, but instead we found that stressful life events and hassles had independent effects. However, that study did not examine uplifts intensity, nor did it examine hassles and uplifts exposure scores. The primary purpose of the present study is to more completely examine the relationships between various longitudinal patterns of hassles and uplifts, using both exposure and intensity scores and mortality.

### Present study

The present study examined the relationship between the probabilities of hassles and uplifts trajectory class memberships over a 16-year period and mortality. This research is an expansion of our previous works in two ways. First, prior research did not examine the effects of uplifts on mortality. Second, we did not examine the association of the exposure scores with mortality.

Our first hypothesis is that, for both hassles exposure and intensity scores, higher probabilities of trajectory classes with higher or increasing higher levels will have higher risks of mortality. Given the generally protective relationship between positive affect and mortality risk (e.g., Pressman & Cohen, 2005), it would be reasonable to hypothesize that higher probabilities of uplift trajectory classes with higher levels of uplifts would be associated with decreased risk; however, given the cross-sectional studies cited earlier, it is also possible that higher levels of uplifts will be associated with higher mortality risk. Second, we expected that classes based on intensity scores will be better predictors than those based on frequency scores and will eliminate the effects of exposure, based on the finding that an individual's appraisals of stress are often

better predictors of outcomes than is mere exposure to stress (Aldwin, 2007). As DeLongis et al. (1982) found that uplifts had no effect on health outcomes independent of hassles, we hypothesize that the effects of uplifts on mortality will be attenuated by the inclusion of hassles in the same model. Given that neuroticism is associated with mortality (Mroczek, Spiro, & Turiano, 2009) and also with higher stress appraisals (Aldwin, Levenson, Spiro, & Bossé, 1989), we controlled for it, as well as demographic characteristics (e.g., marital status), self-rated health, and health behaviors, in all analyses.

## Methods

### Sample and procedure

The VA Normative Aging Study screened over six thousand men in Boston area between 1961 and 1970; 2280 men were selected based on their good health and strong social ties to the community. Men were considered to be in good health if they had no serious chronic illness and blood pressures below 140/90. These men were also selected for extensive family and social ties in the region (see Bell, Rose, & Damon, 1972). They had a higher socioeconomic status than the general Boston population. About 86 % had a high school diploma; more than 91 % of men were married at enrollment. The sample was primarily non-Hispanic white, similar to the racial composition of Boston in the late 1960s (Spiro & Bossé, 2001).

The Hassles and Uplifts Scale (HUS; DeLongis, Folkman, & Lazarus, 1988) was administered on the day of the triennial medical examination. Some 1336 men completed the hassles and uplifts questionnaires at least once over a 16-year period from 1989 to 2004. The men were 48–101 years old at baseline. Given small numbers of observations for men under age 53 or over 85, we excluded 104 observations from 89 men; only 21 men were completely excluded. Thus, the sample consisted of 1315 men (mean age = 63.31; SD = 7.6 in base year) having a total of 3894 observations, with a mean of 3.6 (SD = 1.3) observations for each man ranging from 1 to 6. Sample characteristics are presented in Table 1.

### Measures

#### Mortality

We examined the vital status of the men between 1990 and 2010. The NAS employs several procedures to acquire comprehensive information on deaths among the participants, including regular mailings of birthday and holiday cards and supplemental questionnaires. We also utilized

**Table 1** Sample characteristics ( $N = 1315$ )

	n	Percent (%)	Mean (SD)
Mortality status by 2010	1315		
Deceased	567	43.1	
Probability of class membership			
Hassle exposure	1313		
Class 1			0.04 (0.17)
Class 2			0.09 (0.21)
Class 3			0.10 (0.23)
Class 4			0.17 (0.29)
Class 5			0.15 (0.27)
Class 6			0.09 (0.24)
Class 7			0.09 (0.22)
Class 8			0.07 (0.18)
Class 9			0.11 (0.24)
Class 10			0.09 (0.24)
Hassles intensity	1293		
Low stable			0.29 (0.34)
Medium stable			0.44 (0.32)
Medium nonlinear			0.20 (0.29)
High stable			0.07 (0.22)
Probability of class membership	1311		
Exposure classes			0.05 (0.20)
Class 1			0.09 (0.23)
Class 2			0.05 (0.18)
Class 3			0.15 (0.28)
Class 4			0.05 (0.17)
Class 5			0.26 (0.33)
Class 6			0.07 (0.19)
Class 7			0.23 (0.37)
Class 8			0.05 (0.16)
Class 9			0.05 (0.20)
Intensity classes	1306		
Low stable			0.29 (0.34)
Medium stable			0.44 (0.32)
Medium nonlinear			0.20 (0.29)
High stable			0.07 (0.22)
Covariates			
Education	959		
Less than high school	90	9.4	
High school	285	29.7	
Some college or college degree	436	45.5	
Beyond college	148	15.4	
Married	1134		
Yes	1002	88.4	
Smoking	1304		
Yes	448	34.4	
Drinking status	996		
No drink	155	15.6	
Light/moderate drink	634	63.7	

**Table 1** continued

	n	Percent (%)	Mean (SD)
Heavy drink	207	20.8	
Self-rated health	1132		4.11 (0.69)
Neuroticism	1116		2.93 (2.21)

non-NAS participants as informants, such as next-of-kin and postal authorities. In addition, the NAS conducts routine checks for death records through the Department of Veterans Affairs and the Social Security Administration. Out of the 1315 men, 43.1 % ( $n = 567$ ) were deceased as of 2010.

#### *Individual probabilities of class memberships*

Aldwin et al. (2014b) examined how hassles and uplifts trajectories varied by age and identified different trajectory patterns of hassles and uplifts, using group-based-modeling (GBM). These trajectories of hassles and uplifts were based on the scores from the Hassles and Uplifts Scale (HUS; DeLongis et al., 1988) over a 16-year period. This scale examines both positive and negative daily experiences. The 53 items address health, work, interpersonal, intrapersonal, and environmental events. Each item is rated twice, first as to the degree the item had been a hassle and then the degree it had been an uplift, using a 4-point Likert scale (0 = *none or not applicable* to 3 = *a great deal*). For both hassles and uplifts, we computed two types of scores: exposure (a count of the number of events experienced) and intensity (average ratings for those items experienced). As seen in Fig. 1, four patterns were found for both hassles and uplifts intensity. However, the exposure patterns were much more complex, with ten and nine patterns found for hassles and uplifts, respectively.

For this study, we used the posterior probabilities of membership in the hassle and uplift exposure and intensity class memberships from the previous study (Aldwin et al., 2014b). They measure the probability that an individual with specific characteristics belongs to a specific trajectory class (Nagin, 2005). Therefore, each man in our sample has the total of 27 posterior probabilities of belonging to the various hassles and uplifts classes. Mean and SD for the probability of belonging to each group are presented in Table 1. Note that the probabilities are higher for the intensity classes, given that there are fewer classes.

#### *Covariates*

Demographic characteristics, health behaviors and status, and neuroticism were used as covariates (see Table 1). We

**Table 2** Imputed proportional hazard models for *Probabilities of Hassle Frequency & Intensity Class* memberships predicting all-cause mortality

	HR	<i>p</i>	95 % CI	
Covariates				
Education (ref = less than h.s)				
High school	0.96	0.80	0.69	1.33
Some college or college	0.79	0.14	0.58	1.08
Beyond college	0.84	0.34	0.59	1.20
Being married	0.72	0.02	0.55	0.94
Self-reported health	0.68	0.00	0.59	0.77
Smoking	1.04	0.69	0.87	1.24
Drinking (ref = no drinking)				
Light/moderate drinking	0.83	0.16	0.63	1.08
Heavy drinking	0.99	0.97	0.73	1.35
Neuroticism	1.00	0.84	0.96	1.05
Probabilities of frequency class membership (ref = Class 1)				
Class 2	0.71	0.31	0.37	1.36
Class 3	0.54	0.07	0.28	1.04
Class 4	0.55	0.05	0.30	1.00
Class 5	0.62	0.14	0.34	1.16
Class 6	0.63	0.16	0.33	1.19
Class 7	0.57	0.09	0.30	1.10
Class 8	0.56	0.11	0.28	1.13
Class 9	0.66	0.19	0.35	1.23
Class 10	0.56	0.08	0.30	1.08
Probabilities of intensity class membership (ref = low stable)				
Medium stable	1.40	0.15	0.88	2.23
Medium nonlinear	1.44	0.08	0.96	2.18
High stable	3.51	0.00	1.55	7.97

obtained information on participants’ education from self-reports in 1986 from the MMPI-2 survey (Butcher et al., 1991). Education was categorized into four levels (1 = less than high school, 2 = high school or equivalent, 3 = some college or college degree, 4 = beyond college). Among the sample, those with some college or college education were the largest group (45.5 %), followed by high school graduates (29.7 %). Only 9 % of the sample did not complete high school. High school education was the reference category, and three dummy variables were included in the analysis. Marital status was drawn from 1988 Social Survey (Bossé, Aldwin, Levenson, Spiro, & Mroczek, 1993). Marital status was dichotomized (0 = non-married; 1 = married); most of the study sample (88 %) was married.

The health behaviors of tobacco and alcohol consumption were included as covariates. Smoking status was drawn from a self-report on the day of medical exam. It was dichotomized (0 = not currently smoking; 1 = currently smoking); 34 % of the sample were current smokers.

Drinking status was obtained from the MMPI-2 survey 1986. We used three categories: non-drinkers (15.6 %) were those who had never consumed alcohol or who used to drink but did not drink anymore at the interview; light/moderate drinkers (63.7 %) included those who drank socially or who drank to get high; and heavy drinkers (20.8 %) were those who often drank excessively, had serious drinking problems, considered themselves as alcoholic, or had been treated for alcohol problem. Health status was self-reported in the 1988 Social Survey (Bossé et al., 1993) and was rated on 5-Likert scale (1 = very poor to 5 = excellent). In this study, this variable was treated continuous. Men in this study rated their health as “good” on average (mean = 4.11; SD = 0.69).

Neuroticism was measured with nine dichotomous items from the Eysenck Personality Inventory (EPI-Q; Floderus, 1974) from 1988 Social Support Survey. To compute the scores, we included respondents with at least seven valid items, and then calculated neuroticism scores by multiplying the mean of valid items by 9, the number of items on



the scale. The average neuroticism score was 2.93 (SD = 2.21). We used the Kuder-Richardson Formula 20 (KR20) to estimate internal reliability. For this sample, KR20 = 0.71.

## Analyses

Cox proportional hazard models were computed using *Stata 13* (StataCorp, 2013) to investigate the extent to which probabilities of class membership were associated with mortality, controlling for the covariates. The duration of survival was calculated from the first year when HUS was assessed until either the year of death or 2010, the last year with complete vital status data.

It is important to note that nearly a fifth of the items in the hassles and uplifts scale are health-related, broadly defined, including exercise, health, medical care, physical appearance, alcohol, smoking, mind altering drug use, physical abilities, and the like. We considered excluding these health-related items from hassles and uplift scores and did a factor analysis to identify which items were exclusively addressing health matters. However, the factors were not clearly defined—perhaps because the items did not center around physical symptoms or diseases per se. Further, it is possible that a hassle involving smoking, for example, could have referred to annoyance with another's smoking, a problem in trying to quit, or difficulty finding a particular brand of cigarettes. Medical care hassles could have involved making an appointment for one's own health problem or a family member's. Thus, rather than excluding a large number of items from the scale scores, making comparability to other studies problematic, we controlled for baseline self-rated health status in the survival analyses.

We computed two separate proportional hazards models examining the relationship between the probabilities of hassles exposure and intensity classes and the probabilities of uplifts exposure and intensity classes with mortality, controlling for demographic characteristics, health behaviors, self-rated health, and neuroticism. Then we computed a third model which examined the joint influences of probabilities of classes found to be significant in the previous two models. For the reference class, we used the class that had the lowest levels of hassles or uplifts for each analysis.

As can be seen in Table 1, the covariates had a number of missing values which would have decreased the sample size if listwise deletion had been used. Consequently, we employed multiple imputation using *mi impute and mi combine* in *Stata 13* (StataCorp, 2013) to treat non-response bias (Vinnard, Bisoon, & Winston, 2013). Multiple imputation involves three steps (StataCorp, 2013). In the first step, a certain number of completed datasets are created under a chosen imputed model. For this study, we

added death status and survival years as well as the covariates to generate 20 imputed data sets, following the recommendation that a censoring factor and the survival time be included as predictors (Royston, 2004). In addition, these two variables were related to the missing pattern of the covariates. We used 20 imputations, the number regarded as the lowest number that can reduce the sample error due to imputations (StataCorp, 2013). In the second step of multiple imputation, the survival analyses were conducted on each of the 20 imputed datasets. Lastly, the estimates of the models from the 20 imputed datasets were combined into a single multiple-imputation result. The results after imputation were similar to the ones with non-imputed data, so we present the results based on the imputed dataset. The non-imputed data sets are presented in the online Appendix A.

## Results

### Probabilities of trajectory classes and mortality: survival analyses

In the following analyses, we entered demographic characteristics, health behaviors, self-reported health, and neuroticism as covariates. Across analyses, being married and having better self-reported health were consistently protective, with significant hazard ratios (HRs) < 1.0. No other covariates were significantly associated with mortality in this sample.

Table 2 presents the model examined for the probabilities of hassle exposure and intensity score trajectory class memberships and mortality. None of the probabilities of the hassle exposure class memberships reached significance. Men with higher probabilities in classes 3, 4, 7, and 10 had marginally lower risks of mortality, with from HRs ranging from 0.54 to 0.57. However, the CIs all included one, and there were no similarities in the intercepts and slopes across these classes.

In contrast, the probabilities of membership in hassle intensity classes were related to mortality in ways consistent with our hypotheses. Men with higher probabilities of belonging to higher levels of intensity classes had greater mortality risk. A probability of the high stable class membership was associated with the most mortality risk, HR = 3.51 (95 % CI 1.55, 7.97). A probability of medium nonlinear class membership showed a marginally increased mortality, HR = 1.44 (95 % CI 0.96, 2.18). We did post estimation in order to test the equality of coefficients of the high stable and medium nonlinear class membership probabilities. The result showed that these two coefficients were significantly different,  $F(1, 120430.9) = 5.39$ ,

$p = 0.02$ , which indicates that perceiving hassles as more stressful increased the risk of mortality.

Table 3 presents the effects of probabilities belonging to uplift exposure and intensity classes on all-cause mortality. Again, none of the classes of uplift exposure were significantly associated with mortality risk. The probabilities of being a member in three uplift frequency classes (2, 4, and 6) decreased mortality risk, although the effects were marginal with HRs from 0.63 to 0.66 and there was no consistency across the groups in either intercept or slopes. Contrary to our hypotheses, individuals who consistently reported high intensity uplifts had 54 % higher risk of mortality HR = 1.54 (95 % CI 1.03, 2.30), compared to the low stable intensity class. Overall, the results indicated that the number of events that one experienced was less important than how intensely those experienced were appraised.

We examined whether hassles and uplifts intensity classes contributed independent or had overlapping variance to mortality, controlling for the covariates (see Table 4). We excluded the simple exposure classes, as none of the classes in hassles or uplifts significantly predicted mortality in the prior analyses. The results showed that the probability of being in the high stable hassle intensity class membership was significantly associated with a greater risk of mortality, HR = 2.81 (95 % CI 1.19, 6.65), compared to the low stable class membership. However, none of probabilities belonging to the uplift intensity classes remained significant. This suggests that the hassles intensity may be more useful for estimating risk of mortality than uplifts intensity.

## Discussion

While minor stressful events such as daily hassles are known to affect proximal health outcomes, less is known about their ability to predict distal health outcomes, and even fewer studies exist on the health effects (whether short-term or long-term) of uplifts, or positive events. It is unlikely that one hassle would have long-term effects, but we reasoned that the long-term patterns of both exposure to hassles and uplifts, as well as how one appraises them (e.g., intensity of the experience) might have health consequences, including mortality. Accordingly, we calculated classes of hassles and uplifts trajectories over a 16-year period, separately examining exposure and intensity, to examine the ways in which trajectories of negative and positive experiences were related to an important distal health outcome, mortality. Using Cox proportional hazard models, we investigated the association of probabilities of membership in trajectory patterns of hassles and uplifts exposure and intensity scores with mortality.

The probabilities of hassle and uplift intensity class memberships were related to mortality. Again, the findings were partly unexpected. As found previously (Aldwin et al., 2014a), individuals in higher levels of hassle intensity classes showed higher risks of mortality. In particular, the men with higher probabilities in the high stable hassle intensity class were approximately three times more likely to die than those who consistently appraised their hassles as not very stressful. These results support Fredman et al.'s (2010) finding that only those who reported high levels of stress experienced higher risk of mortality. However, we also observed the unexpected finding that individuals in the high stable uplift intensity class had a 54 % higher mortality risk. While surprising, this is in line with Pressman and Cohen's (2005) observation that intense emotions, whether positive or negative, result in physiological arousal, which can have negative consequences, especially for those with cardiovascular conditions.

The analyses examining the different classes of trajectories found a surprising and counter-intuitive result. Individuals in higher probabilities of several higher hassle exposure trajectory classes showed marginally lower risks of mortality, compared to the probability of low stable hassle class membership. Despite statistically non-significant results, this unexpected direction may be interpreted in several ways. Those with higher exposure to hassle events may have more social roles than those who have fewer roles in later life. With more social roles, they might have had a greater sense of meaning or purpose in life, which has been shown to be associated with greater longevity (Park, 2010). Alternatively, individuals who maintained more social roles and thus experienced more hassles might be healthier than individuals who were forced to relinquish social roles due to ill health and thus reported fewer hassles. However, further examination is needed because four classes marginally associated with mortality had lower scores at some points than the comparison class. Another caution should be taken because whether this direction reflects the beneficial effects of a full and meaningful life or simply better health status is still unclear. Perhaps the men who consistently reported low levels of hassles and uplifts are those who Lowenthal, Thurner, and Chiriboga (1975) considered to be self-limiting individuals, which may have unfortunate health consequences.

Finally, we also examined the independent effects of the probabilities of hassle and uplift intensity class memberships on mortality. The results showed that the probabilities of hassle intensity class memberships were mostly associated with mortality, and the highest level of hassle intensity predicted higher mortality risk. Contrast to this finding, Nielsen et al. (2008) found that both high levels of exposure and intensity of daily stressors predicted cardiovas-



**Table 3** Imputed proportional hazard models for *Probabilities of Uplift Frequency & Intensity Class* memberships predicting all-cause mortality

	HR	<i>p</i>	95 % CI	
Covariates				
Education (ref = less than h.s)				
High school	1.00	0.99	0.72	1.38
Some college or college	0.84	0.27	0.61	1.15
Beyond college	0.89	0.53	0.62	1.28
Being married	0.73	0.02	0.56	0.95
Self-reported health	0.68	0.00	0.60	0.77
Smoking	1.01	0.88	0.85	1.21
Drinking (ref = no drinking)				
Light/moderate drinking	0.80	0.10	0.62	1.04
Heavy drinking	1.00	1.00	0.74	1.36
Neuroticism	1.01	0.52	0.97	1.06
Probabilities of frequency class membership (ref = Class 1)				
Class 2	0.64	0.08	0.38	1.06
Class 3	0.74	0.30	0.41	1.31
Class 4	0.63	0.05	0.40	1.00
Class 5	1.28	0.37	0.74	2.20
Class 6	0.66	0.05	0.43	1.00
Class 7	0.90	0.70	0.52	1.55
Class 8	0.72	0.13	0.47	1.10
Class 9	0.76	0.35	0.42	1.37
Probabilities of intensity class membership (ref = low stable)				
Medium stable	1.04	0.83	0.76	1.41
Medium nonlinear	1.03	0.87	0.75	1.40
High stable	1.54	0.04	1.03	2.30

cular mortality, especially among men. This may be due either to differences in the types of stress measures used, or in the fact that Nielsen's sample had more power to detect these types of relationships. Indeed, adding in all of the classes in the full model decreased the degrees of freedom, but the HRs in the individual models were not that dissimilar from those in the full model, suggesting that they may have remained significant in a model with a larger sample and thus more power.

As mentioned earlier, the findings of hassles intensity predicting mortality is consistent with Piazza et al.'s (2013) daily diary study showing that emotional reactivity to daily stressors increased the risk of physical health problems. However, negative emotional reactivity, defined as the correlation between stress and negative affect in Mroczek et al. (2013), did not predict mortality. Mroczek et al. (2013) found that positive emotional reactivity, in terms of decreased positive affect in response to stress, predicted mortality. It is important to note that both the Piazza et al. (2013) and Mroczek et al. (2013) studies involved short-term (daily) data and are not directly comparable to the

current study that examined patterns of hassles exposure and intensity over 16 years.

Because neuroticism is correlated with ratings of the stressfulness of events (Aldwin et al., 1989), and has been shown to predict mortality in the NAS men (Mroczek et al., 2009), we covaried neuroticism in our models. Surprisingly, neuroticism did not predict mortality in our sample. However, Mroczek et al.'s study utilized the 1976 assessment of neuroticism and thus had a larger, younger sample and longer follow-up period. We utilized the 1988 assessment in a smaller, older sample. Other studies in older samples have also shown no effects of neuroticism (Costa et al., 2014) or have shown that it is inversely associated with mortality (Friedman, Kern, & Reynolds, 2010). Thus, it would be interesting to see if the adverse effects of neuroticism are seen primarily in mid-life.

Similarly, smoking was unrelated to mortality in this study. This is because very few of the NAS men smoke; further, the older men who have higher mortality risk are less likely to smoke than the younger men, perhaps due to survivor effects. In addition, the nonsignificant effect of

**Table 4** Imputed proportional hazard models for *Probabilities of Hassle & Uplift Intensity Class* memberships predicting all-cause mortality

	HR	<i>p</i>	95 % CI	
Covariates				
Education (ref = less than h.s)				
High school	0.95	0.74	0.68	1.31
Some college or college	0.78	0.12	0.57	1.06
Beyond college	0.82	0.29	0.58	1.18
Being married	0.72	0.01	0.55	0.94
Self-reported health	0.68	0.00	0.59	0.77
Smoking	1.03	0.78	0.86	1.23
Drinking (ref = no drinking)				
Light/moderate drinking	0.82	0.12	0.63	1.06
Heavy drinking	0.99	0.96	0.73	1.35
Neuroticism	1.00	0.98	0.96	1.04
Probabilities of hassle intensity class membership (ref = low stable)				
Medium stable	1.32	0.25	0.83	2.09
Medium nonlinear	1.40	0.09	0.95	2.08
High stable	2.81	0.02	1.19	6.65
Probabilities of uplift intensity class membership (ref = low stable)				
Medium stable	0.98	0.89	0.72	1.34
Medium nonlinear	0.98	0.88	0.71	1.34
High stable	1.33	0.22	0.84	2.08

smoking on mortality risk can be due to the selection effect of this sample at recruitment.

**Limitations**

Several limitations should be noted. As pointed in previous studies using the NAS data with all male, primarily of European American ancestry, first, the study sample did not include other racial/ethnic groups and women. Second, the number of respondents varied slightly across the analyses due to the manner in which intensity scores were computed. As mentioned earlier, the number of men in some classes was fairly low, and it is possible that a larger sample size might have provided more consistency in the findings.

In addition, the hassles and uplifts measure includes about 10 items which are related to health, broadly defined. In studies examining the impact of stress on health outcomes, it is generally preferable to delete the health items from the scale. However, the hassles scale tends to use very general wording, and it was impossible for us to determine the nature of the problem (or uplift) and even to whom it happened. Thus, a “smoking” hassle could have referred to being annoyed by someone else’s smoking, physical appearance hassles could refer to something as trivial as a “bad hair” day, and so on. Thus, we opted to leave these items in the scale to make it comparable to other studies which have examined hassles and health, none of which (it

should be noted) deleted these items, and instead opted to covary self-rated health. Given the fact that higher exposure to hassles was associated with *lower* risk of mortality, we feel that this strategy was justified. Nonetheless, future studies should examine cross-lagged effects (e.g., Finch et al., 2012) between other health measures and these hassle items to tease apart possible confounds.

Despite these limitations, we feel that the strength of this study lies in our ability to characterize long-term patterns of hassles and uplifts exposures and intensity. To our knowledge, the NAS is the only study to examine hassles and uplifts over nearly two decades, and no comparable data set exists.

**Summary and future directions**

This study showed that probabilities of hassle and uplift trajectory memberships predicted mortality, with groups showing probabilities of higher hassle intensity trajectory class memberships experiencing higher mortality. These results support prior research regarding the impact of high levels of daily stressors on health (Almeida et al., 2011) and extend that work by demonstrating the relationship between the experience of high hassle intensity over time and increased risk of mortality.

Future research should examine the relations among hassles, uplifts, and health in other samples with more diverse characteristics, including women and minorities.

Future research should also examine biomarker, social, and psychological mediators to understand why longitudinal patterns of hassles and uplifts are associated with mortality.

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#### Compliance with ethical standards

**Conflict of interest** Authors Yu-Jin Jeong, Carolyn M. Aldwin, Heidi Igarashi, and Avron Spiro III declare that they have no conflict of interest.

**Human and animal rights and Informed consent** All procedures followed were in accordance with ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants for being included in the study.

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