Online Supplementary Materials

Pilot Study and Stimuli Validation

Prior to Study 1, we developed and validated our stimuli set using a broad sample of American participants across the age-span of 18-72 years. We began with 180 possible properties that participants categorized as interoceptive vs. behavioral vs. situational and also measured how much individuals associated each property with the emotion categories of anger, sadness, disgust, fear, and boredom. Additionally, this validation study allowed us to preliminarily assess whether age differences occur for interoceptive emotion properties but not behavioral or situational properties and to estimate the size of that effect for *a priori* power analyses for Study 1. The final stimuli set developed for Study 1 is presented in Table S1 below and a description of how we chose final stimuli is described in Study 1.

Pilot Study Method

Participants. 170 participants (61.2% female) were recruited using Amazon's Mechanical Turk (MTurk). Forty-four out of the full sample either failed attention checks or did not wish to disclose their age and thus we could not use them in the final analyses (given that age is our primary predictor of interest). The remaining 126 participants ranged in age from 18-72 with 74% of participants falling between 18-40 years old, 9% between 41-50 years old, and 17% between 51-72 years old (M_{age}= 39.9 years). Ethnicity and race were representative of typical U.S. demographics (66.4% European American, 11.2% African American, 3.0% Asian American, 1.4% Native American, and 6.0% Latin American). Total annual income ranged from $0 to $400,000 per year ($M_{\text{income}}$ = $60,158.76, SD_{income}= $50,281.34).

Materials. We developed a total of 180 emotion property words with 60 interoceptive, 60 behavioral, and 60 situational properties. Interoceptive properties included: "blood pumping," "drowsy," and "nauseous"; behavioral properties included: "frowning," "moaning," and "looking away"; situational properties included "cheated," "uncertainty," and "abandoned."

Procedure. Participants read that this was an "emotion knowledge survey" and were directed to Qualtrics via Mechanical Turk. The task began after individuals granted informed consent.

Emotion property ratings. First, to serve as an initial validation of our property stimuli, we asked participants to rate how interoceptive, behavioral, and situational they found an emotion property to be. Participants read the following instructions: "For this first task, you will rate 60 words based on their emotional properties. All words are related to experiences you might have when feeling an emotion. When reading a word, try to imagine yourself in relation to that word. How much does this describe a bodily feeling you would have when experiencing an emotion? How much does it describe a behavior you might do when experiencing an emotion? How much does it describe a situation you might be in when experiencing an emotion? These three questions will help guide you in rating how much the 60 words fit into bodily, behavioral, or situational categories. Remember: please answer these questions using your knowledge of your own and other people's emotions."

To reduce participant burden, individuals rated 60 emotion properties randomly selected from the list of 180 total properties. All properties were randomly presented across participants. The 60 emotion properties were broken into 6 blocks of 10 words each with an attention check randomly presented during the block. The order of properties was also randomized across all participants to avoid order effects. All participants rated an equal number of interoceptive, behavioral, and situational properties. Participants

reported how interoceptive, behavioral, and situational each property was using a Likert scale (1 = *Not at all* to 5 = *Completely*). Given our final sample size, 39-48 people rated each emotion property.

Discrete emotion ratings. Participants next rated the extent to which properties were associated with emotion categories. To reduce participant burden, individuals rated the extent to which 30 emotion properties randomly selected from the list of 180 total properties were associated with five emotions (anger, sadness, fear, disgust, and boredom). We focused on negative emotion categories because individuals are more likely to differentiate amongst different negative emotion categories than positive emotion categories (e.g., Ellsworth & Smith, 1988; Erbas, Ceulemans, Pe, Koval, & Kuppens, 2014). Based on normative ratings (Russell, 1980), anger, fear, and disgust are prototypically experienced as high arousal but sadness and boredom are prototypically experienced as low arousal.

All properties were randomly presented across participants. The 30 emotion properties were broken into two blocks of 15 words each with an attention check randomly presented during the block. The order of properties was also randomized across all participants to avoid order effects. Again, all participants rated an equal number of interoceptive, behavioral, and situational properties. Participants rated on a Likert scale (1 = *Not at all* to 5 = *Completely*) how strongly they associated the 30 emotion properties with each of the five emotions. Given our final sample size, 39-48 people rated their associations between each emotion property and the five discrete emotions. Demographics and debriefing were completed after both study tasks were complete.

Analyses. To assess differences in emotion modality associations, we calculated a mean score for all three modalities (an Interoceptive mean, Behavioral mean, and Situational mean) based on participants' likert scale ratings (e.g., "How much does this describe a bodily feeling you would have when experiencing an emotion?"). To assess differences in emotion concept associations, we calculated an emotion mean score across all emotion categories (anger, sadness, fear, disgust, and boredom) for each modality of interoception, behaviors, and situations. All variables demonstrated univariate and multivariate normality. As a preliminary test of our primary hypothesis that older adults will report interoceptive-specific differences in their emotion categories, we present bivariate correlations below.

Pilot Study Results

Emotion property ratings. Age was significantly correlated with interoceptive ratings (r= -.23, p=.009), suggesting that older adults rated themselves as less likely to experience interoceptive sensations relative to younger adults. Age was marginally correlated with behavioral ratings (r = -.16, p = .077), suggesting that older adults may have rated themselves as less likely to enact emotion-relevant behaviors. However, age did not correlate with situational ratings (r = -.05, p = .572), suggesting that older and younger adults were equally likely to rate the emotion-relevant situations as part of their experiences.

Discrete emotion ratings. Next, to test our prediction that older adults would be less likely to associate interoceptive properties with emotion categories, we used bivariate correlations to assess the relation between age and individuals' ratings of how much they experienced the emotion-relevant interoceptive sensations, behaviors, and situations during the emotions of anger, sadness, fear, disgust, and boredom. Age correlated with interoceptive ratings across emotion categories, r= -.18, p=.040, suggesting that older adults were less likely to characterize interoceptive sensations (e.g., "blood pumping") as a property of specific emotion categories relative to younger adults. However, age did not significantly correlate with behavioral or situational ratings across emotion categories: behaviors r= -.08, p=.393; situations r= -.10, p=.281.

Pilot Study Discussion

In this pilot study, participants first rated attributes on the extent to which they could be categorized as interoceptive vs. behavioral vs. situational properties or features of emotional experience. They next rated the extent to which specific interoceptive sensations, behaviors, and situations were associated with the emotion categories anger, sadness, fear, disgust, and boredom. Consistent with our constructionist hypotheses and maturational dualism (Mendes, 2010), older adults characterized their emotions as involving fewer interoceptive attributes: they were less likely to report that interoceptive sensations were something they experienced during emotions. We also found a marginal effect of age on emotion-relevant behaviors, such that with increasing age, adults were less likely to report that behaviors were something they experienced during emotions. However, age did not predict differences in adults' associations between situations and emotions.

When looking at the association between interoceptive sensations, behaviors, situations and specific emotions, age predicted weaker associations between interoceptive sensations and specific negative emotion categories. There were no age differences in the extent to which adults associated behaviors or situations with specific emotion categories, however. These findings provide preliminary evidence that increasing age predicts differences in emotion representations, insofar older adults are less likely to think of emotions as having interoceptive properties than younger adults are.

Finally, this pilot study also allowed us to get a general sense of potential effect sizes for our interoceptive, behavioral, and situational properties. In general, all are smallish effect sizes (when examining the bivariate Pearson correlation r-coefficient, which can serve as a standardized effect size estimate).

Supplementary Analyses to Study 2

Based on questions raised in review, we conducted additional analyses with the Study 2 Day Reconstruction Method data. Using a hierarchical regression approach, we examined whether age moderates the association between high arousal interoceptive sensations and reported negative/positive emotion, and how adding situational and behavioral ratings into the model might alter the role of age-related interoceptive effects on emotion. In particular, we ran these additional analyses with the hope of (1) providing more insight into whether the positivity effect commonly observed in older adults might be related to a decreasing effect of high arousal interoceptive sensations and (2) whether findings might be driven in part by situation selection, wherein older adults are selecting to engage in fewer situations that elicit negative emotions and more situations that elicit positive emotions in daily life.

Negative emotion as the outcome. First, we examined the interaction of age x high arousal interoception on negative emotion reports (see Step 1, **Table S5** below). There was no main effect of age (b= -.03, β= -.04, p= .336), but there was a significant main effect of high arousal interoceptive sensations on negative emotion (b= .70, β= .84, p<.0001), such that higher ratings of high arousal interoceptive sensations were associated with more intense negative emotions across emotion episodes. There was also a significant negative interaction between age and high arousal interoceptive sensations (b= -.07, β= -.08, p= .027), suggesting that as age increases, the link between high arousal interoceptive sensations and negative emotions weakened. Simple slopes tests revealed that the effect of high arousal interoceptive sensations was significant across -1SD, 0SD, and +1SD for age, with the slope significantly decreasing with age. Specifically, the effect of high arousal interoceptive sensations at -1SD age was t(197)= 19.58, p<.0001, at 0SD age was t(197)= 22.45, p<.0001, and at +1SD age was t(197)= 12.95, p<.0001. In other words, there was a positive relation between high arousal interoceptive sensations and

negative emotions but as age increased, this relation remained significant but became attenuated in later ages.

We next examined the effect of adding in simple main effects of situational ratings and behavioral ratings into the model (Step 2). The goal here was to parse out the situational and behavioral variance that was shared or confounded with high arousal interoceptive ratings. In this model, there remained a significant main effect of interoception on negative emotion reports (b= .59, β= .70, p<.0001), but the age x interoception interaction dropped from significance (p= .148). Age, situational, and behavioral main effects were not significant either (ps> .10).

In a final step (Step 3), we also controlled for age differences in situational and behavioral ratings by looking at the full age x modality sets of interactions. Interoceptive sensations remained again significant (b= .59, β= .70, p<.0001). As before, there were no age, situational, or behavioral main effects on negative emotion (ps> .10). Importantly, the interaction of age x interoception was marginally significant in a negative direction consistent with our predictions (b= -.10, β= -.12, p=.068), even when controlling for the age x situation and age x behavior interactions. This may tentatively suggest that high arousal interoceptive sensations are uniquely associated with negative emotion reports, above and beyond any variance explained by situational or behavioral features of emotion, and that this relation between high arousal interoceptive sensations and negative emotions weakens with increasing age. This interpretation would be consistent with a maturational dualism account of emotional aging. However, given the marginal effect and that these models are exploratory, we caution readers to view these findings as preliminary in nature.

Positive emotion as the outcome. In a parallel set of hierarchical regressions, we next examined the interaction of age x high arousal interoception on positive emotion reports (see Step 1, **Table S6** below). We found a significant main effect of age (b= .26, β= .24, p<.0001) and also a significant main effect of high arousal interoceptive sensations on positive emotion (b= .30, β= .28, p<.0001). These main effects suggest that as age increases, so too does the strength of positive emotion reports across emotion episodes; similarly, higher ratings of high arousal interoceptive sensations were associated with more intense positive emotions (controlling for age effects). Additionally, there was a significant negative interaction between age and high arousal interoceptive sensations (b= -.20, β= -.18, p= .006). Simple slopes tests revealed that the effect of high arousal interoceptive sensations was significant only at -1SD and 0SD for age, but not at later +1SD ages. Specifically, the effect of high arousal interoceptive sensations at -1SD age was t(197)= 5.54, p<.0001, and at 0SD age was t(197)= 4.22, p<.0001. The effect of high arousal interoceptive sensations at +1SD age was t(197)= .03, p=.355. In other words, there was a positive relation between high arousal interoceptive sensations and positive emotions but as age increased, this relation remained significant only for younger adults and adults around the mean age of the sample (c. 35 years old), but this relation between high arousal interoceptive sensations and positive emotions disappeared in later ages.

We then examined the effect of adding in simple main effects of situational ratings and behavioral ratings into the model (Step 2). The goal here again was to parse out the situational and behavioral variance that was shared or confounded with high arousal interoceptive ratings. At this step, both age and interoception remained significant (bs= .21, -.67; βs= .19, -.63; ps<.0001 respectively). There were also significant, positive main effects of situational and behavioral ratings on positive emotion reports (bs= .92, .40; βs= .38, .09; ps<.0001 respectively). However, the interaction of age x interoception which was significant at the first step dropped to marginal significance after including in situational and behavioral main effects (b= .09, β= .09, p=.078). This suggests that age-related

interoceptive effects on positive emotion may be in part related to situational or behavioral features of emotion.

Finally, in Step 3, we examined the full age x modality interactions. All main effects remained significant (*ps*<.01). However, the marginal interaction of age x high arousal interoception dropped to nonsignificance (*p*=.255) when accounting for age x situation and age x behavior effects; there was also no effect of age x behavior (*p*=.508). Interestingly, a marginal age x situation interaction did emerge (*b*= .18, β = .17, *p*=.082), such that the association between situational ratings and positive emotions became stronger with increasing age. These findings may be more consistent with a situation selection explanation (albeit, only in the case of positive emotions). Across adulthood into later life, adults may be increasingly experiencing and perhaps selecting life situations that support more positive emotions. We did not ask participants about their motivations or emotion regulation strategies, so it is unclear whether situation selection is actually responsible for this age x situation effect on positive emotion. Again, given the marginal effect and that these models are exploratory, we caution readers to take findings as provisional.

Summary. In conclusion, it is interesting that age differences in high arousal interoceptive ratings seem to matter more for negative emotions, whereas age differences in situational ratings matter more for positive emotions. This may suggest different aging mechanisms for negative and positive emotion. For example, it could be that as peripheral psychophysiology and interoception weaken in later life, this particularly impacts negative emotions, which tend to involve greater recruitment of physiological resources, whereas older adults' later life circumstances (e.g., retiring, perhaps more agency over some decisions and situations) and socioemotional motivations help them rely more on situational strategies and features which boost positive emotions. This asymmetry in mechanisms for negative vs. positive emotion could still work hand-in-hand to help explain why older adults appear to experience fewer negative and more positive emotion. Future work should prioritize disentangling whether different mechanisms (e.g., maturational dualism, situation selection, other attention and regulation motivations, etc.) matter more for negative vs. positive emotions in later life.

Table S1. Study 1 random effects for the multilevel models.

Random Effects	Model 1 (Full Interoceptive) Variance	Model 2 (High Interoceptive) Variance	Model 3 (Low Interoceptive) Variance
Random Intercept	1.61	1.61	1.61
Random Intercept for Behaviors	.32	.32	.33
Random Intercept for Interoception	.47	.63	.79
Random Item Intercept	1.55	1.58	1.50
Residual	4.40	4.37	4.33

Note: Model 1 included all interoceptive items. Model 2 used only on high arousal interoceptive items. Model 3 used only on low arousal interoceptive items.

Table S2. Study 2 random effects for the multilevel models with modalities.

Random Effects	Model 1 (Full Interoceptive) Variance	Model 2 (High Interoceptive) Variance	Model 3 (Low Interoceptive) Variance

Random Intercept for Episode x Subject	.10	.11	.11
Random Intercept for Subjects	.40	.43	.40
Random Item Intercept	.41	.26	.43
Residual	2.02	1.89	2.09

Note: Model 1 included all interoceptive items. Model 2 used only on high arousal interoceptive items. Model 3 used only on low arousal interoceptive items.

Table S3. Study 2 fixed effects for age x interoceptive self-reports.

Fixed Effects	*b*	*β*	S.E.	*t*	*95% CIs*
Intercept	2.01	.00	.18	11.19***	1.66, 2.36
Age	-.12	-.07	.15	-.81	-.42, .18
Age^2	.03	.08	.04	.87	-.04, .11
Behavior	.15	.04	.20	.74	-.24, .54
All Interoception	.23	.06	.20	1.14	-.17, .63
Age x Behavior	-.01	-.01	.03	-.41	-.08, .05
Age x All Interoception	-.05	-.03	.03	-1.48	-.12, .02
Age^2 x Behavior	-.01	-.02	.01	-1.48	-.03, .01
Age^2 x All Interoception	.01	.02	.01	1.16	-.01, .03

***$p < .001$.

Table S4. Study 2 random effects for the multilevel models with states (emotional, physical, cognitive).

Random Effects	Model 1 (Full Emotion) Variance	Model 2 (Neg Emotion) Variance	Model 3 (Pos Emotion) Variance	Model 4 (Hi Emotion) Variance	Model 5 (Low Emotion) Variance
Random Intercept for Episode x Individual	.10	.12	.13	.11	.10
Random Intercept for Individuals	.47	.51	.51	.49	.50
Random Item Intercept	.33	.24	.32	.27	.34
Residual	2.05	1.82	2.21	1.91	2.17

Note: Model 1 included all emotion items. Model 2 used negative emotions. Model 3 used positive emotions. Model 4 used high arousal emotions. Model 5 used low arousal emotions.

Table S4. Hierarchical regression approach to age x modality on negative emotion.

Fixed Effects	*b*	*β*	S.E.	*t*	*p*
Step 1: Interoception Only					
Intercept	1.70	-.01	.03	55.82	<.001
Age	-.03	-.04	.03	-.97	.336
High Arousal (HA) Interoception	.70	.84	.03	22.45	<.001
Age x HA Interoception	-.07	-.08	.03	-2.23	.027
Step 2: Controlling for Sit and Beh					
Intercept	1.70	-.01	.03	56.34	<.001

Age	-.03	-.04	.03	-.97	.331
HA Interoception	.59	.70	.06	10.07	<.001
Situation	.01	.01	.07	.18	.857
Behavior	.13	.16	.08	1.64	.103
Age x HA Interoception	-.05	-.06	.03	-1.45	.148
Step 3: Full Interactions					
Intercept	1.71	.00	.03	56.11	<.001
Age	-.02	-.03	.03	-.67	.507
HA Interoception	.59	.70	.06	9.57	<.001
Situation	.02	.02	.07	.24	.814
Behavior	.12	.15	.08	1.52	.131
Age x HA Interoception	-.10	-.12	.05	-1.84	.068
Age x Situation	-.09	-.10	.07	-1.27	.205
Age x Behavior	.13	.15	.09	1.38	.171

Table S5. Hierarchical regression approach to age x modality on positive emotion.

Fixed Effects	*b*	*β*	S.E.	*t*	*p*
Step 1: Interoception Only					
Intercept	2.57	-.02	.07	36.88	<.001
Age	.26	.24	.07	3.76	<.001
High Arousal (HA) Interoception	.30	.28	.07	4.22	<.001
Age x HA Interoception	-.20	-.18	.07	-2.76	.006
Step 2: Controlling for Sit and Beh					
Intercept	2.60	.01	.05	54.86	<.001
Age	.21	.19	.05	4.34	<.001
HA Interoception	-.67	-.63	.09	-7.39	<.001
Situation	.92	.86	.10	8.99	<.001
Behavior	.40	.38	.13	3.22	.001
Age x HA Interoception	.09	.09	.05	1.77	.078
Step 3: Full Interactions					
Intercept	2.59	.01	.05	54.59	<.001
Age	.20	.19	.05	4.09	<.001
HA Interoception	-.63	-.58	.10	-6.54	<.001
Situation	.91	.85	.10	8.96	<.001
Behavior	.40	.37	.13	3.21	.002
Age x HA Interoception	.10	.09	.08	1.14	.255
Age x Situation	.18	.17	.11	1.75	.082
Age x Behavior	-.10	-.09	.15	-.66	.508