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Health sensitivity in the daily lives of younger and older adults: correlates and longer-term change in health

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ABSTRACT

Objectives: How susceptible older adults' affect is to fluctuations in health (i.e., health sensitivity) indicates how well they adapt to everyday health challenges. Theory and evidence are inconsistent as to whether older adults are more or less health sensitive than younger adults. The role of health burden as correlate and outcome of health sensitivity and age differences therein is also unclear. We thus move the study of health sensitivity ahead from longitudinal inquiry to examine age differences, the role of health burden, and long-term implications of daily life health sensitivity.

Methods: We use data from COGITO where 101 younger adults ($M_{\text{age}} = 25$; range = 20–31) and 103 older adults ($M_{\text{age}} = 71$; range = 65–80) gave daily reports of physical symptoms and positive and negative affect during a ~100-day micro-longitudinal phase, as well as reports of trait-level health two years before and after.

Results: Extending earlier reports, older age and higher health burden were (independently) associated with lower health sensitivity in positive but not negative affect. Health sensitivity was unrelated to long-term changes in health burden.

Conclusion: We take our findings to indicate successful aging (older adults are not *more* emotionally vulnerable to health issues) and discuss habituation as a process underlying how age and health burden may reduce health sensitivity.

KEYWORDS

affect; affective reactivity; physical health; emotional development; health sensitivity

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Introduction

The relevance of momentary fluctuations in physical health for affective well-being (i.e., health sensitivity: Schöllgen, Morack, Infurna, Ram, & Gerstorf, 2016) is often acknowledged in conceptual and empirical research. To illustrate, conceptual accounts suggest that daily life brings about health-related challenges that undermine affective well-being (Lemon, Bengtson, & Peterson, 1972; Williamson, 1998) and empirical studies report that fluctuations in health go hand-in-hand with fluctuations in affect (Charles & Almeida, 2006; Hay & Diehl, 2010; Katana, Röcke, & Allemand, 2019). Small affective reactions to fluctuations in health (lower health sensitivity) are considered necessary to the maintenance of subjective well-being and an indicator of successful aging (Young, Frick, & Phelan, 2009), but little is known about whether these associations change with age. The role of overall experience with health problems is also unclear: notions of habituation and sensitization indicate that higher health burden might cause habituation *or* sensitization to daily symptoms. Finally, exploring longer-term changes in health arising from everyday health sensitivity might give insight into its (mal)adaptive nature. We thus move the study of health sensitivity (the within-person association of daily symptoms with positive and negative affect) ahead in three ways: we examine whether (i) health sensitivity differs between younger and older adults, (ii) health burden moderates this within-person association and whether age differences exist therein, and (iii) longer-term changes in health are preceded by high or low health sensitivity, and whether this differs by age.

Age differences in daily health sensitivity

It is well-established that older adults' *global* affect is less susceptible to the deleterious effects of physical health than younger adults (i.e., *global* health sensitivity; Kunzmann, Little, & Smith, 2000; Schöllgen et al., 2016), but it is an open question whether these age-benefits generalize to daily life. Studies have shown that symptoms in everyday life correspond to lower daily affect (Charles & Almeida, 2006; Katana et al., 2019), but evidence for age difference is sparse (but see Hay & Diehl, 2010; Wolff, Lindenberger, Brose, & Schmiedek, 2016).

The processes theorized to prompt age-related declines in *global* health sensitivity—enhanced emotion regulation and greater adaptive, coping and compensatory skills—also predict age-related declines in *daily* health sensitivity (Kim-Prieto, Diener, Tamir, Scollon, & Diener, 2005). More precisely, notions of adaptation (Staudinger, 1999) and prominent aging and emotion theories (Socioemotional Selectivity Theory; SST: Carstensen, 2006) indicate that a lifetime of experience and skill at handling emotional situations, as well as increasing motivation to prioritize emotional goals, should result in smaller affective reactions to symptoms (Schilling & Diehl, 2015). People also

tend to implicitly evaluate their health by age-comparisons (Ubel et al., 2005), making it possible that older adults perceive health problems as less threatening, and thus less (emotionally) perturbing, when making comparisons to their same-aged peers who represent a generally less healthy demographic than younger adults.

However, daily life might be a context in which older adults are more health sensitive. For example, conceptual accounts (Activity Restriction Model: Williamson, 1998; Activity Theory: Lemon et al., 1972) imply that the effects of symptoms on every-day life are stronger with age because they are often more frequent and severe, thereby making it increasingly difficult to accomplish routine tasks (chores, preparing meals) or engage in meaningful activities (socializing, hobbies: Arai et al., 2007). The Strengths and Vulnerabilities Integration model (SAVI; Charles, 2010) also maintains that aging-related vulnerabilities, particularly the uncontrollable stressors arising from everyday health issues, undermines the experience and skills older adults would otherwise use to maintain affective well-being.

While these theoretical predictions have not been tested in the context of daily health sensitivity, a growing body of research has examined age differences in affective reactivity to daily stressors. Although such research is not entirely consistent (see Hay & Diehl 2010; Wrzus et al., 2013), studies by and large indicate that affective reactivity *decreases* with age (Schilling & Diehl, 2015; see also Stawski et al., 2019, for a large-scale coordinated analyses). However, it remains unclear whether these age-related declines also hold for reactivity to daily symptoms (lower health sensitivity). As discussed above, age-related skill and experience might help older adults deal with daily symptoms, or these might be counteracted by their increased vulnerability in the health domain.

Daily health sensitivity and the role of health burden

Contextual factors beyond age, such as overall experience with health issues (health burden), might also influence how health sensitive people are in their daily lives. To illustrate, affective reactions to physical symptoms are thought to partly depend on one's experience with health issues (Smith & Kirby, 2000). In the case of repeated exposure to physical symptoms, conceptual accounts of habituation predict a reduction in neural and behavioural responsiveness (De Paepe et al., 2019; Rankin et al., 2009), whereas notions of sensitization predict progressively heightened responsiveness (Janssen, 2002). These conflicting conceptual accounts are illustrated empirically with evidence that repeated exposure to pain is linked to increased reports of pain (Gold & Gebhart, 2010; Woolf & Costigan, 1999) *and* decreased reports of pain (Bingel et al., 2007), making the direction of association between health burden and daily health sensitivity unclear. It is also possible that these processes are more or less likely to occur at specific life stages, especially because health conditions faced by younger and older adults likely differ. To illustrate, sensitization may be more prevalent in earlier life stages when health conditions are more likely to be new and acute in nature, thus potentially representing experiences that bring fear and uncertainty, as well as a more pervasive impact on everyday life (absence from work, care for dependents, etc). On the other hand, habituation may be more prevalent in later stages of life when health conditions are more likely to be chronic and long lasting, which may afford older adults the time and knowledge to adapt and learn to live with.

To date, one study has tested the role of global health burden for affective reactivity: Piazza, Charles, & Almeida (2007) reported that people ($N = 983$; 25–74 years) with more health conditions were more reactive (in negative affect) to daily stressors, speaking for sensitization. Consistent with the potential age differences noted above, age attenuated sensitization in this study. However, the scarcity of empirical evidence and conflicting theoretical predictions make it difficult to determine the direction of association between health burden and daily health sensitivity.

Daily health sensitivity and longer-term change in health burden

Various lines of research suggest that health sensitivity might precede long-term changes in health, but the direction of these changes is unclear. Theoretically, increased affective reactivity is thought to indicate instability in the psychological system (Nesselroade, 1991; Rowe & Kahn, 1997). Specifically, larger affective reactions are accompanied by physiological changes which are thought to lead to biological wear-and-tear that increase one's susceptibility to ill-health (Almeida et al., 2009; McEwen, 2006). Correspondingly, evidence exists that stronger within-person associations between daily stressors and affect is associated with long-term declines in health (Cacioppo, 1998; Piazza, Charles, Sliwinski, Mogle, & Almeida, 2013). Because daily symptoms tend to be perceived as distressing (Kroenke, 2003) and attention to these has been linked to prolonged physiological responses (Zoccola, Dickerson, & Lam, 2012), it is possible that being highly health sensitive similarly leads to long-term declines in health.

On the other hand, higher health sensitivity might represent adaptive responses to health stressors that help guide behaviours, thereby leading to health-related improvements. To illustrate, central to health behaviour models is the notion that engaging in such behaviours requires perception of and concern with health issues, which by definition are central features of health sensitivity (Health Belief Model: Rosenstock, 1974; Theory of Reasoned Action: Fishbein, 1980). Moreover, daily symptoms are one of the leading reasons people seek medical care (Kroenke, 2003), supporting the notion that awareness of symptoms initiates behaviours to resolve such issues.

A final possibility is that the implications of health sensitivity follow a u-shaped pattern, wherein medium-levels are beneficial for health by helping people to be alert and responsive, while very high and low levels may be problematic by either triggering biological wear-and-tear or by not prompting health behaviours (respectively). To date, only the aforementioned multi-year study by Schöllgen et al. (2016) has investigated whether health sensitivity predicts health-related developments, but quadratic associations and age differences were not tested.

The present study

We applied multi-level models (MLM) to ~100 days of daily data from COGITO (Schmiedek, Lövdén, & Lindenberger, 2010) to examine whether (i) daily health sensitivity differs between younger and older adults, and (ii) health burden moderates this within-person association of health and affect, and if this differs by age. We also applied multi-level structural equation models (ML-SEM) to explore whether (iii) health sensitivity predicts two-year change in health burden. Drawing from emotion and

adaptation theories as well as evidence of age-related improvements in *global* health sensitivity (smaller within-person association between health and global affect), we tentatively expected health sensitivity to be lower among older adults. Due to conflicting theory and evidence of sensitization versus habituation, we do not specify the direction of association between health burden and health sensitivity or age differences therein. Conflicting theoretical reasoning, scarcity of empirical research, and the possibility of curvilinear associations made it difficult to derive hypotheses on the direction(s) of the longitudinal prediction of health sensitivity on health burden and age differences therein. Based on accumulating evidence that positive and negative affect are not independent dimensions of emotions at the within-person level (e.g., Brose, Voelkle, Lövdén, Lindenberger, & Schmiedek, 2015), we expected hypotheses to hold for positive and negative affect alike.

Materials and methods

This report is part of the larger COGITO study, conducted at the Center for Lifespan Psychology, Max Planck Institute for Human Development, Berlin (Schmiedek et al., 2010). Daily symptoms and affect were used from the ~100-day phase, and trait-measures were used from pretest and follow-up, conducted two years later (see Schmiedek et al., 2010).

Participants and procedure

Participants were recruited through newspaper advertisements, word-of-mouth, and flyers distributed in Berlin, Germany. Pretest and the ~100-day phase included 101 younger and 103 older adults. Of these, 81% took part in the follow-up session two years later, leaving 79 younger adults (23–34 years; 49% women) and 88 older adults (68–83 years; 51% women). Younger and older adults had 12.5 and 10.8 years of education, respectively. Younger and older adults included in the current sample largely mirrored the individual difference distributions of a nationally representative German sample on cognitive functioning and number of doctor visits, but reported better subjective health (Schmiedek et al., 2010; Wolff, Schmiedek, Brose, & Lindenberger, 2013). Pretest (2–2.5 hrs each session) and follow-up (1–1.5 hrs each session) were carried out Mondays–Saturdays in groups. The ~100-day phase (87–107 sessions; $M = 101$; 1–1.5 hrs each) was carried out on Mondays–Saturdays on an individual basis (8 a.m. to 7:30 p.m.) between July 2006 and February 2008. Each hour of participation was incentivized with an average of 9 Euros; a bonus system was implemented to reward participants for finishing the ~100 days phase (100 to 500 Euros). Nineteen younger and five older adults dropped out over the 100 days.

Measures

Daily Positive and Negative Affect were assessed with items from the positive and negative affect schedule (PANAS; Watson, Clark, & Tellegen, 1988). Participants rated how well 20 adjectives (10 for positive affect) described their momentary mood on an 8-point scale (0 = *does not apply at all*; 7 = *applies very well*). Consistent with low affect variability also found in past micro-longitudinal studies (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000), we excluded five negative states (*guilty, scared, hostile, ashamed, afraid*) from analyses because these exhibited very low variability (20% of participants did not fluctuate at all on these items; Brose, Schmiedek, Lövdén, & Lindenberger, 2011). Thus, positive affect was indicated by 10 PANAS items, and negative affect was indicated by five PANAS items. Internal consistency for the ten positive affect items (e.g., *enthusiastic, interested, excited*) was .84, and for the five negative affect items (ω ; *distressed, jittery, nervous, upset, irritable*) was .74.

Daily Physical Symptoms were assessed with a health complaints checklist, which included three items adapted from the Giessen Subjective Complaints List (*headaches and limb aches, cardiovascular complaints, exhaustion*; Brähler, Schumacher, & Brähler, 2000), and two additional health complaints: *upper respiratory complaints and symptoms of restlessness* (see Wolff, Brose, Lövdén, Tesch-Römer, Lindenberger, & Schmiedek, 2012, for psychometric information). Participants were asked if they were experiencing any of these five symptoms on that day and rated them on a 4-point Likert scale (0 = *no, not at all*; 3 = *yes, very much*).

Health Burden Trait-report symptoms obtained at pretest and follow-up was assessed with a 33-item symptoms checklist (Brähler, Hinz, & Scheer, 2008) that included items of exhaustion, gastric complaints, limb pain, circulatory problems, and miscellaneous items. Participants were asked to indicate “how strongly you are troubled by the complaints” on a 5-point scale (0 = *not at all*; 4 = *extremely*).

Statistical analyses

To address our first research question (age differences in daily health sensitivity) the within-person association between daily symptoms and affect with age as a moderator, was estimated using MLMs on SAS PROC MIXED (SAS Institute, 1997). Daily positive and negative affect were modelled (separately) as the outcome variable. To investigate our second research question, we included health burden (trait-report symptoms) to examine its association with health sensitivity. Health burden was grand-mean centred and daily symptoms was person-mean centred. The latter model took the following form:

$$\text{Affect}_{ti} = \beta_{0i} + \beta_{1i}(\text{DailySymptoms}_{ti}) + \beta_{2i}(\text{Time}_{ti}) + e_{ti} \quad (1)$$

$$\beta_{0i} = \gamma_{00} + \gamma_{01}(\text{AgeGroup}_i) + \gamma_{02}(\text{HealthBurden}_i) + \gamma_{03}(\text{AgeGroup}_i \times \text{HealthBurden}_i) + \mu_{0i} \quad (2)$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}(\text{AgeGroup}_i) + \gamma_{12}(\text{HealthBurden}_i) + \gamma_{13}(\text{AgeGroup}_i \times \text{HealthBurden}_i) + \mu_{1i} \quad (3)$$

$$\beta_{2i} = \gamma_{20} + \mu_{2i} \quad (4)$$

At Level-1, affect of person i on occasion t is a function of intercept β_{0i} and two Level-1 predictors: the person's daily symptoms, β_{1i} (reflecting health sensitivity), the time across study phase, β_{2i} , as well as a residual term, e_{ti} . At Level-2, the intercept and health sensitivity are further predicted by age group (γ_{01} and γ_{11}), health burden (γ_{02} and γ_{12}), and the interaction of health burden and age group (γ_{03} and γ_{13}). Age group was coded as 0 (younger adults) and 1 (older adults). Person i 's deviation from the intercept is denoted by μ_{0i} , β_{1i} and β_{2i} were allowed to vary across individual by including random effects, μ_{1i} and μ_{2i} . Random effects were allowed to covary freely.

We used ML-SEMs on Mplus (Muthén, 1994) to examine whether health sensitivity predicts two-year change in health burden. We combined a latent change score model (LCSM: McArdle & Nesselroade, 1994) with MLM (Figure 1; see also Hertzog, Lövdén, Lindenberger, & Schmiedek, 2017). First, we tested measurement invariance in health burden across two years. Next, we modelled latent change with LCSM, focusing on the variance of the latent change score factor (represents individual differences in health changes between pretest and follow-up). We expected this to be related to health sensitivity during the ~100-days phase. This was modelled by integrating the LCSM with the MLM (latent change in health burden and within-person health sensitivity were modelled simultaneously). Individual differences in health sensitivity can be viewed as an unobserved (latent) Level-2 variable, which was then modelled as a predictor of change in health burden. Given a potentially quadratic effect, we included a linear and a quadratic effect of health sensitivity on the latent change score factor. Finally, age was included as moderator of the linear and quadratic effect of health sensitivity on change in health burden.

Results

Descriptive statistics and intercorrelations are presented in Table 1. Unconditional intercept-only models showed the between-person variance (intra-class correlation) to be 83% for positive affect, 66% for negative affect, and 52% for daily symptoms, indicating substantial within-person variability.

Daily life health sensitivity in younger and older adults

Results are reported in Table 2. We found that more daily symptoms were associated with below-average positive affect ($\beta = -0.83$, $CI = -0.95, -0.72$, $p < .0001$) and above-average negative affect ($\beta = 0.49$, $CI = 0.38, 0.60$, $p < .0001$). As expected, such health sensitivity was lower among older adults, but only for the within-person coupling of daily symptoms and positive affect ($\beta = 0.24$, $CI = 0.06, 0.41$, $p < .0001$), not negative affect ($\beta = 0.04$, $CI = -0.13, 0.20$, $p = 0.300$). These results indicate that younger and older adults display comparable levels of health sensitivity in negative affect, but older adults have lower health sensitivity in positive affect.

Daily life health sensitivity and health burden

Results are reported in Table 3. We found that health burden moderated the predictive effects of daily symptoms for positive affect, but not for negative affect, meaning those with higher health burden show a less pronounced relationship between daily symptoms and positive affect. Because higher health burden was associated with lower health sensitivity in positive affect, this finding points towards habituation (see Figure 2). No age differences in moderation were detected, indicating that elevated health burden was associated with health sensitivity in positive affect for younger and older adults alike. Of note, average health burden did not significantly differ between younger and older adults, $t(201.82) = -0.23$, $p = .815$. The effect of age reported above (lower health sensitivity in positive affect) remained significant and almost did not change numerically after testing health burden, indicating that age and health burden have unique and mainly independent predictive effects for health sensitivity.

In follow-up analyses, we included individual difference characteristics—gender, neuroticism and extraversion—as additional predictors so as to account for potential overlap with our predictor variables of interest. To illustrate, those high on neuroticism tend to perceive everyday events as more aversive and react to these with higher levels of negative affect and those high on extraversion tend to experience greater levels of daily positive affect (Suls & Martin, 2005). Females have additionally shown increased everyday emotional reactivity (Bradley, Codispoti, Sabatinelli, & Lang, 2001). Indeed, sensitivity analyses revealed that health sensitivity was higher in positive affect for females ($\beta = -0.18$, $CI = -0.35, -0.01$, $p < .05$) and higher in negative affect for neuroticism ($\beta = 0.33$, $CI = 0.08, 0.57$, $p < .05$), but was unrelated to extraversion. Importantly, reported results did not change after their inclusion (see Online Supplementary Material Table A1).

Daily life health sensitivity and longer-term change in health burden

Results are reported in Table 4. First, strict measurement invariance for health burden across pretest and follow-up (RMSEA = 0.061, CFI = 0.952, SRMR = 0.063) was established, ensuring the same construct was measured across time. ML-LCSMs revealed

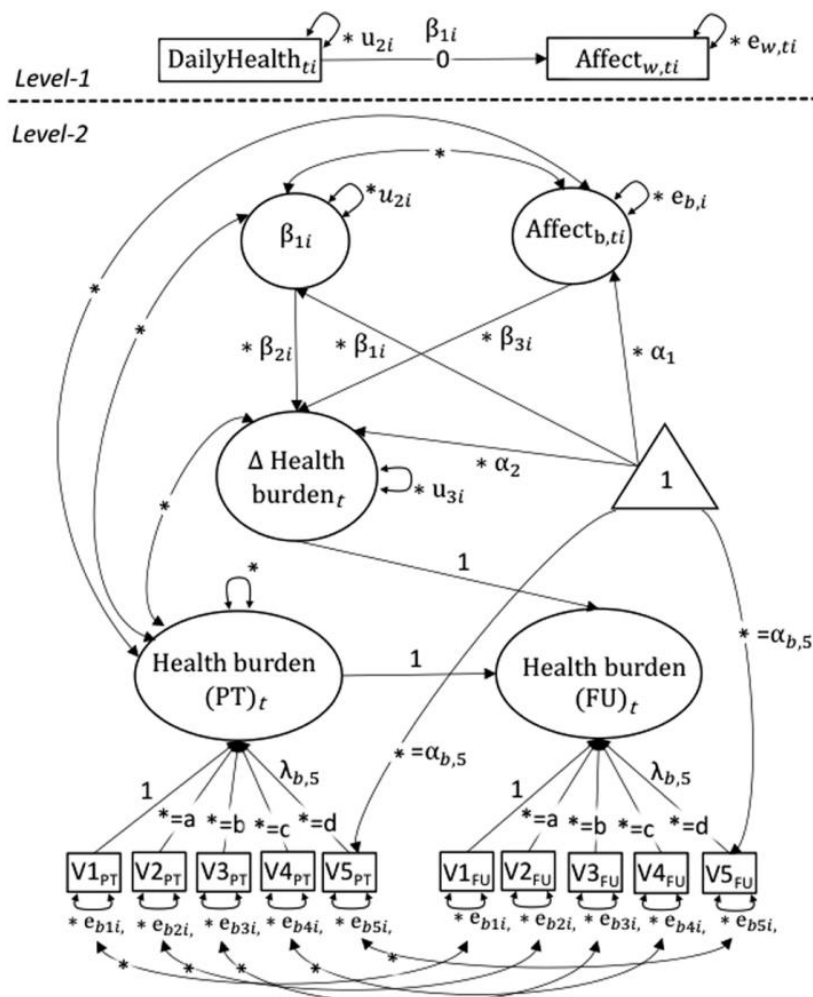


Figure 1. Multilevel structural equation model (ML-SEM) for estimating the effect of health sensitivity on change in health burden.

Note. Schematic representation of the ML-SEM used to test whether health sensitivity across the ~100-day micro-longitudinal phase predicts change in health burden between pretest (PT) and follow-up (FU). The fixed and random effects of health sensitivity are level-2 components of the model; the random effect (individual differences in health sensitivity) is used to predict latent change in health burden. Note that the thick arrow represents a quadratic and a linear effect. Manifest variables are represented in squares. Latent variables are presented by circles. For simplicity, means and intercepts are not represented. Asterisks represent free parameters. Parameters with equal signs are constrained to equality (the observed variables' intercepts were constrained to; the observed variables' residual variances were constrained to equality). V1–V5: observed items (i.e., items from symptom checklist).

Table 1. Descriptive statistics and intercorrelations among study variables for younger adults (top triangle) and older adults (bottom triangle).

Variable	1	2	3	4	5	M _{older}	SD _{older}
1. Health burden (PT)		.72	-.13	.26	.43	0.63	0.43
2. Health burden (FU)	.06		-.16	.20	.24	0.54	0.43
3. Daily positive affect	-.03	.06		.00	-.20	4.53	1.38
4. Daily negative affect	.31	.19	-.11		.38	0.51	0.87
5. Daily symptoms	.43	.11	-.14	.31		0.24	0.34
M _{younger}	0.60	0.53	3.09	1.32	0.28		
SD _{younger}	0.44	0.37	1.25	1.20	0.39		

Note. PT = pretest, FU = follow-up. Younger adults: 51.5% women. Older adults: 49.5% women. Values for daily data are the averages of person-specific means across days.

Intercorrelations of $r = |.08|$ or above differ statistically significantly from zero at $p < .05$.

Table 2. Multi-level model testing for age differences in daily life health sensitivity.

	Positive affect			Negative affect		
	Est.	CI ₉₅		Est.	CI ₉₅	
		Lower	Upper		Lower	Upper
Intercept	3.08*	2.86	3.30	1.28*	0.11	1.44
Daily symptoms	-0.83*	-0.95	-0.72	0.49*	0.38	0.60
Age	1.45*	1.14	1.75	-0.73*	-0.96	-0.50
Age*Daily symptoms	0.24*	0.06	0.41	0.04	-0.13	0.20
Time	-0.002*	-0.00	-0.00	0.001*	0.00	0.00
Variance intercept	1.39	0.97	1.45	0.71	0.65	2.09
Variance slope	0.28	0.04	0.52	0.23	-0.35	0.83
Variance time	0.00	0.00	0.00	0.00	0.00	0.00
Residual variance	0.27	0.26	0.28	0.36	0.35	0.37

Note. Est. = Estimate, Age = age group (0 = younger adults, 1 = older adults).

* $p < .05$.

Table 3. Multi-level model testing for daily life health sensitivity with age group and health burden as predictors.

Variable	Positive affect			Negative affect		
	Est.	CI ₉₅		Est.	CI ₉₅	
		Lower	Upper		Lower	Upper
Intercept	3.07*	2.85	3.29	1.30*	1.14	1.45
Daily symptoms	-0.84*	-0.95	-0.72	0.49*	0.38	0.60
Age	1.46*	1.16	1.76	-0.77*	-0.98	-0.55
Age*Daily symptoms	0.24*	0.07	0.41	0.02	-0.15	0.18
Time	-0.002*	-0.00	-0.00	0.001*	0.00	0.00
Health burden	-0.57*	-1.06	-0.08	0.64*	0.28	0.99
Health burden*Daily symptoms	0.32*	0.07	0.57	0.14	-0.10	0.38
Health burden*Age	0.42	-0.28	1.12	0.04	-0.47	0.54
Health burden*Age*Daily symptoms	-0.31	-0.69	0.06	0.11	-0.25	0.47
Variance intercept	1.39	0.97	1.36	0.63	0.51	0.75
Variance slope	0.28	0.20	0.36	0.23	0.05	0.41
Variance time	0.00	0.00	0.00	0.00	0.00	0.00
Residual variance	0.27	0.26	0.28	0.36	0.35	0.37

Note. Est. = estimate, Age = age group (0 = younger adults, 1 = older adults), Health burden = trait-report symptoms.

* $p < .05$.

Table 4. Multi-level-structural equation model testing for daily life health sensitivity as a predictor of change in health burden.

	Positive affect			Negative affect		
	Est.	CI ₉₅		Est.	CI ₉₅	
		Lower	Upper		Lower	Upper
Within-Person Model						
Level affect	3.76*	3.57	3.95	0.95*	0.94	0.96
Variance affect (between)	1.89*	1.56	2.22	0.87*	0.62	1.12
Residual variance (within)	0.33*	0.27	0.39	0.40*	0.34	0.46
Within-person slope (HS)	-0.65*	-0.75	-0.55	0.49*	0.41	0.57
Slope variance	0.38*	0.24	0.52	0.32*	0.23	0.41
Change model						
Change in health burden	-0.13*	-0.25	-0.01	-0.10	-0.22	0.02
Variance change in health burden	0.31*	0.21	0.41	0.31*	0.21	0.41
Change health b. regressed on HS	-0.12	-0.28	0.04	-0.14	-0.32	0.04
Change health b. regressed on HS ²	0.04	-0.10	0.18	-0.03	-0.19	0.13
Age × Change health b. reg. on HS	0.25	-0.39	0.89	-0.12	-1.02	0.78
Age × Change health b. reg. on HS ²	0.24	-0.09	0.57	-0.04	-0.99	0.91
Covariation						
Affect, HS	-0.05	-0.17	0.07	0.16*	0.03	0.29
Affect, latent health burden	-0.03	-0.15	0.09	0.15*	0.06	0.24
HS, latent health burden	0.06	0.001	0.12	0.07	0.01	0.13
Change in sym., Latent health b.	-0.18*	-0.24	-0.12	-0.17*	-0.24	-0.10
Exhausted PT, FU	0.08*	0.04	0.12	0.07*	0.02	0.12
Gastric complaints PT, FU	0.04*	0.001	0.08	0.04*	0.01	0.07
Limb pain PT, FU	0.04	0.04	0.04	0.04*	0.003	0.08
Circulatory problems PT, FU	0.03	-0.01	0.07	0.03	-0.001	0.06
Additional items PT, FU	0.03*	-0.01	0.08	0.03*	0.003	0.06

Note. Est. = estimate, reg. = regressed, HS = health sensitivity, health b. = health burden (trait-report symptoms), PT = pretest, FU = follow-up.

* $p < .05$.

that mean-level health burden declined slightly across time, with significant individual differences therein. However, health sensitivity in positive or negative affect did not predict (linear or quadratic) change in health burden. These results indicate that, contrary to expectations, how health sensitive people are in their daily life is unrelated to long-term health change.

Discussion

In the current report, we examined the within-person associations of daily symptoms with positive and negative affect (health sensitivity), the role of health burden as moderator and longer-term outcome, and age differences therein. As expected, days participants reported more symptoms than usual were also characterized by lower positive affect and higher negative affect (health sensitivity in positive affect and in negative affect, respectively). We also found evidence for age differences and health burden: older age and higher health burden were (independently) associated with having fewer health-related reductions in positive affect, but reductions in negative affect were comparable between age groups and levels of health burden. Health sensitivity was unrelated to longer-term change in health burden.

Age differences in daily health sensitivity

Results on age differences in health sensitivity indicate an age-related benefit in positive affect. These results mirror the well-established pattern of age-related decline in *global* health sensitivity (Schöllgen et al., 2016), and so is in line with the notion that global and daily affect are part of a unified psychological process wherein age-related benefits in the former are reflected in the latter (Kim-Prieto et al., 2005). Interestingly, the effect of age remained significant after testing for health burden (see Piazza et al., 2007, for a similar finding), suggesting that the age-related reductions in health sensitivity might not be driven by habituation to increased health burden (as is implied by some theoretical models: Williamson, 1998). Other age-related attributes might explain this finding: consistent with prominent lifespan theories, less health sensitivity in older adults may reflect a combination of increased motivation and skill at regulating emotions (Carstensen, 2006) and greater adaptive, coping and compensatory skills (Baltes & Baltes, 1990; Staudinger, 1999). Findings are also consistent with the notion that older adults perceive health problems as less threatening and thus less (emotionally) perturbing than younger adults (Ubel et al., 2005).

Interestingly we found that older adults were not less health sensitive in negative affect. This finding is somewhat consistent with earlier reports of no age differences or even age-related increases in negative affect reactivity to stressors. For example, Wrzus et al. (2013) found more pronounced negative reactions in older adults when they responded to particularly complex stressors. It might be that physical symptoms, given their salience in older adulthood, have similar effects as complex stressors such that older adults' enhanced expertise in dealing with stressors cannot be maintained in the context of daily symptoms. Drawing from SST (Carstensen, 2006), another possibility is that a diminished future time perspective makes physical symptoms especially salient and thus more (emotionally) triggering for older adults. Accordingly, these results are relevant for the small but growing body of literature specifying the conditions under which age-related improvements in emotion regulation fall short. However, these explanations do not account for why older adults showed comparable levels of health sensitivity in negative affect to younger adults. One explanation might be that remaining alert and reactive in negative affect (opposed to positive affect) is evolutionarily adaptive as it signals threat in the environment (Elliot & Thrash, 2002). Such alertness might be advantageous for physical symptoms because, if ignored, they might have more severe consequences than for younger adults.

Taken together, these results indicate that older adults are not *more* emotionally vulnerable to health problems, but rather have better or comparable levels to younger adults, which is consistent with definitions of successful aging as encompassing the maintenance of everyday affect in the face of health challenges (Young et al., 2009).

Daily health sensitivity and the role of health burden

Results corroborate the idea that affective reactions to physical symptoms are partly dependent on one's overall experience with health issues (Smith & Kirby, 2000), and extend previous micro-longitudinal reports by showing that higher health burden is associated with *lower* health sensitivity in positive affect. These results are in line with notions of habituation (Rankin et al., 2009), indicating that those with higher health burden habituate to daily symptoms. That health sensitivity in positive affect was lower in the context of higher health burden for younger and older adults alike is consistent with the proposal that experience with health problems impact affective well-being equally (i.e., regardless of age; Kunzmann et al., 2000). Given that processes of habituation are expected to equally hold for different affective valences, it is unclear why this effect was not seen for negative affect. Similar to the reasoning above, it might be that reactivity in negative affect is evolutionarily adaptive and thus impervious to processes of habituation. On a final note, these results indicate that understanding people's experience with health problems could help to develop individually-tailored interventions targeted at maintaining everyday affect in the face of increasing health challenges, however, subsequent research should first corroborate findings.

Consistent with research indicating that neuroticism and gender are linked to emotional reactivity (e.g., Bradley et al., 2001) sensitivity analyses showed that being female and having higher neuroticism were (independently) associated with higher health sensitivity in positive affect and in negative affect, respectively, but did not change our pattern of results (see Online Supplementary Material, Table A1). Moreover, health sensitivity in negative affect remained significant and largely unchanged, indicating that *health* sensitivity is distinct from a *general* sensitivity to everyday stressors, thought to be driven by neuroticism (Mroczek & Almeida, 2004).

Daily health sensitivity and longer-term change in health burden

Contrary to theory and evidence that larger affective reactions to daily stressors precede long-term change in health (McEwen, 2006; Piazza et al., 2013), we found no evidence of the predictive effects of health sensitivity for longer-term change in health burden. One explanation is that health burden takes more than two years to change— which is consistent with health burden remaining stable over our study (although reliable individual

differences therein were found)— thus potentially reducing the likelihood that the mechanisms proposed to prompt change (wear-and-tear, health behaviours) had an effect. The study of health sensitivity would thus benefit from testing its predictive effects over longer timeframes.

Limitations and outlook

Measures

First, our measures were all self-reports which might have inflated health–affect associations due to shared method variance. Relatedly, older adults' tend to underreport symptoms (Ubel et al., 2005), making it important for subsequent research to operationalize health sensitivity with more objective indicators of daily health (e.g., grip strength). It would also be instructive to explore health sensitivity with indicators that differ in manageability and severity. For example, health issues that differ in functional limitation may advance understanding of the pathways thought to link daily health to affect (i.e., daily disruption: Williamson, 1998). Second, we note that five of the PANAS negative affect items were excluded from analyses because of low (if any) variability. Thus, health sensitivity in negative affect captured emotional reactions in feelings of uneasiness (*distressed, jittery, nervous, upset, irritable*). Because such floor effects are common in old age, future studies might benefit from substantiating our PANAS-based results with additional scales, such as hedonic balance scores which combines unpleasantness scores (regardless of low variability) with overall daily mood scores (Röcke et al., 2009).

Design

Participants with severe health issues were less likely to come to the laboratory, meaning our daily data probably does not include information on more severe health issues, which are presumably more impactful to affect.

Sample

The age range of our older adult sample (65–80 years) was limited: research indicates that *global* health sensitivity becomes lower throughout old-old age (Jang et al., 2004), indicating that daily health sensitivity might be even lower among adults older than 80 years of age. Second, our sample contained predominantly healthy older adults, meaning results may not generalize to those less well-functioning. Lastly, age differences were tested cross-sectionally. We thus strongly encourage future research to corroborate findings with longitudinal data in more representative and heterogeneous samples that include oldest-old adults.

Conclusions

This study examined age differences in health sensitivity, the role of health burden, and associations between health sensitivity and longer-term changes in health burden. Extending previous research, this study showed that older age and higher health burden were (independently) associated with lower health sensitivity in positive affect. Consistent with aforementioned accounts of successful aging, older adults do not become more emotionally vulnerable to momentary health problems, despite increased health-vulnerability compared to younger adults.

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Health Sensitivity in Positive Affect for People with High and Low Health Burden

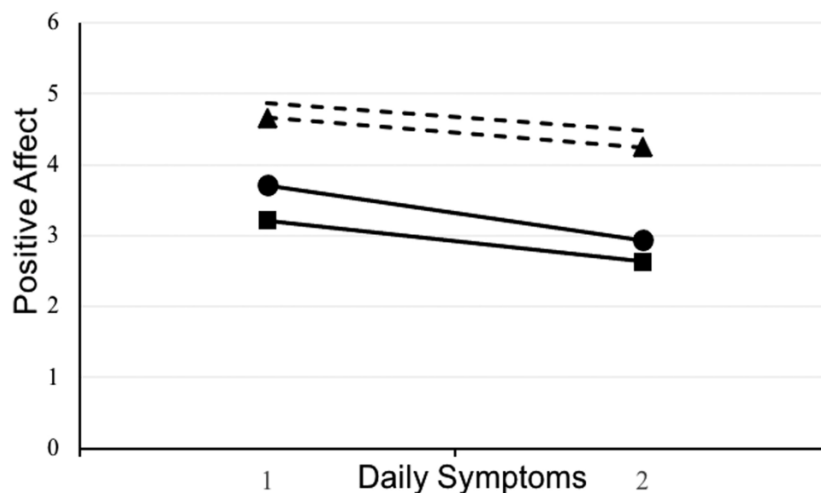


Figure 2. The effect of health burden on health sensitivity in positive affect.

Note. On days when participants reported more symptoms, they also reported lower positive affect. The relative reduction in positive affect with the experience of more daily symptoms is more pronounced among younger adults (solid lines) relative to older adults (dashed lines). As a consequence, health sensitivity was lower for older adults. As can also be seen, health sensitivity was lower for participants with high health burden (1SD above average; younger adults = square symbol, older adults = triangle symbol) relative to those with low health burden (1SD below average; younger adults = circle symbol, older adults = no symbol), indicating that those with higher health burden have a less pronounced relationship between health and positive affect. Age differences therein were non-significant.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

- Almeida, D. M., McGonagle, K., & King, H. (2009). Assessing daily stress processes in social surveys by combining stressor exposure and salivary cortisol. *Biodemography and Social Biology*, 55(2), 219–237. doi:[10.1080/19485560903382338](https://doi.org/10.1080/19485560903382338)
- Arai, A., Ishida, K., Tomimori, M., Katsumata, Y., Grove, J. S., & Tamashiro, H. (2007). Association between lifestyle activity and depressed mood among home-dwelling older people: A community-based study in Japan. *Aging & Mental Health*, 11(5), 547–555. doi:[10.1080/13607860601086553](https://doi.org/10.1080/13607860601086553)
- Baltes, P. B., & Baltes, M. M. (1990). Psychological perspectives on successful aging: The model of selective optimization with compensation. In P. B. Baltes & M. M. Baltes (Eds.), *Successful aging: Perspectives from the behavioral sciences* (pp. 1–34). New York: Cambridge University Press. doi:[10.1017/CBO9780511665684.003](https://doi.org/10.1017/CBO9780511665684.003)
- Bingel, U., Schoell, E., Herken, W., Büchel, C., & May, A. (2007). Habituation to painful stimulation involves the antinociceptive system. *Pain*, 131(1-2), 21–30. doi:[10.1016/j.pain.2006.12.005](https://doi.org/10.1016/j.pain.2006.12.005)
- Bradley, M. M., Codispoti, M., Sabatinelli, D., & Lang, P. J. (2001). Emotion and motivation II: Sex differences in picture processing. *Emotion (Washington, D.C.)*, 1(3), 300–319. doi:[10.1037/1528-3542.1.3.300](https://doi.org/10.1037/1528-3542.1.3.300)
- Brähler, E., Hinz, A., & Scheer, J. W. (2008). GBB-24. Der Gießener Beschwerdebogen. Manual [Gießen Body Complaint List. Manual (3rd revised and standardized version)]. Bern: Verlag Hans Huber.
- Brähler, E., Schumacher, J., & Brähler, C. (2000). First all-Germany standardization of the brief form of the Gissen Complaints Questionnaire GBB-24. *Psychotherapie, Psychosomatik, Medizinische Psychologie*, 50(1), 14–21. doi:[10.1055/s-2000-13233](https://doi.org/10.1055/s-2000-13233)
- Brose, A., Schmiedek, F., Lövdén, M., & Lindenberger, U. (2011). Normal aging dampens the link between intrusive thoughts and negative affect in reaction to daily stressors. *Psychology and Aging*, 26(2), 488–502. doi:[10.1037/a0022287](https://doi.org/10.1037/a0022287)
- Brose, A., Voelkle, M. C., Lövdén, M., Lindenberger, U., & Schmiedek, F. (2015). Differences in the between-person and within-person structures of affect are a matter of degree. *European Journal of Personality*, 29(1), 55–71. doi:[10.1002/per.1961](https://doi.org/10.1002/per.1961)
- Cacioppo, J. T. (1998). Somatic responses to psychological stress: The reactivity hypothesis. In M. Sabourin, F. Craik, & M. Robert (Eds.), *Advances in Psychological Science*, Vol. 2. Biological and Cognitive Aspects (pp. 87–112). UK: Psychology Press/Erlbaum Taylor & Francis.
- Carstensen, L. L. (2006). The influence of a sense of time on human development. *Science (New York, N.Y.)*, 312(5782), 1913–1915. doi:[10.1126/science.1127488](https://doi.org/10.1126/science.1127488)
- Carstensen, L. L., Pasupathi, M., Mayr, U., & Nesselroade, J. R. (2000). Emotional experience in everyday life across the adult life span. *Journal of Personality and Social Psychology*, 79(4), 644–655. doi:[10.1037/0022-3514.79.4.644](https://doi.org/10.1037/0022-3514.79.4.644)
- Charles, S. T. (2010). Strength and vulnerability integration: A model of emotional well-being across adulthood. *Psychological Bulletin*, 136(6), 1068–1091. doi:[10.1037/a0021232](https://doi.org/10.1037/a0021232)
- Charles, S. T., & Almeida, D. M. (2006). Daily reports of symptoms and negative affect: Not all symptoms are the same. *Psychology & Health*, 21(1), 1–17. doi:[10.1080/14768320500129239](https://doi.org/10.1080/14768320500129239)
- De Paepe, A. L., Williams, A. C. D. C., & Crombez, G. (2019). Habituation to pain: A motivational-ethological perspective. *Pain*, 160(8), 1693–1697. doi:[10.1097/j.pain.0000000000001533](https://doi.org/10.1097/j.pain.0000000000001533)
- Elliot, A. J., & Thrash, T. M. (2002). Approach-avoidance motivation in personality: Approach and avoidance temperaments and goals. *Journal of Personality and Social Psychology*, 82(5), 804–818. doi:[10.1037/0022-3514.82.5.804](https://doi.org/10.1037/0022-3514.82.5.804)
- Fishbein, M. (1980). A theory of reasoned action: Some applications and implications. In H. E. Howe Jr. & M. M. Page (Eds.), *Nebraska symposium on motivation* (pp. 65–116). Nebraska, USA: University of Nebraska Press.
- Gold, M. S., & Gebhart, G. F. (2010). Nociceptor sensitization in pain pathogenesis. *Nature Medicine*, 16(11), 1248–1257. doi:[10.1038/nm.2235](https://doi.org/10.1038/nm.2235)
- Hay, E. L., & Diehl, M. (2010). Reactivity to daily stressors in adulthood: The importance of stressor type in characterizing risk factors. *Psychology and Aging*, 25(1), 118–131. doi:[10.1037/a0018747](https://doi.org/10.1037/a0018747)
- Hertzog, C., Lövdén, M., Lindenberger, U., & Schmiedek, F. (2017). Age differences in coupling of intraindividual variability in mnemonic strategies and practice-related associative recall improvements. *Psychology and Aging*, 32(6), 557–571. doi:[10.1037/pag0000177](https://doi.org/10.1037/pag0000177)
- Jang, Y., Poon, L. W., & Martin, P. (2004). Individual differences in the effects of disease and disability on depressive symptoms: The role of age and subjective health. *International Journal of Aging & Human Development*, 59(2), 125–137. doi:[10.2190/RT1W-2HD7-KG5X-K1FB](https://doi.org/10.2190/RT1W-2HD7-KG5X-K1FB)
- Janssen, S. A. (2002). Negative affect and sensitization to pain. *Scandinavian Journal of Psychology*, 43(2), 131–138. doi:[10.1111/1467-9450.00278](https://doi.org/10.1111/1467-9450.00278)
- Katana, M., Röcke, C., & Allemand, M. (2019). Intra- and interindividual differences in the within-person coupling between daily pain and affect of older adults. *Journal of Behavioral Medicine*, 12, 1–16. doi:[10.1016/j.jpain.2011.03.003](https://doi.org/10.1016/j.jpain.2011.03.003)
- Kim-Prieto, C., Diener, E., Tamir, M., Scollon, C., & Diener, M. (2005). Integrating the diverse definitions of happiness: A time-sequential framework of subjective well-being. *Journal of Happiness Studies*, 6(3), 261–300. doi:[10.1007/s10902-005-7226-8](https://doi.org/10.1007/s10902-005-7226-8)
- Kroenke, K. (2003). Patients presenting with somatic complaints: Epidemiology, psychiatric comorbidity and management. *International Journal of Methods in Psychiatric Research*, 12(1), 34–43. doi:[10.1002/impr.140](https://doi.org/10.1002/impr.140)
- Kunzmann, U., Little, T. D., & Smith, J. (2000). Is age-related stability of subjective well-being a paradox? Cross-sectional and longitudinal evidence from the Berlin Aging Study. *Psychology and Aging*, 15(3), 511–526. doi:[10.1037/0882-7974.15.3.511](https://doi.org/10.1037/0882-7974.15.3.511)
- Lemon, B. W., Bengtson, V. L., & Peterson, J. A. (1972). An exploration of the activity theory of aging: Activity types and life satisfaction among in-movers to a retirement community. *Journal of Gerontology*, 27(4), 511–523. doi:[10.1093/geronj/27.4.511](https://doi.org/10.1093/geronj/27.4.511)
- McArdle, J. J., & Nesselroade, J. R. (1994). Using multivariate data to structure developmental change. In S. H. Cohen, & H. W. Reese (Eds.), *Lifespan developmental psychology: Methodological contributions* (pp. 223–267). New Jersey, USA: Lawrence Erlbaum Associates, Inc.
- McEwen, B. S. (2006). Protective and damaging effects of stress mediators: Central role of the brain. *Dialogues in Clinical Neuroscience*, 8(4), 367–381.
- Mroczek, D. K., & Almeida, D. M. (2004). The effect of daily stress, personality, and age on daily negative affect. *Journal of Personality*, 72(2), 355–378. doi:[10.1111/j.0022-3506.2004.00265.x](https://doi.org/10.1111/j.0022-3506.2004.00265.x)
- Muthén, B. O. (1994). Multilevel covariance structure analysis. *Sociological Methods & Research*, 22(3), 376–398. doi:[10.1177/0049124194022003006](https://doi.org/10.1177/0049124194022003006)
- Nesselroade, J. R. (1991). Interindividual differences in intraindividual change. In L. M. Collins & J. L. Horn (Eds.), *Best methods for the analysis of change: Recent advances, unanswered questions, future directions* (pp. 92–105). Washington, D.C., US: American Psychological Association. doi:[10.1037/10099-006](https://doi.org/10.1037/10099-006)
- Piazza, J. R., Charles, S. T., & Almeida, D. M. (2007). Living with chronic health conditions: Age differences in affective well-being. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 62(6), P313–321. doi:[10.1093/geronb/62.6.p313](https://doi.org/10.1093/geronb/62.6.p313)
- Piazza, J. R., Charles, S. T., Sliwinski, M. J., Mogle, J., & Almeida, D. M. (2013). Affective reactivity to daily stressors and long-term risk of reporting a chronic physical health condition. *Annals of Behavioral Medicine*, 45(1), 110–120. doi:[10.1007/s12160-012-9423-0](https://doi.org/10.1007/s12160-012-9423-0)
- Rankin, C. H., Abrams, T., Barry, R. J., Bhatnagar, S., Clayton, D. F., Colombo, J., ... Thompson, F. R. (2009). Habituation revisited: An updated and revised description of the behavioral characteristics of habituation. *Neurobiology of Learning and Memory*, 92(2), 135–138. doi:[10.1016/j.nlm.2008.09.012](https://doi.org/10.1016/j.nlm.2008.09.012)

- Röcke, C., Li, S. C., & Smith, J. (2009). Intraindividual variability in positive and negative affect over 45 days: Do older adults fluctuate less than young adults? *Psychology and Aging, 24*(4), 863–878. doi:[10.1037/a0016276](https://doi.org/10.1037/a0016276)
- Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs, 2*(4), 328–335. doi:[10.1177/109019817400200403](https://doi.org/10.1177/109019817400200403)
- Rowe, J. W., & Kahn, R. L. (1997). Successful aging. *The Gerontologist, 37*(4), 433–440. doi:[10.1093/geront/37.4.433](https://doi.org/10.1093/geront/37.4.433)
- SAS Institute Incorporated, C. O. R. P. O. R. A. T. E (1997). SAS/Iml Software, Changes and Enhancements through Release 6. 11. North Carolina, USA: SAS Publishing.
- Schilling, O. K., & Diehl, M. (2015). Psychological vulnerability to daily stressors in old age: Results of short-term longitudinal studies. *Zeitschrift Fur Gerontologie Und Geriatrie, 48*(6), 517–523. doi:[10.1007/s00391-015-0935-7](https://doi.org/10.1007/s00391-015-0935-7)
- Schmiedek, F., Lövdén, M., & Lindenberger, U. (2010). Hundred days of cognitive training enhance broad cognitive abilities in adulthood: Findings from the COGITO study. *Frontiers in Aging Neuroscience, 2*, 27–38. doi:[10.3389/fnagi.2010.0002](https://doi.org/10.3389/fnagi.2010.0002)
- Schöllgen, I., Morack, J., Infurna, F. J., Ram, N., & Gerstorf, D. (2016). Health sensitivity: Age differences in the within-person coupling of individuals' physical health and well-being. *Developmental Psychology, 52*(11), 1944–1953. doi:[10.1037/dev0000171](https://doi.org/10.1037/dev0000171)
- Smith, C. A., & Kirby, L. D. (2000). Consequences require antecedents: Toward a process model of emotion elicitation. In J. P. Forgas (Ed.), *Feeling and thinking: The role of affect in social cognition* (pp. 83–106). Cambridge, UK: Cambridge University Press.
- Staudinger, U. M. (1999). Older and wiser? Integrating results on the relationship between age and wisdom-related performance. *International Journal of Behavioral Development, 23*(3), 641–664. doi:[10.1080/016502599383739](https://doi.org/10.1080/016502599383739)
- Stawski, R. S., Scott, S. B., Zawadzki, M. J., Sliwinski, M. J., Marcussen-Clavertz, D., Kim, J., ... Smyth, J. M. (2019). Age differences in everyday stressor-related negative affect: A coordinated analysis. *Psychology and Aging, 34*(1), 91–105. doi:[10.1037/pag0000309](https://doi.org/10.1037/pag0000309)
- Suls, J., & Martin, R. (2005). The daily life of the garden-variety neurotic: reactivity, stressor exposure, mood spillover, and maladaptive coping. *Journal of Personality, 73*(6), 1485–1510. doi:[10.1111/j.1467-6494.2005.00356.x](https://doi.org/10.1111/j.1467-6494.2005.00356.x)
- Ubel, P. A., Loewenstein, G., & Jepson, C. (2005). Disability and sunshine: Can hedonic predictions be improved by drawing attention to focusing illusions or emotional adaptation? *Journal of Experimental Psychology. Applied, 11*(2), 111–123. doi:[10.1037/1076-898X.11.2.111](https://doi.org/10.1037/1076-898X.11.2.111)
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070. doi:[10.1037/0022-3514.54.6.1063](https://doi.org/10.1037/0022-3514.54.6.1063)
- Williamson, G. M. (1998). The central role of restricted normal activities in adjustment to illness and disability: A model of depressed affect. *Rehabilitation Psychology, 43*(4), 327–347. doi:[10.1037/0090-5550.43.4.327](https://doi.org/10.1037/0090-5550.43.4.327)
- Wolff, J. K., Brose, A., Lövdén, M., Tesch-Römer, C., Lindenberger, U., & Schmiedek, F. (2012). Health is health is health? Age differences in intraindividual variability and in within-person versus between-person factor structures of self-reported health complaints. *Psychology and Aging, 27*(4), 881–891. doi:[10.1037/a0029125](https://doi.org/10.1037/a0029125)
- Wolff, J. K., Lindenberger, U., Brose, A., & Schmiedek, F. (2016). Is available support always helpful for older adults? Exploring the buffering effects of state and trait social support. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences, 71*(1), 23–34. doi:[10.1093/geronb/gbu085](https://doi.org/10.1093/geronb/gbu085)
- Wolff, J. K., Schmiedek, F., Brose, A., & Lindenberger, U. (2013). Physical and emotional well-being and the balance of needed and received emotional support: Age differences in a daily diary study. *Social Science & Medicine, 91*, 67–75. doi:[10.1016/j.socscime](https://doi.org/10.1016/j.socscime)
- Woolf, C. J., & Costigan, M. (1999). Transcriptional and posttranslational plasticity and the generation of inflammatory pain. *Proceedings of the National Academy of Sciences of the United States of America, 96*(14), 7723–7730. doi:[10.1073/pnas.96.14.7723](https://doi.org/10.1073/pnas.96.14.7723)
- Wrzus, C., Müller, V., Wagner, G. G., Lindenberger, U., & Riediger, M. (2013). Affective and cardiovascular responding to unpleasant events from adolescence to old age: Complexity of events matters. *Developmental Psychology, 49*(2), 384–397. doi:[10.1037/a0028325](https://doi.org/10.1037/a0028325)
- Young, Y., Frick, K. D., & Phelan, E. A. (2009). Can successful aging and chronic illness coexist in the same individual? A multidimensional concept of successful aging. *Journal of the American Medical Directors Association, 10*(2), 87–92. doi:[10.1016/j.jamda.2008.11.003](https://doi.org/10.1016/j.jamda.2008.11.003)
- Zoccola, P. M., Dickerson, S. S., & Lam, S. (2012). Eliciting and maintaining ruminative thought: *The role of social-evaluative threat. Emotion (Washington, D.C.), 12*(4), 673–677. doi:[10.1037/a0027349](https://doi.org/10.1037/a0027349)