THE GERONTOLOGICAL SOCIETY OF AMERICA®

Journals of Gerontology: Psychological Sciences
cite as: *J Gerontol B Psychol Sci Soc Sci*, 2019, Vol. 74, No. 1, 1–6
doi:10.1093/geronb/gby074
Advance Access publication July 6, 2018

OXFORD

Editorial

Back to the Future: Examining Age Differences in Processes Before Stressor Exposure

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Although it is generally accepted that stress is associated with poorer health and cognitive functioning, previous work has focused on what happens *after* stressors occur (Almeida, 2005; Bellingtier & Neupert, 2016; Hyun, Sliwinski, Almeida, Smyth, & Scott, 2018; Neupert, Almeida, & Charles, 2007; Neupert, Almeida, Mroczek, & Spiro, 2006; Schilling & Diehl, 2014; Scott, Ram, Smyth, Almeida, & Sliwinski, 2017; Sliwinski, Smyth, & Hofer, & Stawski, 2006). In this special section, we present a novel conceptual framework and initial empirical work that integrates the temporal space of anticipation *before* stressors occur. Understanding processes that may prevent exposure to or reduce the effects of stressors can have tremendous benefits for longevity and successful aging. In this overview, we describe our conceptual framework and relevant aging theories that form the foundation for our predictions across studies. We also briefly introduce the data sets and study designs and propose preliminary implications.

Conceptual Framework

The terminology used in prior work to describe concepts and processes occurring before stressor exposure has not been entirely consistent. Therefore, we first provide an overview of the terminology we employ in the four empirical manuscripts of this special section. Figure 1 displays the core concepts on which we further elaborate in the following sections.

Anticipatory stress

In previous studies, anticipatory stress has indicated forecasting of imminent upcoming events (e.g., Smyth et al., 1998; Starcke, Wolf, Markowitsch, & Brand et al., 2008) as well as one's future subjective states of stressfulness (Powell & Schlotz, 2012). It seems, however, important to distinguish these two concepts. Just as previous stress research has worked to disentangle events (i.e., stressors; Pearlin, 1999) from feelings of (dis)stress (e.g., Lazarus, 1999), we suggest that examining the anticipation of events and feelings should be considered separately. Following the suggestions of McGrath and Beehr (1990), it is important to distinguish between the prediction of the timing of an event and the prediction of potential consequences. Although forecasting specific stressful events, on the one hand, and anticipating feeling stressed, on the other hand, might both be associated with responses in physiological, cognitive, and psychological variables, there is a reason to suspect that they differ in their behavioral consequences. To that end, it seems paramount to distinguish two forms of anticipatory stress: stressor forecasting and stress anticipation.

Stressor forecasting

Stressor forecasting describes individuals' predictions about stressor occurrence in a defined upcoming time period (Neubauer, Smyth, & Sliwinski, 2018b). In Neupert and Bellingtier (2018), individuals made daily forecasts about the range of likelihood of specific types of events to occur the next day. In Scott, Kim, Smyth, Almeida, and Sliwinski

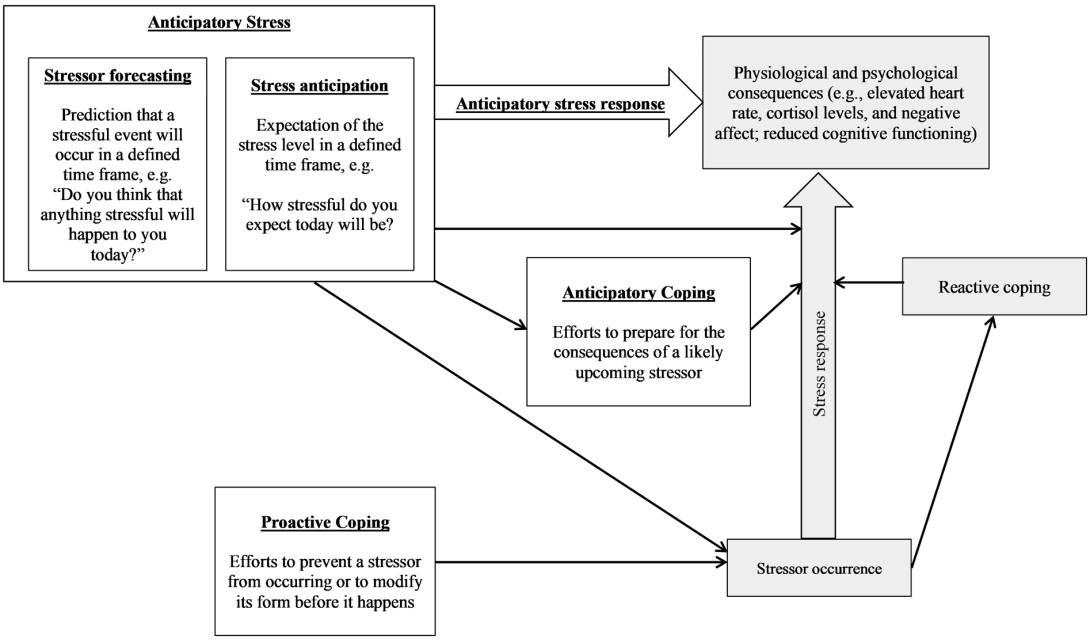

Figure 1. Conceptual framework of processes occurring before stressor exposure (terms underlined) integrated with existing frameworks of processes after stressor exposure (shaded).

(2018), individuals forecasted whether anything stressful or unpleasant would occur in the next few hours. The level of specificity in stressor forecasting, though, can vary. Scott and colleagues raised the following distinctions: an individual can make a prediction about whether a stressor will occur during a specific time period (i.e., temporal specificity), or predict the kind of stressor that will occur (e.g., travel; i.e., type specificity), or predict the specific stressor that will occur (e.g., mechanical breakdown; i.e., event-specificity). Thus, these two studies examine the anticipation of potential future events but differ in the timescale (daily vs hourly), metric (continuous vs binary response), and specificity (type vs temporal), offering a more complete picture of the process of stressor forecasting.

Stress anticipation

In contrast to making predictions about the occurrence of future stressor events (i.e., stressor forecasting), but similar to affective forecasting (Wilson & Gilbert, 2003), stress anticipation involves individuals making predictions about potential affective and cognitive consequences (i.e., feeling stressed; e.g., Powell & Schlotz, 2012). Hyun, Sliwinski, and Smyth (2018) operationalize stress anticipation by asking the extent to which a person expects to experience stress during the upcoming day. Stress anticipation was assessed at two time points, on each morning ("Overall, how stressful do you expect today will be?") and on the prior evening ("Overall, how stressful do you expect tomorrow will be?"), to compare differential effects on cognition of stress anticipation assessed in the morning versus at the end of the prior day. This study builds upon and extends the approach of traditional daily diary studies by using both end-of-day as well as morning reports.

Anticipatory stress response

As argued earlier, both subtypes of anticipatory stress can be linked to physiological, cognitive, and psychological variables (e.g., Neubauer et al., 2018b; Smyth et al., 1998). We define anticipatory stress response as the effect of anticipatory stress on physiological, psychological, and cognitive variables. Linking with the existing daily stress literature that often refers to responses to stressor exposure as "reactivity" (e.g., Almeida, 2005), responses to forecasted stressors could be thought of as "pre-reactions" or "preactions" as Scott and colleagues (2018) discuss in their article. Anticipatory stress response refers to stress-related responses when a stressor is forecasted but has not yet occurred (Paterson & Neufeld, 1987) or unique responses to anticipated stress over and above the effects of actual stressors. In Scott and colleagues (2018), the anticipatory stress response is operationalized as the within-person slope of prior stressor forecast predicting current negative affect. Hyun, Sliwinski, and Smyth (2018) bring in the concept of stress anticipation in the form of future states and operationalize the anticipatory stress response as the within-person slope of cognitive performance regressed on stress anticipation.

Proactive coping

Proactive coping as defined by Aspinwall and Taylor (1997) comprises efforts undertaken by the individual that aim at preventing a stressor before it occurs. There are several strategies that can be applied to prevent stressor occurrence (behavioral and cognitive) and they can broadly be differentiated into passive forms (e.g., avoidance) and active forms, but have traditionally been examined from a between-person perspective. Neubauer, Smyth,

and Sliwinski (2018b) apply a within-person approach to investigate age differences in proactive coping with minor hassles in study participants' daily lives.

Anticipatory coping

In contrast to reactive coping that involves coping with an event that has already occurred and also in contrast to proactive coping that is supposed to prevent a future stressor from occurring, anticipatory coping involves efforts to prepare for the stressful consequence of an upcoming event that is likely to happen (Folkman & Lazarus, 1985). Although anticipatory coping is posited to be situation-specific and associated with a reduced response to a stressor (Aspinwall & Taylor, 1997; Schwarzer & Knoll, 2003), we are only aware of one study (Neupert, Ennis, Ramsey, & Gall, 2016) that examined anticipatory coping from a within-person perspective within changing contexts (i.e., various stressor domains). Anticipatory coping can reduce responses to stressors by facilitating the management of known risks and capitalizing on initial coping efforts (Aspinwall & Taylor, 1997; Schwarzer & Knoll, 2003). Indeed, Neupert and colleagues (2016) found that increases in a specific form of anticipatory coping were associated with better cognitive responses to arguments. Neupert and Bellingtier (2018) extend previous work to examine the within-person relationship of domain-specific anticipatory coping and domain-specific stressor forecasting.

Relevant Aging Theories

Strength and vulnerability integration

The process of approaching and reacting to stressors may be experienced differently across the life span. Strength and vulnerability integration (SAVI) is a theoretical model which describes changes in emotion regulation across adulthood (Charles, 2010). The model predicts that older adults have both strengths and vulnerabilities that affect their emotional reactions to stressors. With advancing age, individuals may display emotion regulatory strengths in the form of strategies to avoid or limit exposure to negative experiences. These strategies may translate to preventing the occurrence of a stressor or reframing the meaning of stressful events (Charles, 2010). SAVI also posits, however, that advancing age is associated with vulnerabilities in the form of physiological inflexibility (Charles, 2010) or fewer social supports (Schilling & Diehl, 2014) which may result in greater difficulty in responding to stressors that produce large and sustained responses. Importantly, SAVI suggests that there are limits to the age-related strengths, such that time functions as a moderator to increase or reduce age-related benefits in emotional functioning. Specifically, age-related improvements in emotion regulation abilities should be minimized immediately before or following a stressor, but reappear as time passes and that situations of prolonged stress will reduce age-related emotion-response advantages. Each article in this special section acknowledges the importance of time with respect to potential strengths and vulnerabilities and applies within-person models to examine processes of anticipation and response.

Coping, appraisal, and resilience in aging

Aldwin and Igarashi's (2016) coping, appraisal, and resilience in aging (CARA) model speaks directly to the dynamic nature of resources and coping. According to CARA, resilience goes beyond individual resources to involve a complex transaction among sociocultural, contextual, and individual resources that can change and be changed by one's coping strategies in stressful situations. When coping with stressors, immediate, individual, contextual, and sociocultural resources are drawn upon. Neupert and Bellingtier (2018) integrate the transaction of dynamic coping strategies and stressful situations by examining age differences in domain-specific anticipatory coping strategies on a daily basis as they relate to domain-specific reactivity. In addition, Neubauer and colleagues (2018b) acknowledge the role of changing contexts by focusing on within-person variability in proactive coping along with age differences in these processes.

Socioemotional selectivity theory

Advancing age is linked not only to longer time already lived, which has been argued to increase older adults' emotion regulation capacities (Charles, 2010) but also to shorter perceived time left to live. According to socioemotional selectivity theory (SST; Carstensen, Isaacowitz, & Charles, 1999), this shrinking time horizon leads individuals to shift their motivational preferences toward positive experiences, by, for example, proactively pruning their social networks. Linking these considerations to processes before stressor occurrence, SST can provide a meaningful framework to examine age-related differences in the employment of proactive coping strategies.

Inhibitory deficit hypothesis

With respect to cognition, inhibitory deficiency, that is, a diminished capacity among older adults in inhibiting irrelevant, off-task information, such as stress (Hasher, Zacks, & May, 1999) is one of the theoretical accounts to explain age-related decline in working memory capacity. Considering that such stress-related thinking has more detrimental effects on older adults compared with younger adults (Wrzus, Luong, Wagner, & Riediger, 2015), it is plausible that stress anticipation may be especially detrimental for older adults' cognitive performance.

Data Sets and Designs

Neupert and Bellingtier (2018) draw from the Mindfulness and Anticipatory Coping Everyday (MACE; Neupert & Bellingtier, 2017) study. In this 9-day (baseline + 8 repeated daily assessments) daily diary project, 116 older participants (aged 60–90) were recruited via Amazon's Mechanical Turk (mTurk) and 107 younger participants (aged 18–36) were recruited through an online subject pool. Data were collected from both age groups online via Qualtrics. mTurk is an online marketplace where "requesters" can post Human Intelligence Tasks (HITs), that is, jobs, for "workers" to

complete. It has become popular inside academia as a method for collecting survey data, especially for cross-sectional studies. To our knowledge, MACE is the first study to use mTurk to recruit older adult participants for an online daily diary study. Each day, participants reported on stressor forecasts and anticipatory coping for each of five stressor domains that could be experienced the following day. The equations used to test the relevant sections of the conceptual framework appear in the supplemental materials to enhance transparency and replication in future studies.

Scott and colleagues (2018) and Hyun, Sliwinski, and Smyth (2018) use data from the first wave of the Effects of Stress on Cognitive Aging, Physiology, and Emotion (ESCAPE) study, which utilized a prospective longitudinal measurement-burst design (Scott et al., 2015). The ESCAPE study used systematic probability sampling of a densely populated zip code in Bronx, NY; resulting in a socio-economically, racially, and ethnically diverse sample of 240 25–65-year-olds. This 14-day smartphone-based study employed a hybrid design, with features of both a diary as well as an ecological momentary assessment (EMA) study. Upon waking each day, participants completed diary surveys including how stressful they expected the day to be. Five quasi-random times each day, participants received a prompt to complete an EMA survey on their current affect, whether a stressor had occurred since the prior survey, and whether they expected a stressor to occur in the next few hours. Immediately following these EMA surveys, participants completed the brief cognitive task on the smartphones. At the end of each day, participants completed diary surveys again including how stressful they expected tomorrow to be. Scott and colleagues provide the SAS code necessary to replicate their models so future studies can examine the new construct of anticipatory stress responses. Hyun, Sliwinski, and Smyth also include the equations for their models to explicate the time-ordered sequence of stress anticipation on subsequent cognitive performance.

Neubauer and colleagues (2018a) use data from a measurement burst study with 175 participants between 20 and 79 years of age (Mogle, Muñoz, Hill, Smyth, & Sliwinski, 2017). At each of the three measurement bursts, participants were assessed in an EMA for seven consecutive days and provided information on the occurrence of negative events and, if no event had occurred, reasons for no occurrence of negative events five times per day. These reasons included, for example, self-reported use of active proactive coping ("I handled situations before they became stressful") and avoidance ("I avoided stressful situations"). The EMA was repeated two more times, resulting in three measurement bursts that were each approximately 9 months apart. This measurement burst design allows for investigating within-person changes in the use of proactive coping in addition to cross-sectional age differences (see Sliwinski, 2008). Neubauer and colleagues provide model equations and a step-by-step guide to their data analysis plan to ease replication.

Discussion

The empirical studies in this special section provided initial evidence for various components of the proposed conceptual framework in Figure 1. Specifically, Neupert and Bellingtier (2018) found evidence for within-person associations between domain-specific stressor forecasting and anticipatory coping along with age differences in both constructs, and Scott and colleagues (2018) identified associations between stressor forecasting and stressor occurrence. Although a direct link between stressor forecasting and emotional stress response was not found in Scott and colleagues, they did find that when stressors did not occur, people were in worse moods if they had previously forecasted a stressor than if they had not forecasted a stressor at the prior survey. Similarly, Neupert and Bellingtier found that forecasting home stressors for the next day but then not experiencing the forecasted stressor was also associated with an increase in negative affect. Hyun, Sliwinski, and Smyth (2018) found a link between stress anticipation and cognitive stress response. Specifically, they found that stress anticipation reported upon waking, but not the prior evening, was associated with deficit in working memory performance later that day over and above the effect of actual stressful events. Given the pattern of differences between articles examining stressor forecasting (i.e., Neupert & Bellingtier, Scott et al.) and stress anticipation (Hyun, Sliwinski, & Smyth), the distinction between events (stressor forecasting) and states (stress anticipation) as outlined in the conceptual framework appears critical. Neupert and Bellingtier found age differences in stressor forecasting moderating next-day reactivity to actual stressors, but only for a particular stressor domain (home). Forecasting home stressors was associated with a stronger reduction in reactivity for younger adults relative to older adults, but stagnant deliberation coping was associated with increased reactivity for younger adults and not for older adults. These results underscore the importance of linking stressor forecasting, stress anticipation, anticipatory coping, and stress responses to specific stressor domains and outcomes (Aldwin & Igarashi, 2016). In addition, the timescale of the study (daily vs EMA) as well as the age range of study participants (extreme age groups vs 20–65) could be important factors. Results by Scott and colleagues (2018) and Hyun, Sliwinski, and Smyth were in line with the expectation of anticipatory stress responses. Specifically, stressor forecasting was associated with higher momentary negative affect, and stress anticipation predicted diminished cognitive performance on the same day.

Age differences were not ubiquitous across studies. Neubauer and colleagues (2018a) found that older age was associated with a higher likelihood of employing active proactive coping strategies to prevent stressor occurrence, while no age differences for passive proactive coping (avoidance) were observed. Scott and colleagues (2018) did not find age differences in stressor forecast accuracy nor in negative affect responses to forecasted stressors

(i.e., anticipatory stress response). However, Neupert and Bellingtier (2018) found that older adults forecasted more home stressors than younger adults and tended to report less stagnant deliberation and fantasy outcome anticipatory coping than younger adults. Hyun, Sliwinski, and Smyth (2018) did not find evidence to support age differences in the association between stress anticipation and cognitive performance, suggesting that the detrimental effect of stress anticipation was invariant across age. These results may differ depending on the conceptualization of anticipation (i.e., stress anticipation vs anticipatory coping) as well as study design (e.g., timing of assessment, measures of stress response (e.g., cognitive, emotional, sample). Of particular note, the maximum age in Hyun, Sliwinski, and Smyth and Scott and colleagues was 65, whereas it was 79 in Neubauer and colleagues (2018a) and 90 in Neupert and Bellingtier (2018). This suggests that a comprehensive examination of age differences in anticipatory processes should be examined in future work with adult life-span samples, as differences in sampling and sampling procedures may underlie the discrepant age difference results across studies.

Across all studies in this special section, we see that age differences in anticipatory stress processes depend on the research question and study design. The context of the research study matters, but even within a study we see the importance of context as well. In Neupert and Bellingtier (2018), the link between anticipatory coping and stressor forecasting was stronger for some stressors than others, and the age differences in stressor forecasting moderating subsequent emotional reactivity differed by stressor domain. In Neubauer and colleagues (2018a), age differences only emerged for one specific subtype of proactive coping. Scott and colleagues (2018) and Hyun, Sliwinski, and Smyth (2018) did not find age differences in their constructs of interest. Thus, we suggest that context in all forms—persons, anticipatory process, stressor domain, outcome—are important ingredients to fully understand the temporal space before the occurrence of stressors and we recommend against trying to make big, overarching statements that are devoid of context.

Anticipated Future Directions

We are excited by the focus on anticipatory processes that these articles represent in stress research. Just as research on reactive processes related to stress has involved detailed descriptions and predictions regarding stressor domains, contexts, timescales, and individual differences in these processes, we assert that the anticipatory temporal space is ripe for these types of inquiries as well. The conceptual framework outlined in this article represents a starting point for future inquiries into processes occurring before stressor exposure. The articles in this special section apply a variety of within-person designs and raise important questions for future research. For example, does effectiveness of proactive or anticipatory coping depend on the perceived length of time available to implement the strategy? Could daily diary studies be missing sudden, abrupt events whereas EMA beeps artificially accelerate possible coping? What can accuracy in forecasting future stressors tell us? If there is a strong link between stressor forecasts and stressor exposure, does that represent true accuracy or a possible failure of proactive coping to avoid the stressor? At the individual difference level, individuals' behaviors and appraisals shape their environments (e.g., self-fulfilling prophesies, Merton, 1984; Neuroticism and differential appraisal, Bolger & Zuckerman, 1995; depression and stress generation, Hammen, 2006)—but within individuals, how might appraisals about the day ahead and expectations about upcoming events in effect generate stressors? Are there age, stressor type (i.e., daily vs major life event vs chronic), or stressor-domain differences in this process? Is it in any way beneficial to "see it coming," or is stressor forecasting more detrimental (due to an anticipatory stress response) than helpful? What factors (situational, individual, interpersonal) determine whether stressor forecasting attenuates the stress response? We encourage future work that takes a social-contextual perspective (Berg, Meegan, & Deviney, 1998) to examine how connections with other people influence these processes. We look forward to a continued focus on important processes that occur before stressor exposure, especially as they relate to promoting health and cognitive functioning in aging.

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