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The effects of the Columbia shuttle disaster on the daily lives of older adults: Findings from the VA Normative Aging Study

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Abstract
During 2002–2003 the VA Normative Aging Study conducted an eight-day diary survey of stressors and well-being. A sub-sample of 19 men and 13 women (mean age = 71.78) completed daily questionnaires before and after the Columbia shuttle exploded on 1st February 2003, presenting a unique look into peoples' daily lives before and after a tragic event. Results indicated no significant changes in negative affect or physical symptoms, but people reported significant decreases in both positive affect and memory failures on days following the shuttle explosion. Implications of these findings and directions for future research are discussed.

Introduction

Events that are appraised as stressors typically have potent negative effects on physical, psychological, (Almeida & Kessler, 1998; Almeida, Wethington, & Kessler, 2002; Bolger, DeLongis, Kessler & Schilling, 1989; Mroczek & Almeida, 2004) and cognitive (Sapolsky, 1992) health. When the Columbia shuttle exploded on 1st February 2003, the VA Normative Aging Study (NAS) was conducting a daily diary investigation of daily stressors and well-being. While the explosion of the shuttle was a tragic event, it may or may not have acted as a stressor for the participants in the study. Therefore, one of the central goals of the present investigation was to examine whether the shuttle explosion functioned as a stressful event in individuals' daily lives; that is, whether it was associated with increased negative affect, decreased positive affect, increased physical symptoms, and increased memory failures. An additional goal of the present study was to examine responses to a tragic event to which all participants had been exposed. In this naturalistic experiment, we sought to examine the effects of an event as it occurred to examine its potential impact on various indicators of well-being.

Affect is particularly useful for measuring psychological well-being because the preponderance of either positive or negative affect comes closest to an everyday meaning of happiness (Diener, Suh, Lucas, & Smith, 1999). Although there are other important models of well-being (e.g., Ryff, 1989), most researchers rely on participants' global reports of well-being typically recalled over months and even years, which are largely correlated with personality traits and relatively stable (Costa, Somerfield, & McCrae, 1996). An advantage of daily reporting is the ability to assess intra-individual variability—the extent to which people fluctuate around their own average level of affect (Nesselroade & Boker, 1994). Unlike average levels of affect, intra-individual variability seems to reflect environmental influences rather than innate factors (Lykken & Tellegen, 1996). Perhaps the most valuable feature of diary methods is the ability to assess within-person processes (Almeida, 2005). This represents a shift from assessing mean levels of events and well-being between individuals to charting the day-to-day fluctuations in events and well-being within an individual as well as to identify their predictors, correlates and sequelae (Reis & Gable, 2000). For example, instead of asking whether individuals with high levels of work stress experience more distress than individuals with less stressful jobs, a researcher can ask whether a worker experiences more distress on days when he or she has too many deadlines (or is reprimanded) compared to days when work has been stress free. This within-person approach allows the

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researcher to rule out temporally stable personality and environmental variables as third variable explanations for the relationship between events and well-being (Almeida, 2005). By establishing within-person through-time associations between events and well-being, researchers can more precisely establish the short-term effects of concrete daily experiences (Bolger, Davis, & Rafaeli, 2003; Larson & Almeida, 1999). In addition, measuring affective well-being over shorter time frames may more accurately reflect actual experience, because length of recall period systematically influences how people recall emotions (Parkinson, Briner, Reynolds, & Totterdell, 1995; Winkielman, Knauper, & Schwartz, 1998).

In addition to the potential affective reactions to events, daily physical symptoms are also important to examine in order to more comprehensively assess the impact of events on individuals' well-being. Daily health symptoms, such as headaches and musculoskeletal problems, significantly impact the ongoing lives of adults. Verbrugge (1986) argued that the study of daily symptoms is critical because 'most of the daily discomforts of our lives are known only to ourselves and our families. There is no count of them in our national health statistics, which record only the problems that send us to a doctor, put us in the hospital, or kill us' (p. 34). These symptoms may not only reflect or exacerbate major health problems, but also act in insidious ways by interfering with our day-to-day activities, satisfaction, and affective well-being (e.g., Van Wijk, Huisman, & Kolk, 1999).

Events or situations that are appraised as stressful have also been linked to poorer cognitive functioning. Specifically, laboratory-based studies have generally found a link between stress hormones, decreased hippocampal volume, and impaired cognitive functioning. People who experience more acute stressors (and therefore acute changes in the stress hormone cortisol) tend to have poorer memory functioning compared to people with fewer acute stressors (e.g., Vedhara, Hyde, Gilchrist, Tytherleigh, & Plummer, 2000). Newcomer et al. (1999) found that several days of exposure to cortisol at doses and plasma concentrations associated with physical and psychological stress can reversibly decrease specific elements of memory performance in otherwise healthy individuals. Additionally, some studies have linked everyday stressors with poorer laboratory-based memory performance (e.g., VonDras, Powless, Olson, Wheeler, & Snudden, 2005). These studies, however, do not explain the entire picture of the relationship between naturally occurring stressors and cognitive performance. For example, many previous studies have focused solely on the relationship between physiological indicators of stress and cognition. In the present study, we sought to examine whether the tragic event of the Columbia shuttle explosion would function as a stressor and therefore lead to an increase in memory failures.

The present study

During 2002–2003 the VA Normative Aging Study (NAS) conducted by mail a daily diary survey of stressors and well-being that participants completed for eight consecutive evenings. A current theory of well-being argues that understanding global aspects of well-being requires a careful consideration of more micro-levels of behaviors and experiences (Kahneman, Diener, & Schwarz, 1999). Although the original intention of the project was to assess the impact of daily stressors on daily well-being in a micro-level context, the explosion of the Columbia shuttle on 1st February 2003 presented an opportunity to examine the impact of a shared national event on daily well-being. In order to examine the potential reactions of the older adults in the present investigation to a shared event, we examined three different aspects of well-being: (a) psychological (defined and measured in terms of affect); (b) physical (operationalized as daily physical health symptoms); and (c) memory (assessed via memory failures). If the shuttle explosion functioned as a stressor for participants, it was expected that individuals would experience increases in negative affect, physical symptoms, and memory failures, and decreases in positive affect after the shuttle explosion.

Method

Sample

Participants were drawn from the VA Normative Aging Study, a longitudinal study that began in the 1960s as an investigation of normal aging processes in men (Bossé, Ekerdt, & Silbert, 1984; Spiro & Bossé, 2001). Starting in August 2002, recruitment began for the daily diary study. Between August 2002 and April 2003, we contacted 529 NAS respondents and their wives and invited them to participate. Of these, 374 agreed, and 333 (181 men, 152 women) returned usable surveys. Most participants completed all eight days of the study (2649 diary days completed), yielding a compliance rate of 99%. Respondents who completed the diary did not differ significantly from those who refused on variables such as neuroticism, number of stressful life events, health, age, or marital status.

The present paper used data primarily from respondents who happened to be participating in the project during the week of the Columbia shuttle explosion. Although 37 participants experienced the shuttle explosion during the diary study, five of those participants began the study on the day the shuttle exploded (1st February 2003). Therefore, changes in well-being surrounding the shuttle explosion could

not be modeled for these individuals, so the sub-sample used in the present analyses consisted of 32 individuals. This sub-sample ($n = 32$; 19 men, 13 women) ranging in age from 59–89 years ($M = 71.78$, $SD = 6.84$) completed the diary before (85 total observations; 2.65 days on average per participant) and after (171 total observations; 5.34 days on average per participant) the Columbia shuttle exploded on 1st February 2003. This was a national news event, and although the NAS began in Boston, many of the participants have moved. Thus, it should be noted that some of the participants in the shuttle sub-sample were not living in the Boston area (e.g., two were in Rhode Island and two were in Maine).

Some of the participants were part of a couple where both members were reporting ($n = 10$ couples), thus the data cannot be considered completely independent. However, issues at the couple level were not the central focus of the present study. Therefore, analyses (aggregated across persons) were conducted to determine if it was appropriate to treat the data as coming from independent sources. Specifically, bivariate correlations were conducted to see if there were any significant associations between wives' and husbands' indicators of daily well-being (i.e., physical symptoms, positive affect, negative affect, and memory failures). None of the husbands' and wives' variables were significantly related, so subsequent analyses treated the participants' responses as independent observations.

Because the data used in the present investigation were drawn from a larger dataset, analyses were conducted to compare individuals who participated in a mailed survey in 2001 (but who did not participate in the diary study), with the two sub-samples of diary participants (i.e., those who did not experience the shuttle explosion during the time of the study and those who did). The three samples did not differ significantly from each other on any of the variables in Table I.

Procedure

Instructions indicating when to complete the diary (approximately ½ hour before going to bed) and when to return the surveys (all at once when the eight were completed), a pre-addressed postage-paid envelope, and a form to be completed for payment were sent to each participant. For eight consecutive evenings, participants completed short semi-structured questionnaires consisting of mostly forced-choice responses about their daily experiences (e.g., stressors, physical symptoms, positive and negative affect, memory failures). On the final day participants were also asked questions regarding the previous week. Husbands and wives were instructed to complete each survey separately. At the conclusion of the eight-day period, participants returned the completed diaries; if they completed five or more of the eight study days, they received an honorarium of $30; if they completed four or fewer days, they received $15.

Diary measures

Daily affect. The Positive and Negative Affect Schedule (PANAS: Watson, Clark, & Tellegen, 1988) was used to measure daily affect. The PANAS is a brief measure that consists of two 10-item mood scales. The scales contain words that describe different feelings and emotions (e.g., upset, enthusiastic), and participants were asked to indicate to what extent they felt each of the emotions on that day. Responses ranged from 1 (very slightly or not at all) to 5 (extremely). The PANAS scales have been shown to demonstrate acceptably high internal consistency reliabilities, with alphas ranging from 0.84 to 0.90 (Watson et al., 1988). In addition, PANAS scores have shown seven year stability and very good test-retest reliabilities (Watson & Walker, 1996). One composite score for each indicator of affect (positive and negative) was created, with a higher score indicating more of the target construct. Positive and negative affect

Table I. Comparisons of the three sub-samples.

Variable	Not in diary $n = 792$ M (SD)	In diary, no shuttle day $n = 296$ M (SD)	Shuttle sub-sample $n = 37$ M (SD)
Background variables (2001)			
Age	72.50 (7.53)	71.54 (7.23)	70.51 (6.62)
Neuroticism	2.29 (2.20)	2.23 (2.09)	2.05 (1.93)
Life event stressors	3.74 (4.18)	3.33 (3.28)	3.59 (5.43)
Self-rated health	2.69 (0.97)	2.58 (0.95)	2.54 (0.96)
Daily diary variables (2002–2003)			
Physical symptoms	–	1.60 (1.25)	1.43 (1.23)
Memory failures	–	0.97 (0.89)	0.70 (0.73)
Positive affect	–	27.19 (9.21)	26.76 (8.03)
Negative affect	–	12.58 (3.38)	11.79 (2.19)
Stressors	–	0.85 (0.82)	0.87 (0.69)

None of the samples differed significantly from each other on any of the variables.

were treated as distinct constructs based on recent studies from cognitive neuroscience (e.g., Davidson, Shackman, & Maxwell, 2004; Murphy, Nimmo-Smith, & Lawrence, 2003) where it has been documented that positive and negative affect are activated in different areas of the brain, as well as studies on the PANAS itself (e.g., Crawford & Henry, 2004), where the best fitting model is one with positive affect and negative affect as separate constructs (although slightly negatively related).

Daily physical symptoms. Daily physical symptoms were measured using a shortened version of Larsen and Kasimatis' (1991) physical symptom checklist. The 13-item scale assessed symptoms such as aches/pain (headaches, backaches, and muscle soreness), gastrointestinal symptoms (poor appetite, nausea/upset stomach, constipation/diarrhea), chest pain or dizziness (symptoms often associated with cardiovascular functioning), and upper respiratory infection symptoms (sore throat, runny nose, congestion). Two additional items (cold/flu symptoms and joint pain) were included in the checklist. Each day the respondents indicated whether they experienced each symptom over the past 24 hours. A composite score for total physical symptoms on each day was calculated, with a higher score indicating more physical symptoms.

Everyday memory failures. Everyday memory failures were assessed through a shortened version of an everyday memory questionnaire developed by Sunderland, Harris and Baddeley (1983). The original questionnaire consisted of 35 questions designed to tap five distinct aspects of everyday memory failures (i.e., speech, reading and writing, faces and places, actions, and learning new things). In order to demonstrate the validity of the questionnaire, Sunderland et al. (1983) conducted correlations between the subjective test (i.e., the 35-item questionnaire) and objective tests (i.e., laboratory-based cognitive tests). More frequent subjectively reported memory failures were associated with poorer immediate ($r = 0.50$) and delayed ($r = 0.46$) story recall. Additionally, more subjective memory failures were also associated with poorer performance on an objective paired association task ($r = 0.46$). To reduce participant burden in the present study, we selected one item from each of the five dimensions (see the Appendix), because they assessed memory failures common in an aging sample. To demonstrate that a shortened version of this scale could maintain the five domains of the original scale and also capture commonly experienced memory failures, a pilot study ($n = 30$; 16 men, 14 women) was conducted in October 2001. Participants were a convenience sample from the Tucson community and ranged in age from 35–82 ($M = 56$, $SD = 10.2$). The five everyday memory questions outlined above were included in a daily diary questionnaire where participants completed the survey every evening for eight consecutive days. Results indicated that the five items tap different aspects of memory failures (i.e., bivariate correlations ranged from 0.20 to 0.45), suggesting that the shortened version maintains the original goal of five distinct memory failure types by Sunderland et al. (1983). An additional question was added to assess everyday memory failures regarding use of prescription medication. A consistent medication regimen is a critical component of the maintenance of health as people age, and although many older adults (age 55+ years) incorporate taking prescription medication into their daily routines, as many as 50–75% do not adhere to the medication regimen presented to them (O'Brien, Petrie, & Raeburn, 1992). Although there are numerous reasons for non-adherence to prescription medications (e.g., price of medication, belief that the medication is not helping), the present study focused on non-adherence associated with memory failures. A composite score for total memory failures on each day was calculated, with a higher score indicating more memory failures.

Daily stressors. Daily stressors were assessed via the Daily Inventory of Stressful Events (DISE; Almeida et al., 2002). Participants answered seven questions regarding arguments, potential arguments, stressors that occur at work/volunteer settings and home, network stressors (stressors that occur to a network of friends and family), health-related events, and other stressors each day. Eleven (34%) of the 32 participants listed the shuttle explosion as a stressful event in the 'other' category of the (DISE) questionnaire. A composite score for total stressors across all seven questions on each day was calculated, with a higher score indicating more stressor exposure.

Analyses

In order to maximize data that were gathered through a daily diary design, multilevel modeling was implemented for analysis. In this framework, individual change/variability is represented through a two-level hierarchical model (Hawkins, Guo, Hill, Battin-Pearson, & Abbott, 2001). At Level 1, each person's variability is represented by an individual regression equation that depends on a set of parameters (intercept and slope) (Hawkins et al., 2001). These individual parameters become the outcome variables in a Level 2 model, where they may depend on some person-level characteristics (Hawkins et al., 2001). These sub-models express relationships among variables within a given level, and specify how variables at one level influence relations occurring at another (Raudenbush & Bryk, 2002). Specifically, multiple observations are seen as nested within the person, and this treatment of multiple observations allows the investigator to proceed without difficulty when the number and

spacing of time points vary across persons (Raudenbush & Bryk, 2002).

Multilevel modeling is frequently used to model intra-individual variability; that is, people's variability around their own average. This technique was especially useful in the current study because we sought to examine intra-individual changes associated with the Columbia shuttle explosion. In order to test for the effects of the shuttle explosion independent of other stressful events that the participants encountered, all models controlled for stressor exposure by including the sum of the number of stressors reported on each day. For example, the following model was used to examine the effect of the shuttle explosion on negative affect controlling for the number of stressors:

$$\begin{aligned}\text{Level 1:}\quad &\text{NEGATIVE AFFECT}_{it} \\ &= \beta_{0it} + \beta_{1it}(\text{SHUTTLE}) \\ &\quad + \beta_{2it}(\text{STRESSOR \#}) + r_{it}\end{aligned}$$

$$\begin{aligned}\text{Level 2:}\quad &\beta_{0i} = \gamma_{00} + u_{0i} \\ &\beta_{1i} = \gamma_{10} + u_{1i} \\ &\beta_{2i} = \gamma_{20} + u_{2i}\end{aligned}$$

The intercept, β_{0it}, is defined as the expected level of negative affect for person i before the shuttle explosion on stressor-free days (i.e., SHUTTLE = 0 and STRESSOR # = 0). The first slope, β_{1it}, is the expected change in negative affect associated with the shuttle explosion; that is, the change associated with moving from a value of 0 (days before the shuttle explosion) to a value of 1 (the day of the explosion and all subsequent days). The second slope, β_{2it}, is the expected change in negative affect associated with stressor exposure. The error term, r_{it}, represents a unique effect associated with person i (i.e., the amount of fluctuation around the mean). In the Level 2 equations, γ_{00} is the mean of negative affect for the sample on days before the shuttle exploded without other stressors (i.e., SHUTTLE = 0 and STRESSOR # = 0), γ_{10} is the average slope between the shuttle explosion and negative affect, and γ_{20} is the average slope between stressor exposure and negative affect. The degree to which people vary from the sample mean of negative affect is represented by u_{0i}, and the degrees to which people vary from the two slopes are represented by u1i and u_{2i}, respectively.

It is recommended to conduct a preliminary analysis to ensure that there is enough variability between and within persons in the outcome variables to warrant continuation with analyses (e.g., Nezlek, 2001; Raudenbush & Bryk, 2002). This preliminary analysis is termed a fully unconditional model (also referred to as a null model), in which only the intercept is included (Curran, 2000; Nezlek, 2001). For example, the fully unconditional model that was used to examine the between-person and within-person variability in negative affect was:

$$\begin{aligned}\text{Level 1:}\quad &\text{NEGATIVE AFFECT}_{it} = \beta_{0it} + r_{it} \\ \text{Level 2:}\quad &\beta_{0i} = \gamma_{00} + u_{0i}\end{aligned}$$

In addition to providing a point estimate and confidence interval for the grand mean, γ_{00} (Raudenbush & Bryk, 2002), this model also provides information about the outcome variability at each of the two levels through two parameters. From these two parameters (σ^2 signifying the within-person variability and τ_{00} signifying the between-person variability), the intra-class correlation coefficient was calculated which measures the proportion of the variance in the outcome variable that is between people (Level 2 units) (Raudenbush & Bryk, 2002). This correlation can be calculated through the following formula:

$$\rho = \tau_{00}/(\tau_{00} + \sigma^2)$$

Results from this analysis indicated that τ_{00} was 3.1 and σ^2 was 8.2, yielding an intra-class correlation coefficient of 0.27. This coefficient is interpreted in terms of variability, such that 27% of the variability in negative affect was between people and 73% was within people. In other words, people tended to fluctuate around their own average more than they differed from other people in terms of negative affect. Results from the other fully unconditional models indicated that 75% of the variability in positive affect was between people while 25% was within-people, 68% of the variability in physical symptoms was between people while 32% was within-people, and 60% of the variability in memory failures was between people while 40% was within people. Therefore, the fully unconditional models indicated that there was sufficient variability within people in each outcome variable for further analyses of within-person changes in well-being. Additionally, the Akaike Information Criterion (AIC) was obtained for all models in order to quantify the relative goodness-of-fit.

Results

Before conducting analyses designed to address the research hypotheses outlined previously, descriptive analyses were conducted to obtain information regarding: (a) average values for variables of interest; (b) distributions of those variables; and (c) aggregated between-person associations. See Table II for descriptive characteristics and intercorrelations among study variables for the shuttle sub-sample. As would be expected, age and physical health symptoms were positively correlated with memory failures. Non-significant correlations indicate that there were no age differences in positive affect, negative affect, or physical symptoms.

Table II. Descriptive characteristics and intercorrelations of variables for the sub-sample that experienced the shuttle explosion during the diary study.

Variable	M	SD	Range	1	2	3	4	5	6
1. Age[1]	71.78	6.84	59–89	–	–	–	–	–	–
2. Positive affect	26.71	8.07	10–48.5	−0.07	–	–	–	–	–
3. Negative affect	11.50	2.02	6.6–16.1	−0.05	0.08	–	–	–	–
4. Physical symptoms	1.21	0.92	0–3.3	−0.11	−0.10	0.10	–	–	–
5. Memory failures	0.67	0.71	0–2.4	0.43⋆	−0.19	0.15	0.41⋆	–	–
6. Gender	19[a]	13[b]		−0.39⋆	0.01	0.26	0.03	−0.08	–

$n = 32$; ⋆ $p < 0.05$; [1]Age during diary study; [a]number of men; [b]number of women; gender was coded such that 0 = men and 1 = women.

Table III. Multilevel models of change in well-being after the Columbia shuttle explosion, controlling for stressor exposure (i.e., the number of daily stressors).

Fixed effects	Negative affect	Positive affect	Memory failures	Physical symptoms
Well-being, β_0				
Intercept, γ_{00}	9.94 (0.34)***	28.33 (1.34)***	0.69 (0.14)***	1.06 (0.15)***
Stressor exposure slope, β_1				
Intercept, γ_{10}	1.55 (0.23)***	−0.41 (0.57)	0.10 (0.05)⋆	0.11 (0.07)
Shuttle explosion slope, β_2				
Intercept, γ_{20}	0.54 (0.43)	−2.37 (0.94)⋆	−0.16 (0.08)⋆	0.11 (0.13)

⋆ $p < 0.05$; ⋆⋆ $p < 0.01$; ⋆⋆⋆ $p < 0.001$.

Additionally, positive affect and negative affect were not related to each other, physical symptoms, or memory failures.

Although we were primarily interested in the potential changes in well-being surrounding the shuttle explosion, we also conducted analyses on days from all of the diary participants (n days = 2649) to see if the day of the shuttle explosion and the days immediately following were significantly different from the other diary days. Controlling for the frequency of daily stressors experienced, multilevel model results indicated that the day of the explosion and the days immediately following the explosion were characterized by lower levels of positive affect ($\gamma_{20} = -2.20$, $t = -2.48$, $p < 0.05$, AIC = 16151.8) and fewer memory failures ($\gamma_{20} = -0.20$, $t = -2.32$, $p < 0.05$, AIC = 6345.0). There were no significant differences in negative affect ($\gamma_{20} = -0.01$, $t = -0.02$, $p > 0.05$, AIC = 13695.1) or physical symptoms ($\gamma_{20} = -0.11$, $t = -0.86$, $p > 0.05$, AIC = 7098.3) by study day, but stressor exposure was positively associated with both negative affect ($\gamma_{10} = 1.20$, $t = 11.78$, $p < 0.001$) and physical symptoms ($\gamma_{10} = 0.14$, $t = 6.08$, $p < 0.001$); that is, on days when people experienced more frequent daily stressors, they also experienced more physical symptoms and greater negative affect.

Multilevel models were then conducted on the sub-sample of 32 individuals (n days = 171) who experienced the shuttle explosion during their diary week, in order to examine whether within-person changes in well-being were associated with the explosion. Because not all participants began the diary on the same day, the shuttle explosion occurred on the third day for some individuals, the fourth day for others, and some experienced it on the fifth day. Although our focus in the present investigation was the potential within-person change/variability in well-being associated with the shuttle explosion, we did control for the number of diary days that people reported after the shuttle explosion by adding the percent of days that were post-shuttle days into the Level 2 equations for each model that predicted the intercept in well-being. The pattern of results from these models were identical to the ones described below, so the more parsimonious models with only Level 1 predictors are reported.

Results from the models are presented in Table III. Controlling for the frequency of daily stressors experienced, there were no significant changes in negative affect (AIC = 1243.4) or physical symptoms (AIC = 561.4), but people reported a significant decline in positive affect (AIC = 1537.6) on the days following the shuttle explosion. Although people did not report an increase in negative affect after the shuttle explosion, they did report higher levels of negative affect on days when more daily stressors were experienced. Interestingly, people reported a significant decline in memory failures (AIC = 511.0) on days following the explosion, even though they reported more memory failures on days when more daily stressors were experienced. An additional analysis was conducted to see if reports of daily stressors changed across the diary week, and results indicated that people reported fewer stressors on days following the event ($\gamma_{10} = -0.21$, $t = 1.99$, $p < 0.05$, AIC = 683.4).

When examining significant effects in Table III one can see that participants reported an average level of negative affect of 9.94 on days before the shuttle explosion when no stressors were experienced (i.e., the value of the shuttle and stressor

variables was zero). On days when stressors were experienced, the level of negative affect increased 1.55 units for each stressor, but there were no reliable differences before and after the explosion. When looking at positive affect, the initial value (28.33) before the shuttle explosion when no stressors were experienced decreased by 2.37 units on days following the explosion. In terms of memory failures, the initial number of failures (0.69) before the shuttle explosion when no stressors were experienced increased by 0.10 for each stressor but decreased by 0.16 on days following the explosion. These models accounted for 16% of the within-person variability in negative affect, 36% of the within-person variability in positive affect, and 9% of the within-person variability in memory failures.

The models described previously treated the explosion as dichotomous; that is, days preceding the explosion were given a score of 0 and all days following the explosion were given a score of 1. However, it is possible that the effects of the shuttle explosion were more potent on days immediately following the explosion compared subsequent days. In order to test for this effect, additional models similar to regression discontinuity models were conducted with the following coding scheme: all days before the explosion were given a score of - 1; the day of the explosion was given a score of 0; and each day after the explosion was given a score of an increasing integer, such that 2nd February received a score of 1 and 3rd February received a score of 2, and so forth. The results of these models were consistent with the findings from the previous models with the dichotomous coding scheme, such that the days after the explosion were characterized by decreased positive affect and increased memory failures.

We also conducted analyses with participants who were not part of the diary sub-sample to see if the patterns of well-being for the first versus second half of the week differed. For this analysis, we were particularly interested in examining whether the day of the week had any effect. Because the Columbia shuttle exploded on a Saturday, we conducted analyses with data from individuals who did not experience the shuttle explosion during the diary period but did have a Saturday during the middle of their reporting week. Results from these analyses with 525 diary days (controlling for daily stressor exposure) indicated that there were no changes associated with time of the week in any of the indicators of well-being (negative affect [$\gamma_{20} = 0.07$, $t = 0.22$, $p > 0.05$, AIC = 4237.3], positive affect [$\gamma_{20} = -1.07$, $t = -1.47$, $p > 0.05$, AIC = 5350.9], physical symptoms [$\gamma_{20} = -0.06$, $t = -0.51$, $p > 0.05$, AIC = 2383.4], or memory failures [$\gamma_{20} = -0.07$, $t = -0.89$, $p > 0.05$, AIC = 2038.1]). Therefore, the changes in well-being associated with the shuttle explosion do not appear to be related to the day of the week that the explosion occurred.

Discussion

The main purpose of this study was to examine the effects of a tragic event on the daily lives of older adults and to examine whether the event functioned as a stressor in terms of its impact on daily well-being. Interestingly, the two main findings that emerged from this investigation point to differential effects of this event on daily well-being. While people experienced a significant decline in their positive affect after the Columbia shuttle explosion, they also experienced better memory performance (i.e., fewer memory failures). Although the number of daily stressors reported decreased after the shuttle explosion, it is important to note that the findings held even after controlling for the number of stressors that the participants experienced. It is possible that people recalibrated their definition of a stressor after the shuttle explosion and were therefore less likely to report minor incidents.

Perhaps no significant increase in negative affect was observed because of the 'dampening' effect (increases in the threshold for experiencing negative affect due to repeated activation) (Diener, Colvin, Pavot, & Allman, 1991). The participants in this sample were older (59–89) and therefore might have been able to regulate their negative emotions when faced with the explosion of the Columbia shuttle. Although they had not experienced this particular event before, their previous experiences with stressors and negative affect may have helped minimize their negative response in this instance.

In line with our hypothesis, people did experience a significant decrease in their level of positive affect after the shuttle explosion. Although participants were able to regulate their negative emotions, perhaps the decrease in positive emotions resulted from the realization of the somberness of the event and its consequences. Because participants in this sample likely understood the magnitude of giving one's life for his or her country, they may have regulated their emotions and experienced lower levels of positivity following the explosion. It is also possible that our differential findings for positive and negative affect are related to the independence of the constructs (see the correlation in Table II); that is, they appear to be distinct dimensions. This finding supports those previously reported by Watson and Tellegen (1985) and Tellegen, Watson and Clark (1999).

Although no significant increase in physical symptoms was observed after the shuttle explosion, it is possible that the mechanism underlying this process may be similar to the one operating for negative affect. Specifically, the 'dampening' effect may be especially salient for this older adult sample because they have likely experienced more physical symptoms and health problems throughout their life, thus raising their threshold for experiencing/reporting daily physical symptoms (Diener et al., 1991; Zautra, Affleck & Tennen, 1994).

In a somewhat surprising finding, individuals experienced fewer memory failures on the days after the shuttle explosion. However, on days when more frequent daily stressors were experienced, more memory failures were also experienced. These findings suggest that the shuttle explosion functioned differently than a daily stressor in terms of its impact on memory. Although we are unable to examine it empirically with the present data, one possible explanation for this finding may be an increase in social activity level (e.g., seeking physical proximity, more verbal communication with others) after the shuttle explosion, which has been associated in previous studies with better memory and cognitive functioning (e.g., Fratiglioni, Paillard-Borg, & Winblad, 2004; Hill, Wahlin, Winblad, & Bäckman, 1995; Smits, Van Rijsselt, Jonker, & Deeg, 1995).

Limitations

It is important to point out the limitations of the present study. First, because we could not foresee the tragedy of the Columbia shuttle explosion, only 32 individuals were in the process of completing the daily diary survey on 1st February 2003. In additional analyses we examined all participants who completed the diary, and although we could not examine potential changes in well-being surrounding the shuttle explosion, we did find similar results (i.e., the days immediately after the shuttle explosion were characterized by significantly fewer memory failures and lower levels of positive affect) to those with the smaller sub-sample. Therefore, we assert that the findings regarding changes in well-being in the smaller sub-sample could be representative of changes in a larger population.

Because the diaries were sent and returned all at once and administered via paper and pencil, we cannot be certain that participants followed the exact instructions regarding when to complete the diaries (i.e., at the end of each day, about 30 minutes before going to bed). Although Stone and colleagues (2003) noted high rates of noncompliance with paper diaries when the study protocol called for four assessments each day for 21 consecutive days, we assert that our participants were more likely to be compliant because of the decreased burden associated with our protocol (i.e., one assessment per day for eight days), and previous research noting the high levels of compliance with paper diaries when only one assessment per day is required (e.g., Sherliker & Steptoe, 2000). In addition, given the NAS participants' history of compliance with this longitudinal study over the past 40 years (of the survivors, over 90% are continuing participants, most of the men who are continuing participants report to the Boston VA every three years for a biomedical exam and complete a number of questionnaires either mailed a month in advance or administered the day of the exam) it is unlikely that they waited until the eighth day to complete all of their diaries.

Conclusion

Limitations notwithstanding, the results of this study shed light on the complexity of the relationship between tragic events and daily well-being. Changes in positive affect were observed after the shuttle explosion, but the participants in this sample did not exhibit an increase in negative affect or physical symptoms and actually experienced fewer memory failures. Therefore, we assert that it is important to further assess emotional, physical, and memory responses to tragic events because it is possible that these events are not consistently detrimental to older adults' daily well-being.

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Appendix

In the past 24 hours:

1. Did you go back to check whether you had done something that you meant to do?
   ___ No ___ Yes

2. Did you start to read something (a book or an article in a newspaper or a magazine) without realizing you had already read it before?
   ___ No ___ Yes
3. Did you find that a word was 'on the tip of your tongue,' you knew what it was but could not quite find it?
   ___ No ___ Yes
4. Did you have difficulty picking up a new skill, for example, finding it hard to learn a new game or to work some new gadget after you had practiced once or twice?
   ___ No ___ Yes
5. Did you fail to recognize, by sight, close relatives or friends, or fail to recognize famous people seen on television or in photographs?
   ___ No ___ Yes
6. Did you forget to take your medications as scheduled?
   ___ No ___ Yes