Age Advantages in Emotional Experience Persist Even Under Threat From the COVID-19 Pandemic

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Abstract

The COVID-19 pandemic is creating unprecedented, sustained, and unavoidable stress for the entire population, with older people facing particularly heightened risk of contracting the virus and suffering severe complications including death. The present study was conducted when the pandemic was spreading exponentially in the United States. To address important theoretical questions about age differences in emotional experience in times of crisis, we surveyed a representative sample of 945 Americans aged 18-76 and assessed the frequency and intensity of a range of positive and negative emotions. We also assessed perceived risk of contagion and complications from the virus, as well as personality, health, and demographic characteristics. Age was associated with relatively greater emotional well-being with and without controlling for perceived risk and other covariates. Findings extend previous research about age and emotion by demonstrating that older adults' relatively better emotional well-being persists even in the face of prolonged stress.

Keywords: emotions, emotion regulation, goals, socioemotional selectivity theory, strength and vulnerability integration

Statement of Relevance

The COVID-19 pandemic poses grave risks to physical health and persistent stress from limited social contact and economic uncertainty. The crisis jeopardizes the entire population, yet the virus places older adults at greatly heightened risk. Typically, older people report less frequent and intense negative emotions than younger people. Theoretical accounts of these relative advantages differ in the emphasis placed on heightened avoidance of high-stress environments or, alternatively, on prioritizing goals about meaningful aspects of life. Because of the inescapable and prolonged nature of the pandemic, avoidance is impossible. Subsequently, the present circumstances uniquely allow for the examination of competing postulates. We surveyed Americans aged 18 to 76 to assess positive and negative emotions during these extraordinary times. We observed better emotional well-being in older people compared to their younger counterparts. Findings provide additional evidence for emotional gains in late life and raise doubts that avoidance alone accounts for them.

Age Advantages in Emotional Experience Persist Even Under Threat From the COVID-19 Pandemic

The COVID-19 pandemic has taken an unprecedented toll on daily life around the world. In addition to grave risks to physical health, the pandemic has resulted in looming uncertainties about contagion, fears about shortages, restricted social contacts, and profound economic uncertainties. A threat of this scope and severity holds the potential to reduce global collective well-being.

In addition to the practical importance of understanding the emotional reactions people are experiencing during these extraordinary times, examining age differences in responses to population-wide stressors may also shed light on important theoretical questions about age differences in emotional experience and emotion regulation. There is abundant evidence that emotional well-being improves with age. However, it is unclear whether this relatively positive emotional profile reflects improved regulation of experienced emotions or the active avoidance of environments that elicit negative emotions. Below, we describe empirical findings about emotion and aging and review two important theoretical accounts of age differences. We then present findings from a survey deployed to assess age differences at the point when threats to well-being from the COVID-19 pandemic were first peaking in the United States and inescapable external shocks to daily life were ubiquitous.

Emotional Experience Improves with Age

There is substantial evidence that, on balance, older people's daily emotional experience is more positive than younger people's (Burr et al., 2020; Carstensen et al., 2000; 2011; Stone et al., 2010). Older people report that they manage their emotions better than they did when they were younger (Gross et al., 1997) and display greater emotional stability in day-to-day life (Burr et al., 2020). When faced with serious diseases such as cancer, older patients report better affective states than younger patients (Hart & Charles, 2013). Life satisfaction also increases from mid- to late life (Blanchflower & Oswald, 2008; Galambos et al., 2020); and while there is some evidence that satisfaction begins to

decline after 70 (Baird et al., 2010), the decline is better predicted by closeness to death than chronological age (Gerstorf et al., 2008).

Theoretical Accounts of Improved Emotional Experience

Considerable theoretical work has been devoted to explaining these widely documented age associations with emotional well-being. While virtually all life-span theories view *selection* as essential to adult development, some theories posit that age-related advantages reflect the avoidance of stressors while others maintain that age advantages are driven by motivational shifts that direct cognitive and behavioral resources to positive and meaningful aspects of life.

Shifts in motivation and goals. Socioemotional selectivity theory (SST; Carstensen, 1993, 2006; Carstensen et al., 1999) argues that late-life improvements in emotional well-being result from motivational shifts that occur as individuals perceive constraints on future time. When time is perceived as expansive, as it typically is in youth, goals about exploration and expanding horizons are prioritized because these goals prepare individuals to adapt to nebulous future conditions. In contrast, when future time is constrained, goals and related preferences favor emotional meaning and positive experience. SST maintains that the approach of endings allows people to live in the present and to prioritize feeling states over future preparedness. While mortality represents a powerful ending, geographical relocations, college graduations, and political events that prime the fragility of life (e.g., terrorist attacks) also result in the prioritization of emotionally meaningful goals (Fredrickson & Carstensen, 1990; Fung & Carstensen, 2004). In a study by Barber and colleagues (2016), the experimental priming of endings instantiated the positivity effect in young adults. And, importantly, when time horizons are *expanded* experimentally, older people display preferences for exploration (Fung & Carstensen, 2004).

SST predicts that because goals direct cognitive processing, attention and memory come to support emotionally meaningful goals as people grow older. Older people react less to negative situations, are less distracted by irrelevant negative stimuli, and display preferential attention to and

memory for emotionally meaningful and positive stimuli (Reed et al., 2014). Termed the "positivity effect" (see Mather & Carstensen, 2005), this literature suggests that differential emotion processing is a default mode of processing that emerges across adulthood and involves minimal cognitive effort in directing attention to positive elements of life (Allard et al., 2010). Mather (2012) maintains that the positivity effect reflects cognitive control and has proposed a model that illuminates preservation of cognitive and neural support for emotion processing that favors positive stimuli over negative information. Attending to and remembering positive information over negative – while not a conscious *strategy* – may well contribute to improved emotional experience.

Situation selection and avoidance of stressors. A complementary conceptualization of age-related advantages in emotional well-being is the strength and vulnerability integration model (SAVI; Charles, 2010). SAVI acknowledges age-related improvements in emotional experience in daily life but suggests that advantages rest primarily on the avoidance of stressful situations. Under conditions where stress is prolonged and inescapable, SAVI maintains that the degradation of physiological homeostasis will limit the capacity to effectively regulate emotions and subsequently age-related advantages will be eliminated or reversed. In one study, Charles et al. (2009) observed that older people experienced less affective reactivity than younger people when they were able to avoid stressful or tense interactions, yet when they did engage in these stressful interactions, older and younger people experienced similar levels of reactivity. Similarly, Birditt (2014) found that older people reported less reactivity than younger adults to a mildly distressing event they could largely avoid, but when they were required to engage in such events, similar levels of reactivity were observed across age. The degree to which situation selection accounts for emotional well-being in daily life is unknown, however, and age differences in the use of situation selection have not been observed when directly examined (Eldesouky & English, 2018).

In summary, theory and empirical evidence suggest that aging is associated with improved emotional experience. An important unresolved issue is whether age-related gains in emotional

experience rest principally on avoiding stressors or if other factors, such as cognitive control, play a role. To answer this question experimentally, researchers would need to expose older and younger people to prolonged, inescapable, high-stress conditions. For obvious ethical reasons, this has never been done. However, the COVID-19 pandemic has been providing just such conditions, forcing people to shelter-in-place and raising fears and uncertainties about a mortal threat that is affecting the entire population and is especially dangerous for older adults.

The Present Study

In April 2020, we deployed a survey assessing positive and negative emotional experiences to a sample of American adults spanning fifty-eight years. The pandemic was appearing at different rates and times around the world. April was the month when it first surged in the United States. Hundreds of thousands of Americans contracted the virus, and COVID-related deaths increased exponentially from roughly 5,000 at the beginning of the month to 60,000 at the end. News about the pandemic was omnipresent and it was clear that older people were at greatly heightened risk of both health complications and death.

We reasoned that if avoidance (a.k.a., situation selection) accounts for the demonstrated advantages in emotional experience in older people, then conditions such as these would eliminate age differences. If, instead, age differences in emotional experience remained, findings would speak against situation selection as the central explanation for observed age advantages. Reasoning from SST and bolstered by empirical evidence concerning an age-related positivity effect, we hypothesized that age differences would be preserved, even during this fragile time.

Method

Participants and Procedures

The study was approved by Stanford University's Institutional Review Board, and informed consent was obtained from all participants. Following recent recommendations to recruit large samples

when testing age effects (Brydges, 2019) we preregistered a sample size of 970. We used Prolific (www.prolific.co) to recruit an online sample of 974 adults who were currently living in the United States, with age and gender stratified across the sample. Participants were invited to complete a study entitled "Responses to the coronavirus" and received a payment of $4 as compensation. Data from all participants were collected using Qualtrics survey software on April 23rd and 24th, 2020.

Exclusions. Consistent with our preregistered plan, we excluded data from participants (*n*=20) who completed the entire survey in less than five minutes on the presumption that they had not paid adequate attention to the survey items and instructions. On Prolific's recommendation, we also excluded eight cases with suspicious response patterns. We also excluded data from one participant who did not report age, resulting in a final sample size of 945.

Sample characteristics. Participants were 49.2% female and ranged in age from 18 to 76 (*M* = 45.15, *SD* = 16.79). Seventy-five percent of participants identified as White. The median household income for the sample was between $50,000 and $60,000, which is comparable to the median U.S. income of $62,000 (U.S. Census Bureau, 2018a). Fifty-six percent of participants were currently working for pay, which is comparable to the 60% employment rate nationwide (Bureau of Labor Statistics, 2020). The sample was somewhat more educated than the U.S. population: 88% of participants reported attending at least some college, compared to 60% in the US population (U.S. Census Bureau, 2019). Twenty-three percent of participants reported living alone, again comparable to the 28% of American households with one occupant (U.S. Census Bureau, 2018b).

Measures

Emotional well-being. Emotional well-being was assessed with items about the frequency and intensity of 29 emotions (16 positive and 13 negative). These emotions were adapted from Carstensen et al. (2011) and designed to vary in valence and arousal level. Participants first rated how often they experienced each of the emotions over the past week, using a scale from *Never* (coded as 0) to *All or*

nearly all of the time (coded as 4). After all frequency ratings were completed, participants were asked to rate the intensity for each of the emotions they had reported experiencing (i.e., any emotion they rated as anything other than "*Never*"). Intensity of emotions was rated on a scale from 1 = *Not at all [emotion]* to 5 = *Extremely [emotion]*. For example, participants who reported that they had felt angry over the past week would see an item asking, "When you felt **angry** this past week, how **angry** did you typically feel?" with response options of *Not at all angry*, *A little angry*, *Somewhat angry*, *Very angry*, and *Extremely angry*.

In instances where frequency for an emotion was endorsed but intensity was rated as "not at all," we entered frequency as N/A, per the preregistration plan. Cronbach's alphas indicated high internal consistency for frequencies (α = 0.90 for both positive and negative emotions) and intensities of emotions (positive: α =.90 and negative: α = .89). Thus, we averaged frequency and intensity within valence and used composite scores in all subsequent analyses.

Time horizons. Time horizons were measured with the Future Time Perspective Scale (FTP; Carstensen & Lang, 1996). The scale contains ten statements about people's subjective perceptions of time (e.g., "Many opportunities await me in the future") and participants rate how true each statement is for them using a 7-pt scale from *Very untrue* to *Very true*. After reverse-keying three items (e.g., "I have the sense that time is running out"), the ten items were averaged to create an overall FTP score with higher scores indicating more expansive futures (α = .93, *M* = 4.09, *SD* = 1.35). Based on a recent factor analysis by Rohr et al. (2017) suggesting that the FTP scale reflects three related but separate constructs, we calculated scores for each subscale: Extension (subjective sense of time left in life; α = .87, *M* = 4.02, *SD* = 1.91), Opportunity (future opportunities; α = .92, *M* = 4.73, *SD* = 1.62), and Constraint (future limitations ; α = .83, *M* = 3.74, *SD* = 1.76). Because perceived time left aligns best with the key

theoretical mechanism postulated in SST, FTP-Extension was used in subsequent analyses of time horizons[1].

Perceived risk. We measured perceived risk related to coronavirus in terms of personal risk as well as perceived risk to others. Using a scale where 0 = *no risk*, 1 = *very low risk*, 2 = *low risk*, 3 = *moderate risk*, 4 = *high risk*, and 5 = *very high risk*, participants rated their own risk of contracting coronavirus (*M* = 2.36, *SD* = 1.11) as well as their risk of complications from coronavirus given their current health status (*M* = 2.45, *SD* = 1.34). Participants used the same 6-pt scale to rate the risk of contracting coronavirus in the general population (*M* = 2.97, *SD* = 0.94).

Effect on employment. Participants also indicated the extent to which their employment or retirement status had been affected by the coronavirus pandemic, using a 5-pt scale from *Not at all* to *A great deal* (*M* = 1.41, *SD* = 1.46).

Subjective health. Subjective health was measured using the item from the Short Form 36 (Ware & Sherbourne, 1992) that asks participants to describe their health on a 5-pt scale from *excellent* to *poor*. Responses were reverse-coded such that higher scores indicate better health (*M* = 3.36; *SD* = 0.99).

Personality. We measured personality traits with the Ten-Item Personality Inventory (TIPI; Gosling et al., 2003), which captures the Big Five personality traits of extraversion, conscientiousness, agreeableness, openness, and emotional stability. Participants read ten pairs of personality traits (e.g., "Dependable, self-disciplined", "Reserved, quiet") and rated the extent to which each applied to them using a 7-pt scale from *disagree strongly* to *agree strongly*. The two items for each trait were averaged to create a score for each of the five personality domains. Means (with standard deviations in parentheses) ranged from 3.44 (1.65) for extraversion to 5.23 (1.33) for conscientiousness.

[1] Results were effectively unchanged when we used the average of all FTP scale items, or each of the other two scales, though effects were stronger for the Extension subscale.

Results

All analyses were conducted using R version 3.6.1. See R Packages in the Supplemental Material for specific packages.

Preliminary Analyses

Emotional experience. As a whole, participants reported positive emotions ($M_{positive}$ = 1.97, *SD* = 0.56) more frequently than negative emotions ($M_{negative}$ = 1.42, *SD* = 0.66 ; *t*(944) = 15.41, *p* < .001, *d* = 0.5, 95% CI [.48, .63]). As noted above, Cronbach's alphas within valence were high for both positive and negative emotions.[2] Repeated measures ANOVAs documented significant differences in the frequencies of specific positive emotions (F_{within}(15, 13446) = 194.6, *p* < .001) and negative emotions (F_{within}(12, 10501) = 500.2, *p* < .001). The top three most frequently reported positive emotions (with comparable frequencies) were calm, quiet, and appreciative. Of the negative emotions, concern was reported more frequently than other emotions. See Table 1 for full results.

Table 1
Mean Frequencies of Emotions

	M	*SD*	95% CI
Positive Emotions			
Calm [a]	2.44	0.87	[2.39, 2.50]
Quiet [ab]	2.43	0.87	[2.38, 2.49]
Appreciative [a]	2.40	0.93	[2.35, 2.46]
Interested [b]	2.28	0.83	[2.23, 2.33]
Content [c]	2.15	0.94	[2.09, 2.21]
Happy [c]	2.13	0.80	[2.08, 2.18]
Relaxed [c]	2.13	0.89	[2.07, 2.19]
Peaceful [c]	2.05	0.95	[1.99, 2.11]
Energetic [d]	1.90	0.80	[1.85, 1.95]
Affectionate [d]	1.89	0.86	[1.83, 1.94]
Amused [d]	1.87	0.72	[1.83, 1.92]
Accomplished [d]	1.84	0.87	[1.78, 1.89]
Joyful [e]	1.71	0.90	[1.65, 1.76]

[2] When controlling for emotion-specific variation in the observed effects through mixed-effects linear models with random age slopes for specific emotions, results remained unchanged (see Age Correlations with Emotions, Mixed Effects Models Results, and Table S2 in the Supplemental Material).

Proud [e]	1.67	0.97	[1.61, 1.73]
Relieved [f]	1.48	0.88	[1.42, 1.53]
Excited [f]	1.46	0.79	[1.41, 1.51]
Negative Emotions			
Concerned [a]	2.23	0.91	[2.17, 2.29]
Anxious/Worried [b]	2.00	1.06	[1.94, 2.07]
Bored [bcd]	1.88	1.12	[1.81, 1.95]
Frustrated [c]	1.85	0.93	[1.79, 1.91]
Irritated [de]	1.75	0.89	[1.70, 1.81]
Sad [ef]	1.69	0.97	[1.63, 1.76]
Lonely [f]	1.55	1.25	[1.47, 1.63]
Fearful [g]	1.38	1.06	[1.31, 1.44]
Angry [g]	1.35	0.89	[1.29, 1.41]
Disgusted [h]	1.16	0.99	[1.10, 1.22]
Guilty [i]	0.63	0.87	[0.58, 0.69]
Embarrassed [j]	0.51	0.76	[0.47, 0.56]
Ashamed [j]	0.44	0.76	[0.40, 0.49]

Note: N=945. Within each valence, emotions that share a superscript do not differ significantly in a paired t-test at the alpha=0.05 level, after a Bonferroni correction for multiple comparisons.

Participants also rated positive emotions ($M_{positive}$ = 1.92, *SD* = 0.58) as more intense than negative emotions ($M_{negative}$ = 1.77, *SD* = 0.70) though the difference was small (*t*(941) = 4.48, *p* < .001, *d* = 0.15, 95% CI [.09, .22]). Overall, the most frequently reported emotions were also rated as most intense. Responses indicated that among the negative emotions, concern was most intense, followed by frustration, anxiety/worry, and boredom. Among positive emotions, participants reported that appreciation and quietness were experienced most intensely followed by calmness and interest. See Intensity of Emotions and Table S1 in the Supplemental Material for full results for emotional intensity.

Primary Analyses

Age and frequency of emotions. Next, we examined the correlations of age with key variables in the study (see Table 2). We found that age was positively correlated with perceived risk, suggesting that older adults were aware of their heightened risk and related threats to emotional well-being.

Table 2

Simple Correlations of Age and Dependent Variables with Background Variables

Variable	Age	Frequency of Emotions		Intensity of Emotions	
		Negative	Positive	Negative	Positive
Age	—	**-.27***** (-.33, -.21)	**.19***** (.13, .25)	**-.24***** (-.30, -.18)	**.09**** (.03, .15)
FTP	**-.35***** (-.41, -.29)	**-.25***** (-31, -.19)	**.42***** (.37, .47)	**-.21***** (-.27, -.15)	**.40***** (.34, .45)
Extension	**-.62***** (-.66, -.58)	-.01 (-.07, .05)	**.18***** (.12, .24)	-.03 (-.10, .03)	**.21***** (.15, .27)
Opportunity	**-.23***** (-.29, -.17)	**-.23***** (-.29, -.17)	**.43***** (.38, .48)	**-.16***** (-.22, -.10)	**.42***** (.37, .47)
Constraint	**-.12***** (-.18, -.05)	**-.32***** (-.37, -.26)	**.29***** (.23, .35)	**-.27***** (-.33, -.21)	**.26***** (.20, .32)
Openness	.08* (.01, .14)	**-.10**** (-.16, -.03)	**.14***** (.07, .20)	.005 (-.06, .07)	**.14***** (.08, .20)
Conscientiousness	**.24***** (.18, .30)	**-.30***** (-.36, -.24)	**.28***** (.22, .34)	**-.24***** (-.30, -.18)	**.23***** (.16, .29)
Extraversion	**.13***** (.07, .19)	**-.13***** (-.19, -.06)	**.20***** (.14, .26)	**-.09**** (-.15, -.03)	**.15***** (.09, .21)
Agreeableness	**.30***** (.24, .35)	**-.29***** (-.35, -.23)	**.30***** (.25, .36)	**-.19***** (-.25, -.13)	**.27***** (.21, .33)
Emotional Stability	**.26***** (.20, .32)	**-.57***** (-.61, -.52)	**.49***** (.44, .54)	**-.45***** (-.50, -.40)	**.40***** (.34, .45)
Risk to self	**.21***** (.15, .27)	**.17***** (.10, .23)	**-.13***** (-.19, -.06)	**.16***** (.10, .22)	**-.10**** (-.17, -.04)
Risk of complications	**.42***** (.37, .47)	**.11***** (.05, .18)	**-.09**** (-.15, .02)	**.12***** (.05, .18)	-.08* (-.14, -.01)
Risk for the population	-.08* (-.14, -.01)	**.20***** (.13, .26)	**-.10**** (-.16, -.03)	**.17***** (.11, .23)	-.03 (-.10, .03)
Gender (Female)[a]	.01 (-.05, .08)	**.15***** (.09, .21)	-.07* (-.14, -.01)	**.12***** (.06, .18)	-.03 (-.09, .03)
Race (White)[a]	**.36***** (.31, .42)	-.08* (-.15, -.02)	.01 (-.05, .08)	-.05 (-.11, .02)	.02 (-.05, .08)
Employment status (Working)[a]	**-.15***** (-.21, -.08)	-.003 (-.07, .06)	.01 (-.05, .08)	-.01 (-.07, .06)	.03 (-.03, .10)
Employment/retirement affected	-.07* (-.13, -.01)	**.26***** (.20, .32)	**-.15***** (-.22, -.09)	**.22***** (.16, .28)	**-.11***** (-.18, -.05)
Self-rated health	**-.13***** (-.20, -.07)	**-.17***** (-.23, -.11)	**.27***** (.21, .33)	**-.16***** (-.22, -.09)	**.26***** (.20, .31)
Living alone (Yes)[a]	**.22***** (.16, .28)	-.07* (-.13, -.01)	-.002 (-.07, .06)	.04 (-.02, .10)	.03 (-.03, .10)
Household income	-.05 (-.12, .01)	-.02 (-.08,.05)	.05 (-.01, .12)	-.08* (-.14, -.02)	.06 (-.00, .13)

Education level	**.22*****	-.05	.01	-.06	.02
	(.16, .28)	(-.11, .01)	(-.05, .08)	(-.12, .01)	(-.05, .08)

Note. Bold values indicate p<0.01. 95% Confidence Intervals appear beneath each correlation.
[a] Parentheses denote values of binary variables coded as 1.
*p < .05. **p < .01. ***p < .001.

To test the hypothesis that age is associated with a reduction in the frequency of negative emotions, we ran a series of linear regressions with frequency of negative emotions as the dependent measure[3]. In the first model, we established that age was inversely associated with the frequency of negative emotions (see Figure 1, and full results in Table 3). We then added the two perceived risk items (risk of contracting coronavirus and risk of coronavirus-related complications) to the model and found that the effect of age was stronger when accounting for risk, and that perceived risk was associated with experiencing negative emotions more frequently. This suggests that although older adults were exposed to greater risk and its negative emotional outcomes, they still reported experiencing negative emotions less frequently. Next, we added TIPI personality traits to the model. Age remained a significant predictor of the frequency of negative emotions. Finally, we added demographic variables that were significantly associated with age (i.e., health, race, living alone, and employment status)[4] into the model**.** The significant association of age and negative emotional frequency remained.

[3] To facilitate interpretation, age was standardized (as were all other continuous predictors) and categorical demographic variables were binarized.
[4] Given the sample size, we used a relatively conservative threshold for determining significance of associations (α=.01).

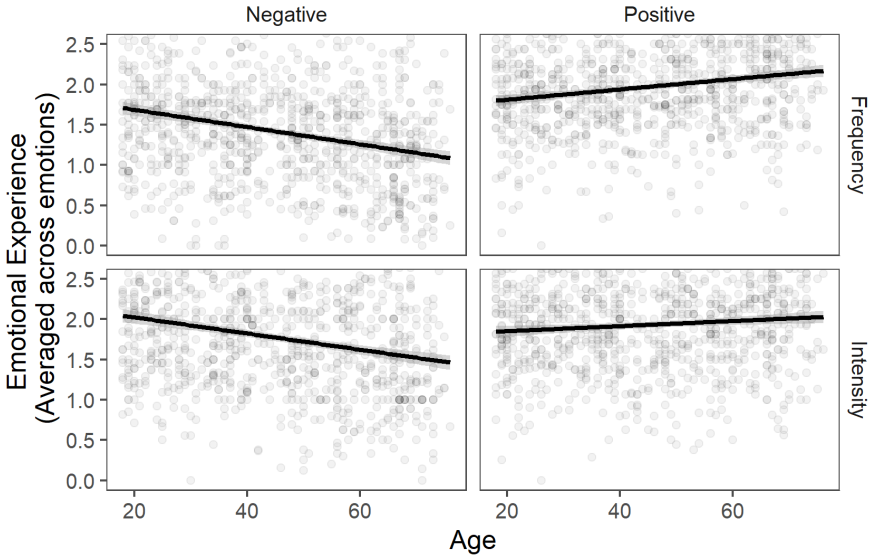

Fig. 1. Relationship of age with emotional experience. Frequency of emotions was rated on a scale from 0 = *Never* to 4 = *All or nearly all of the time;* intensity was rated from 0 = *Not at all [emotion]* to 4 = *Extremely [emotion]*. Ratings were averaged across positive and negative emotions separately. Grey areas represent 95% confidence intervals around the regression estimate. Correlation coefficients can be found in Table 2.

Table 3

Age Effects on Frequency of Negative Emotions

	Model 1 (*N* = 945)			Model 2 (*N* = 945)			Model 3 (*N* = 945)			Model 4 (*N* = 942)		
Variable	*B*	95% CI		*B*	95% CI		*B*	95% CI		*B*	95% CI	
(Intercept)	**1.42*****	1.38	1.46	**1.42*****	1.38	1.46	**1.42*****	1.38	1.45	**1.43*****	1.35	1.51
Age	**-0.18*****	-0.22	-0.14	**-0.25*****	-0.30	-0.21	**-0.13*****	-0.17	-0.09	**-0.13*****	-0.17	-0.08
Risk to self				**0.09*****	0.04	0.14	**0.09*****	0.05	0.13	**0.09*****	0.05	0.13
Risk of complications				**0.13*****	0.08	0.18	**0.06***	0.01	0.10	**0.06***	0.01	0.11
Openness							0.01	-0.02	0.05	0.01	-0.02	0.05
Conscientiousness							**-0.05***	-0.09	-0.01	**-0.05****	-0.09	-0.01
Extraversion							0.01	-0.02	0.05	0.02	-0.02	0.05
Agreeableness							-0.02	-0.06	0.02	-0.02	-0.06	0.02
Emotional Stability							**-0.31*****	-0.35	-0.27	**-0.31*****	-0.35	-0.27
Race (White) [a]										-0.02	-0.11	0.06
Health										-0.00	-0.04	0.04
Education Level										0.01	-0.03	0.05
Employed (Yes) [a]										0.01	-0.06	0.08
Live alone (Yes) [a]										-0.02	-0.10	0.06
Adjusted R^2	0.07			0.15			0.37			0.37		
Test for change in R^2			$F(2, 941) =$ **57.07*****			$F(5, 936) =$ **67.91*****			$F(5, 928) = 0.17$			

Note. Continuous predictors were standardized.

[a] Parentheses denote values of binary variables coded as 1.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

To test the relationship between age and frequency of positive emotions, we used the same hierarchical regression approach described above (see full results in Table 4). When age alone was in the model, it was positively associated with the frequency of positive emotions. Mirroring our findings for negative emotions, this relationship was significant and explained variance increased when perceived risk, personality, and demographics were added in consecutive steps to the model.

Age and the intensity of experienced emotions. We used similar hierarchical linear regressions to test the relationship between age and the intensity of negative and positive emotional experience. In this sample, we found relatively strong correlations between frequency and intensity scores ($r(943) = .78$ for positive emotions and $r(940) = .70$ for negative emotions, both p's < .001). The pattern of results is similar. As shown in Tables 5 and 6, age was negatively associated with the intensity of negative emotions and positively associated with the intensity of positive emotions. Both relationships were significant when perceived risk was entered to the model, and models accounting for risk were better fits for the data, again suggesting that older adults report experiencing greater well-being during the pandemic even though they were at greater risk. The inverse association of age with intensity of negative emotions remained significant after controlling for personality and demographics, whereas the association of age and intensity of positive emotions was no longer significant.[5]

[5] Gender interacted with age only for frequency of positive emotions (Age x Gender interaction: β = -.08, p = .009), with older females more likely than younger females to report higher frequencies (β = .011, p < .001). This was not the case for non-females (β = .03, p = .33). All other age effects held across gender. See Age and Gender Interactions in the Supplemental Material for full results of gender analyses.

Table 4

Age Effects on Frequency of Positive Emotions

	Model 1 (*N* = 945)			Model 2 (*N* = 945)			Model 3 (*N* = 945)			Model 4 (*N* = 942)		
Variable	*B*	95% CI		*B*	95% CI		*B*	95% CI		*B*	95% CI	
(Intercept)	**1.97*****	1.94	2.01	**1.97*****	1.94	2.01	**1.97*****	1.94	2.00	**2.02*****	1.94	2.09
Age	**0.11*****	0.07	0.14	**0.15*****	0.12	0.19	**0.04***	0.01	0.08	**0.07****	0.03	0.11
Risk to self				**-0.06*****	-0.10	-0.02	**-0.06****	-0.10	-0.02	**-0.05****	-0.09	-0.02
Risk of complications				**-0.08*****	-0.13	-0.04	-0.02	-0.06	0.02	0.02	-0.02	0.07
Openness							0.00	-0.04	0.03	0.00	-0.03	0.03
Conscientiousness							**0.04***	0.01	0.07	0.03	-0.01	0.06
Extraversion							**0.05****	0.01	0.08	**0.04******	0.00	0.07
Agreeableness							**0.05****	0.02	0.09	**0.05****	0.02	0.08
Emotional Stability							**0.22*****	0.18	0.25	**0.20*****	0.17	0.24
Race (White) [a]										-0.05	-0.12	0.03
Health										**0.10*****	0.07	0.14
Education Level										**-0.03***	-0.07	0.00
Employed (Yes) [a]										0.01	-0.05	0.07
Live alone (Yes) [a]										-0.07	-0.14	0.01
Adjusted R^2	0.04			0.08			0.27			0.30		
Test for change in R^2			$F(2, 941) =$ **27.30*****			$F(5, 936) =$ **52.60*****			$F(5, 928) =$ **7.10*****			

Note. Continuous predictors were standardized.

[a] Parentheses denote values of binary variables coded as 1.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 5

Age Effects on Intensity of Negative Emotions

	Model 1 (*N* = 942)			Model 2 (*N* = 942)			Model 3 (*N* = 942)			Model 4 (*N* = 939)		
Variable	*B*	95% CI		*B*	95% CI		*B*	95% CI		*B*	95% CI	
(Intercept)	**1.77*****	1.73	1.82	**1.77*****	1.73	1.81	**1.77*****	1.73	1.81	**1.71*****	1.61	1.80
Age	**-0.17*****	-0.21	-0.13	**-0.24*****	-0.29	-0.20	**-0.15*****	-0.19	-0.10	**-0.17*****	-0.22	-0.12
Risk to self				**0.09*****	0.04	0.14	**0.09*****	0.05	0.14	**0.09*****	0.04	0.14
Risk of complications				**0.13*****	0.08	0.19	**0.07****	0.02	0.12	**0.07***	0.01	0.12
Openness							**0.07****	0.03	0.11	**0.07****	0.03	0.11
Conscientiousness							**-0.04***	-0.09	0.00	-0.04	-0.09	0.00
Extraversion							0.00	-0.04	0.04	0.01	-0.04	0.05
Agreeableness							0.02	-0.03	0.06	0.01	-0.03	0.06
Emotional Stability							**-0.27*****	-0.32	-0.22	**-0.27*****	-0.31	-0.22
Race (White) [a]										0.04	-0.06	0.14
Health										-0.01	-0.06	0.04
Education Level										0.00	-0.04	0.04
Employed (Yes) [a]										-0.01	-0.09	0.07
Live alone (Yes) [a]										**0.16*****	0.06	0.25
Adjusted R^2	0.06			0.12			0.26			0.27		
Test for change in R^2			$F(2, 938) =$ **43.99*****			$F(5, 933) =$ **35.70*****			$F(5, 925) =$ **2.29***			

Note. Continuous predictors were standardized.

[a] Parentheses denote values of binary variables coded as 1.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Table 6

Age Effects on Intensity of Positive Emotions

	Model 1 (*N* = 945)			Model 2 (*N* = 945)			Model 3 (*N* = 945)			Model 4 (*N* = 942)		
Variable	*B*	95% CI		*B*	95% CI		*B*	95% CI		*B*	95% CI	
(Intercept)	**1.93*****	1.89	1.97	**1.93*****	1.89	1.97	**1.93*****	1.90	1.96	**1.91*****	1.83	1.99
Age	**0.05****	0.02	0.09	**0.09*****	0.05	0.13	-0.02	-0.06	0.02	-0.02	-0.06	0.03
Risk to self				**-0.05***	-0.09	-0.01	**-0.05***	-0.09	-0.01	**-0.04***	-0.08	0.00
Risk of complications				**-0.05***	-0.10	-0.01	0.00	-0.05	0.04	**0.05***	0.00	0.10
Openness							0.02	-0.02	0.05	0.02	-0.02	0.05
Conscientiousness							0.04	0.00	0.08	0.02	-0.02	0.06
Extraversion							0.03	-0.01	0.06	0.02	-0.02	0.06
Agreeableness							**0.07****	0.03	0.11	**0.06****	0.02	0.10
Emotional Stability							**0.19*****	0.15	0.23	**0.18*****	0.14	0.22
Race (White) [a]										0.02	-0.07	0.10
Health										**0.12*****	0.08	0.16
Education Level										-0.02	-0.06	0.02
Employed (Yes) [a]										0.01	-0.06	0.08
Live alone (Yes) [a]										0.01	-0.07	0.09
Adjusted R^2	0.01			0.03			0.18			0.20		
Test for change in R^2			$F(2, 941) =$ **11.94*****			$F(5, 936) =$ **36.09*****			$F(5, 928) =$ **6.34*****			

Note. Continuous predictors were standardized.

[a] Parentheses denote values of binary variables coded as 1.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

Mediation by future time perspective. To examine whether age effects were mediated by FTP, we followed Baron & Kenny's (1986) mediation method complemented with a bootstrap analysis advocated by Preacher & Hayes (2008). We used a bias-corrected 95% CI of the bootstrapped indirect effects to measure statistical significance for each of our dependent variables. To facilitate interpretation of effect sizes, we standardized all variables so that estimates reflected the strength of the correlations. Results for frequency and intensity of positive and negative emotions are shown in Figure 2.

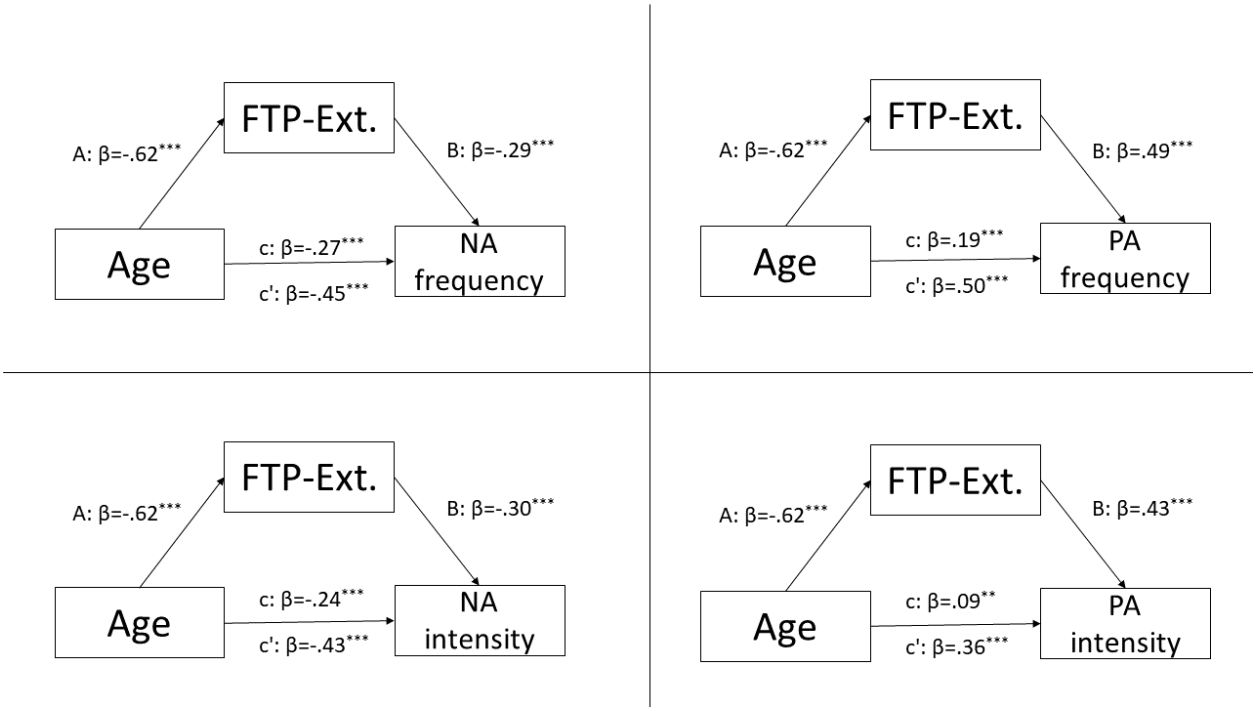

Fig. 2. Mediation models illustrating the statistical suppression of future time perspective (Extension subscale) on the relationship between age and better emotional well-being. Measures were standardized such that the coefficients represent correlations between variables.

As expected, age was significantly associated with FTP. However, *longer* time horizons were associated with greater emotional well-being (see Table 2). When both age and FTP-Extension were included in the model, a suppression effect was observed. Namely, the effect of age became stronger rather than weaker. This was the case for frequency of negative emotions, frequency of positive emotions, intensity of negative emotions and the intensity of positive emotions (95% bootstrap CIs for

the indirect effect: [.13, .23], [-.36, -.25], [.13, .24], and [-.32, -.22], respectively). In all models, perceiving more time left in life was associated with better emotional well-being, suggesting that older adults experience better emotional well-being *despite* perceiving less time left in life.

Discussion

The present survey was deployed in April 2020, as the COVID-19 pandemic began its initial surge in the United States. It had become clear that the risks of severe illness and death increased starkly with age, and that these threats would be compounded by extended economic uncertainty and social isolation. The unique circumstances of the pandemic allowed us to address an important theoretical issue about emotional aging. Namely, do relative age advantages in emotional experience persist when people are exposed to prolonged and inescapable threats? The present findings suggest that they do.

Reasoning from SST, we hypothesized that emotional well-being would be preserved. As people age and perceive shrinking time horizons, priority is increasingly placed on emotionally meaningful goals, and goal-supportive behavior and cognitive processing operate in the service of emotional fulfillment. However, another important conceptual model, SAVI, maintains that the avoidance of stressful situations plays a central role in the preservation of emotional well-being at older ages. SAVI maintains that emotional advantages will be eliminated or even reversed if older people are exposed to prolonged and inescapable stress. In contrast, because SST attributes advantages to broad motivational shifts, it predicts that relative advantages will persist even when exposed to stress. For ethical reasons, experimental tests of these predictions have been quite limited and mostly indirect. Sadly, the COVID-19 pandemic has created precisely the type of unavoidable stress in which predictions derived from SAVI and SST diverge.

Interestingly, findings provide no evidence that the pandemic is altering widely documented age patterns of emotional well-being. Granted, we do not have a pre-pandemic baseline for the present sample. However, the findings are strikingly similar to those of multiple studies conducted before the

pandemic. Compared to younger participants, older participants reported less negative emotion and more positive emotion in their current lives. This relative age advantage cannot be explained by risk denial: older participants perceived greater risk than younger adults and comparable amounts of financial stress. Recent reports suggest that older adults are following COVID-19 news even more closely than younger adults (Jurkowitz &Mitchell, 2020), suggesting that it is unlikely that limited exposure to stressors or a lack of awareness account for preserved well-being.

Though the present findings provide no evidence that emotional well-being has been degraded in older people during the pandemic, it is possible that the experience is not generating the type of high arousal states specified by SAVI. It is also possible that findings would be different in a much older sample or in populations at highest risk, such as frail nursing home residents. Importantly, however, the avoidance of stress outlined in SAVI has been interpreted broadly in the literature on emotion and aging as *the* primary explanation for improved emotional well-being with age (Birditt, 2014; Wrzus et al., 2014; Katana & Hill, 2020). The present findings speak against this interpretation. In the midst of a major life-altering experience, older people continue to report better emotional experience than younger people report.

Future time horizons, as measured by the FTP scale, did not mediate age differences in emotional experience, which is consistent with findings from a number of recent studies suggesting that longer, not shorter, perceived futures predict better emotional functioning (Grühn et al., 2016), less preoccupation with negative events (Strough et al., 2016), and higher levels of achievement motivation (Kooij et al., 2018). The FTP scale (Carstensen & Lang, 1996) was developed to document the face-valid association of age with time left in life, which has proven highly reliable. However, the construct has not proven to be a good proxy for the sense of time running out that leads to a reprioritization of goals (Barber et al., 2020), even though there is ample evidence that the priming of endings leads to prioritizing emotional goals (Fredrickson & Carstensen, 1990; Fung & Carstensen, 2006). Indeed, one

recent study instantiated the positivity effect in young people by experimentally priming endings (Barber et al., 2016). Considered together, findings from this emerging literature suggest that the deliberative assessment of mortality risk, captured by the FTP measure, does not reflect the more visceral sense of time scarcity that SST postulates leads to shifts in goal priorities.

All told, findings add to evidence that emotional functioning may not only be spared from age-related decline but may improve. Even when enveloped by persistent and dire threats to health and well-being, older people display notable emotional resilience.

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Author Contributions

L. L. Carstensen developed the study concept. All authors contributed to the study design. Data collection was overseen by J. T. Barnes. Y. Z. Shavit conducted the data analyses and interpretation of results under the supervision of L. L. Carstensen. L. L. Carstensen drafted the manuscript with considerable input from Y. Z. Shavit and J. T. Barnes. All authors approved the final version of the manuscript for submission.

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Open Practices Statement

This study was preregistered with OSF using the *AsPredicted.org* template. The data set can be downloaded from https://osf.io/h7uqv/files/.