



# HHS Public Access

Author manuscript

*Emotion*. Author manuscript; available in PMC 2021 July 09.

Published in final edited form as:

*Emotion*. 2021 April ; 21(3): 453–464. doi:10.1037/emo0000734.

## Emotion dynamics across adulthood in everyday life: Older adults are more emotionally stable and better at regulating desires

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### Abstract

Older adults report experiencing improved emotional health, such as more intense positive affect and less intense negative affect. However, there are mixed findings on whether older adults are better at regulating emotion—a hallmark feature of emotional health—and most research is based on laboratory studies that may not capture how people regulate their emotions in everyday life. We used experience sampling to examine how multiple measures of emotional health, including mean affect, dynamic fluctuations between affective states and the ability to resist desires—a common form of emotion regulation—differ in daily life across adulthood. Participants ( $N = 122$ , ages 20–80) reported how they were feeling and responding to desire temptations for 10 days. Older adults experienced more intense positive affect, less intense negative affect and were more emotionally stable, even after controlling for individual differences in global life satisfaction. Older adults were more successful at regulating desires, even though they experienced more intense desires than younger adults. In addition, adults in general experiencing more intense affect were less successful at resisting desires. These results demonstrate how emotional experience is related to more successful desire regulation in everyday life and provide unique evidence that emotional health and regulation improve with age.

### Keywords

aging; emotion dynamics; emotion regulation; well-being; experience sampling

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Data and analysis scripts can be found at: [https://github.com/daisyburr/Emotiondynamics\\_across\\_adulthood\\_in\\_everyday-life](https://github.com/daisyburr/Emotiondynamics_across_adulthood_in_everyday-life)

Emotional experiences are inherently dynamic processes that unfold over time and in response to the current environment. How individuals regulate their emotions is a key component of this evolving process. Importantly, individuals may choose to regulate their emotions in different ways across adulthood (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Sims, Hogan, & Carstensen, 2015). One major form of regulation that may differ across adulthood is how individuals resist tempting desires. Consider Alex, a young adult in their twenties who is feeling distressed and unstable all morning, then receives an invite to a bar opening that evening. If Alex has been trying to avoid alcohol and has an important work presentation the following morning, they may attempt to resist this temptation and stay home. But Alex may also have trouble finding the courage to stay home when they are already feeling so bad. However, consider Lee, an older adult in their sixties who may be particularly motivated to not feel guilty and decide to resist the temptation to join friends for dinner out that evening in order to succeed at their work presentation the following morning. In order to adequately characterize individuals' emotional experiences, researchers could consider how desire regulation, emotional intensity and emotional stability co-occur and differ across adulthood.

Emotional health and stability are invariably related to the larger context, such as the presence of tempting stimuli in the environment. Throughout the day, people of all ages try to self-regulate and resist many appetitive desires—in essence, regulate their emotions to avoid certain feelings and behaviors that conflict with long-term goals. Individuals experience appetitive desires (henceforth referred to as desires) when they are driven to approach or behave in a certain way in order to feel pleasure (Koole, van Dillen, & Sheppes, 2011; Koole, van Dillen, & Sheppes, 2011). The urge to indulge in a desire, such as skipping school to go to the movies or watching television instead of helping out a friend, is natural and commonplace. Temptation is a ubiquitous feature of human life across the life span.

How individuals respond to temptation is important for emotional health and well-being (Hofmann, Baumeister, Förster, & Vohs, 2012; Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2014; Koole, van Dillen, & Sheppes, 2011). For example, someone might resist the desire to check Twitter notifications during the workday in order to be more productive or go for a run instead of eating fast food to be healthier. The world is saturated with tempting stimuli, and being able to resist these omnipresent desires is a hallmark of psychological stability and well-being (Baumeister & Vohs, 2004; Gross & Munoz, 1995; Hofmann, Baumeister, Förster, & Vohs, 2012).

Tempting desires often result in conflict between short-term and long-term goals. Although the original desire may generate an approach-related emotion, the conflict between short-term and long-term goals can be unpleasant. In order to reduce this conflict, individuals may, in turn, regulate their emotions by resisting the desire and any actions associated with the desire. In other words, the feeling of desire is the target of emotion regulation. Though individuals sometimes regulate their emotions automatically and with little effort, resisting desires is generally thought to reflect an effortful form of self-regulation that entails the cognitive control of emotion (Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2014; Koole, van Dillen, & Sheppes, 2011).

Extensive research has demonstrated how emotional experiences vary across the adult life span in numerous domains (Carstensen & Charles, 1999; Feng, Courtney, Mather, Dawson, & Davison, 2011; Röcke, Li., & Smith, 2009; Scott, Sliwinski, Mogle, & Almeida, 2014). Specifically, older adults have been shown to experience higher levels of positive relative to negative affect (Carstensen et al., 2010; Carstensen, Pasupathi, Mayr, & Nesselrode, 2000) and respond to, attend more deeply to, and better remember positive compared to negative stimuli (Feng, Courtney, Mather, Dawson, & Davison, 2011; Mather & Carstensen, 2003). However, other research has noted that older adults may be particularly vulnerable in certain emotional contexts and experience heightened negative affect when exposed to stressors (Mroczek, Daniel & Almeida, David, 2004; Stawski et al., 2019). Beyond the intensity of affective experiences, research has outlined how dynamic aspects of emotional experience differ across adulthood. For example, older adults are known to be more emotionally stable (Carstensen et al., 2010; Carstensen, Pasupathi, Mayr, & Nesselrode, 2000; Röcke, Li., & Smith, 2009). In addition to being more stable, research shows that older adults more often experience the co-occurrence of positive and negative emotional states, an adaptive trait thought to offer resilience against stressors (Hershfield, Scheibe, Sims, & Carstensen, 2013; Larsen & McGraw, 2011; Scott, Sliwinski, Mogle, & Almeida, 2014).

Despite convergent research illustrating how emotional experience differs across adulthood, research on how older adults differentially regulate emotion—a key component of emotional health—is more limited and mixed. For example, numerous behavioral and neuroimaging studies have emphasized how adolescents regulate in distinct ways (Guassi Moreira, McLaughlin, & Silvers, 2019; Silvers et al., 2017; Nook, Bustamante, & Somerville, 2019). But it is both theoretically and empirically unclear if older adults are better at resisting desires than younger adults. Some research has shown that older adults are better at cognitively reframing the meaning of stimuli (Shiota & Levenson, 2009), while others have found a decline in this ability (Wincoff, Labar, Madden, Cabeza, & Huettel, 2011), or no age-related differences (Martins, Sheppes, Gross, & Mather, 2018; Martins & Mather, 2016). Similarly, research conducted in the laboratory has demonstrated that older adults are more successful at suppressing their emotions (Magai, Consedine, Krivoshekova, Kudadjie-Gyamfi, & McPherson, 2006; Phillips, Henry, & Hosie, 2008), though others have found no age-related differences (Kunzmann, Kupperbusch, & Levenson, 2005). In addition, theoretical accounts of emotional processing across adulthood (e.g. Socioemotional Selectivity Theory; Carstensen, 2006; Carstensen, Isaacowitz, & Charles, 1999; Charles & Carstensen, 2010) do not provide clear directional predictions about desire regulation in older adults. For example, socioemotional selectivity theory posits that older adults prioritize short-term and emotionally meaningful goals due to a perceived time constraint in their life, resulting in better regulation of emotion (Carstensen, 2006; Carstensen, Fung, & Charles, 2003; Carstensen, Isaacowitz, & Charles, 1999; Charles & Carstensen, 2010). However, this perceived time constraint could lead to older adults relinquishing long-term goals that conflict with desires. For example, why not experience the joy of a piece of cake now instead of the longer-term advantages of weight loss in the future? Existing empirical and theoretical literature suggest competing hypotheses about whether older adults are better or worse at resisting desires. Research is needed to reconcile this ambiguity in how older adults regulate emotion.

Importantly, how individuals experience desires and attempt to resist them is also tied to larger contextual variables independent of age, such as if the desire conflicts with personal goals and if other individuals are present enacting the desire that the person is trying to resist (Hofmann, Baumeister, Förster, & Vohs, 2012; Mischel et al., 1996). What makes a desire more or less tempting is inherently individualized to the person, situation and stimuli. A desire only warrants regulation insofar as it conflicts with personal goals. The desire to eat cake when attempting to lose weight would naturally lead to a conflict and some attempt to resist said desire in order to meet their goal. By contrast, someone whose job is to manage social media profiles would typically not aim to resist browsing Twitter. Similarly, a tempting desire may be more difficult to resist when others are around enacting that desire. It may be easy to avoid eating cake if you are just walking past a cake shop, but increasingly difficult at a birthday party when others are present enacting the desire (Hofmann, Baumeister, Förster, & Vohs, 2012; Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2014). It is important to capture this natural variability and study desire regulation outside the laboratory.

The majority of research investigating individual differences in emotion regulation across adulthood are restricted to the laboratory and rely on instructing participants how and when to regulate. However, this may not reflect true differences in how older adults experience and regulate desires (Sims & Carstensen, 2014; Sims, Hogan, & Carstensen, 2015). Indeed, findings from experience sampling studies provide more consistent evidence that older adults are more effective at regulating their emotions in the real world (Sims, Hogan, & Carstensen, 2015). Data collected in everyday life suggests that older adults are more successful at regulating their emotions, often by carefully choosing situations that align to their personal goals—a strategy typically not possible in laboratory-based experiments (Carstensen, Pasupathi, Mayr, & Nesselrode, 2000; Sims, Hogan, & Carstensen, 2015).

Prior research has suggested that both regulation ability and affective instability are important components of emotional health (Baumeister & Vohs, 2004; Gross & Munoz, 1995; Hofmann, Baumeister, Förster, & Vohs, 2012), yet no research of which we are aware has directly explored the connection *between* these core components. Switching between affective states may disrupt peoples' self-regulatory goals (Mueller, 2011). The present study expands upon prior research largely informed by average snapshots of affect intensity to measure regulation and stability in everyday life in order to offer a more nuanced index of how peoples' feelings change. In the present study, we replicated and clarified prior research on adult age differences in emotional experience. Importantly, we built on previous research and offer a novel contribution that examines how one form of emotion regulation, the regulation of desires, differs across adulthood.

In line with prior research, we examined how affective intensity and instability differ across adulthood. By allowing adults to naturally engage in their daily lives and obtaining time-structured data, we were able to characterize how affective dynamics and regulation success differ across adulthood. We also controlled for global life satisfaction (well-being) in our models. Though many studies have investigated how happiness is associated with higher life satisfaction (Koval, Sütterlin, & Kuppens, 2016), the current study examines how emotional experiences differ across adulthood while controlling for varying levels of life satisfaction.

For example, it is unclear if improvements with age in emotional experience or desire regulation are only observed in individuals who are more satisfied with their lives in general. In addition, it is unclear how life satisfaction interacts with affect intensity and instability to influence desire regulation. In order to bridge this gap in the existing literature, the current study aimed to disentangle the effect of life satisfaction, affect intensity and affect instability on desire regulation. Taken together, we offer a novel contribution that illustrates how individuals across adulthood regulate desires in everyday life.

Based on prior research demonstrating that emotional health improves over the adult life span (Carstensen & DeLiema, 2018; Charles, Reynolds, & Gatz, 2001), we predicted that older adults would experience more intense and frequent positive affect and less intense and frequent negative affect in their daily lives. Similarly, and in line with prior research, we expected that older adults would be more stable in their affective experiences (Carstensen et al., 2011; Lang & Carstensen, 2002; Röcke, Li., & Smith, 2009). Importantly, we had no strong directional hypotheses about age differences in emotion regulation based on the mixed empirical evidence. Finally, we expected that individuals would be better at resisting desires if the temptation conflicted with personal goals and worse at resisting desires when others were around enacting the desire (Hofmann, Baumeister, Förster, & Vohs, 2012; Mischel et al., 1996).

## Method

### Participants

We collected experience sampling measures of emotional experience and regulation as supplementary data within larger neuroimaging studies of aging and decision making. We determined sample size for these larger studies based on the expected effects for associations between aging, brain function and decision making. However, past research on emotion and aging suggests that there should be enough data within these samples to detect effects. For example, a similar cross-sectional study using experience sampling of emotion across adulthood reported a negative correlation between age and negative affect of ( $r = -.29$ ) in a between-subject analysis (Carstensen, Pasupathi, Mayr, & Nesselrode, 2000). In order to obtain an effect this large, we would need a sample of 91 for at least 80% power. Our initial sample consisted of 122 healthy, adult participants ranging in age from 20 to 80 ( $M_{\text{age}} = 41$ ,  $SD_{\text{age}} = 15$ ; 55% female; 4% Asian, 1% Hispanic, 9% Black, 86% White). Given some minimal missing observations, analyses are based on specific sample sizes (e.g,  $n = 113$  or  $n = 117$ ), which are provided in each result section and in figure captions.

All participants provided written informed consent to participate and all procedures were approved by the Institutional Review Board at Vanderbilt University. Participants were all psychiatrically and neurologically healthy as determined by initial medical screening including a Structured Clinical Interview for the DSM-IV (Frist et al. 1997) and a brief physical exam.

## Data collection

In order to study emotional dynamics in everyday life, we relied on ecological momentary assessment (EMA) as an experience sampling technique. We messaged participants on their mobile device three times a day, for 10 days in order to assess current emotional states; we provided mobile devices to participants who did not have their own. Typical awake hours were split into three equal time periods and one survey link was randomly messages to the participant during each period. Participants rated the degree to which they felt eight emotional states on a 5-point scale ranging from “Slightly or not at all” to “Extremely.” These emotional states align to the Affect Valuation Index (Tsai, Knutson, & Fung, 2006). The eight emotional states were: positive-pleasant (“How happy, satisfied, or content do you feel right now?”), which reflects moderate arousal pleasant states; low-arousal positive (“How calm, at rest, relaxed, peaceful, or serene do you feel right now?”); high-arousal positive (“How enthusiastic, excited, elated, or strong do you feel right now?”); negative-unpleasant (“How sad, lonely, or unhappy do you feel right now?”), which reflects moderate arousal unpleasant states; low-arousal negative (“How dull, sleepy, or sluggish do you feel right now?”); and high-arousal negative (“How fearful, hostile, or nervous do you feel right now?”); low arousal (“How quiet, still, or passive do you feel right now?”); high arousal (“How aroused, surprised, or astonished do you feel right now?”).

Researchers continue to investigate the underlying structure of affective space (Cacioppo & Berntson, 1994; Mattek, Wolford, & Whalen, 2017; Russell, 1980; Watson & Tellegen, 1985). Consequently, there is inconsistency in how affective dimensions such as valence and arousal are treated in experimental design and analysis. In factor analyses, low-arousal states—such as feeling calm—load on both positive and negative valence factors (Watson & Clark 1994), or load on a distinct factor unrelated to positivity or negativity. Based on this, many studies only utilize high arousal affective markers. However, studies often pool across low-arousal and high-arousal terms to reduce the dimensionality of the data (e.g., Carstensen et al., 2010; Carstensen, Pasupathi, Mayr, & Nesselrode, 2000). In order to be consistent with prior research, the current study used a similar pooling and operationalization of positive affect as the average of low-arousal positive, high-arousal positive, and positive-pleasant ratings ( $\alpha = .63$ ) and negative affect as the average of low-arousal negative, high-arousal negative, and negative-unpleasant ratings ( $\alpha = .38$ ). Although there is lower internal consistency among the negative affect scales, suggesting that the scales are not all indexing the same factor, the current study uses the pooled scales in order to align to the research being replicated (e.g., Carstensen et al., 2010; Carstensen, Pasupathi, Mayr, & Nesselrode, 2000). Hereafter, the current manuscript refers to the pooled positive ratings as positive and the pooled negative ratings as negative. However, given the low internal reliability of the composite measures, we also provide analyses of the un-pooled data, using just the moderate arousal level positive-pleasant and negative-unpleasant terms and excluding high- and low-arousal terms, in the supplemental material. Using the un-pooled data, the overall pattern of results does not differ substantially.

In addition to providing emotion ratings, participants then answered questions regarding which desires, if any, were tempting them and if they were able to resist the desires or not in the past 3 hours. Participants indicated the nature of the desire (“Eating, snacking,

nonalcoholic drinks; Alcohol, cigarettes, tobacco, other drugs; Entertainment media (TV, movies, web browsing, video games); Social media (Facebook, Twitter, Instagram, etc.); Spending; Sex; Sleep; Social contact (in person or phone conversation, texting, Facetime, etc.); Leisure and relaxation; Exercise; Work; Other; None”). If participants noted that they experienced any type of desire within the past three hours, they were prompted with further questions. Specifically, they indicated: the strength of the desire on an 8-point scale ranging from “No desire at all” to “Irresistible;” the extent to which the desire conflicted with personal goals on a 5-point scale ranging from “No conflict at all” to “Very high conflict;” if they attempted to resist the desire or not; if they enacted the desire; and if others were present (physically or via media) enacting the desire. Participants could indicate up to 3 desires per measurement occasion. The current manuscript only presents analyses from the first-mentioned desire.

In addition to the time-structured EMA data, participants also responded once to the Satisfaction with Life Scale (SWLS) (Diener, Emmons, Larsen, & Griffin, 1985). The SWLS measures life satisfaction in five questions each on a 7-point scale, but explicitly avoids questions about current affect. To assess global life satisfaction, we calculated within-subject average scores, with higher average scores representing higher life satisfaction. In addition, participants completed a brief neurocognitive assessment and responded to a series of decision-making tasks while undergoing functional magnetic resonance imaging. The current manuscript only presents the experience sampling and SWLS data (Koval, Sütterlin, & Kuppens, 2016; Kuppens, Realo, & Diener, 2008).

### Data preprocessing

The affective EMA afforded the possibility of measuring both mean affect and affective instability. We computed root mean successive square difference (rMSSD) as a measure of affective instability. rMSSD captures trial-by-trial variability in affective experiences and short-term fluctuations over time (Koval et al., 2013; Koval, P., Sütterlin, S., & Kuppens, 2016; Shaffer & Ginsberg, 2017). rMSSD is employed as a time-series statistic that accounts for changes over time and therefore reflects instability (Carstensen et al., 2010; Jahng, Wood, & Trull, 2008; Leiderman & Shapire, 1962; von Neumann, Kent, Bellinson, & Hart, 1941). For each participant, we obtained the rMSSD of positive and negative affect by computing the average of the squared differences in affect ratings between successive sampling occasions:

$$RMSSD = \sqrt{\frac{1}{N-1} \sum_{i=1}^{i=N-1} (RR_{i+1} - RR_i)^2}$$

### Modeling emotion dynamics.

With this sample, we were able to model state-based intraindividual affect dynamics and between-subject trait level differences. The structure of the data is inherently nested, so, where appropriate, we used multilevel modeling to accurately model intraindividual variability and between-subject differences. Specifically, all multilevel linear mixed models accounted for time (measurement occasion) nested within each participant and allowed for

random subject intercepts (Koval et al., 2013; Koval, Sütterlin, & Kuppens, 2016). Models were implemented using lme4 and lmerTest in R (Bates, Mächler Bolker, & Walker, 2015; Kuznetsova, Brockhoff, & Christensen, 2017).

## Results

### Affect intensity across adulthood

**Do older adults experience more positive affect than younger adults?**—We ran a linear mixed model allowing for random subject intercepts including age as a fixed effect to test how average level of positive affect differed across the adult life span (positive affect =  $\beta_{0j} + \beta_{1j}Age + e_{ij}$ ;  $R^2 = .36$ ,  $n = 117$ ). Older adults experienced significantly higher levels of positive affect ( $\beta = .13$ , 95% CI [.03, .22],  $p = .01$ ). Importantly, we followed up this model with a model including global life satisfaction as a covariate in order to examine whether age effects varied based on level of global life satisfaction (positive affect =  $\beta_{0j} + \beta_{1j}(age_{ij}) + \beta_{2j}(global\ life\ satisfaction_{ij}) + \beta_{3j}(age \times global\ life\ satisfaction_{ij}) + e_{ij}$ ;  $R^2 = .36$ ). Older adults still experienced significantly higher levels of positive affect, even after accounting for global life satisfaction, ( $\beta = .14$ , 95% CI [.06, .23],  $p < .001$ ; Figure 1. As expected, higher levels of global life satisfaction were significantly associated with higher positive affect ( $\beta = .18$ , 95% CI [.10, .25],  $p < .001$ ; Figure 1. The interaction between age and global life satisfaction did not significantly predict mean level of positive affect ( $\beta = .02$ , 95% CI [−.05, .1],  $p = .57$ ).

**Do older adults experience less negative affect than younger adults?**—We ran a linear mixed model allowing for random subject intercepts including age as a fixed effect to test how average level of negative affect differed across the adult life span (negative affect =  $\beta_{0j} + \beta_{1j}(age_{ij}) + e_{ij}$ ;  $R^2 = .30$ ,  $n = 117$ ). Older adults experienced significantly lower levels of negative affect ( $\beta = -.10$ , 95% CI [−.16, .04],  $p < .001$ ). We further investigated whether this effect varied based on global life satisfaction by including global life satisfaction as a covariate (negative affect =  $\beta_{0j} + \beta_{1j}(age_{ij}) + \beta_{2j}(global\ life\ satisfaction_{ij}) + \beta_{3j}(age \times global\ life\ satisfaction_{ij}) + e_{ij}$ ;  $R^2 = .30$ ). When including global life satisfaction as a covariate, older adults still experienced lower levels of negative affect ( $\beta = -.11$ , 95% CI [−.17, −.06],  $p < .001$ ). Age also interacted with global life satisfaction such that older adults who were most satisfied with their lives experienced the lowest levels of negative affect ( $\beta = -.08$ , 95% CI [−.13, −.02],  $p = .01$ ; Figure 1). In addition, participants with higher levels of global life satisfaction experienced lower levels of mean negative affect, irrespective of age ( $\beta = -.08$ , 95% CI [−.13, −.02],  $p = .01$ ). Based on these results and the results above on positive affect, we included global life satisfaction in all future models.

### Affect instability across adulthood

In order to more sensitively investigate the dynamics of affective experiences across the adult life span, we next modeled fluctuations in affect throughout the day (Eid & Diener, 1999). Because affect instability is captured with a non-repeated measure, we ran two linear regression models (ordinary least squares) to test the effects of age and global life satisfaction on positive affective instability ( $R^2 = .09$ ,  $n = 113$ ) and negative affective instability ( $R^2 = .12$ ,  $n = 113$ ). See Figure 2 for all instability effects.



Older adults were less unstable (i.e., more stable) in their positive affective experiences ( $\beta = -.07$ , 95% CI  $[-.12, -.03]$ ,  $p < .001$ ), and this did not vary based on how satisfied they were with their lives ( $\beta = -.02$ , 95% CI  $[-.07, .02]$ ,  $p = .33$ ). Interestingly, there was no main effect of global life satisfaction ( $\beta = 0.00$ , 95% CI  $[-.05, .05]$ ,  $p = .98$ ). Older adults were also more stable in their negative affective experiences ( $\beta = -.05$ , 95% CI  $[-.10, -.01]$ ,  $p = .02$ ). In addition, age interacted with global life satisfaction such that older adults who were most satisfied with their lives were the most stable in their negative affective experiences ( $\beta = -.07$ , 95% CI  $[-.11, -.02]$ ,  $p = .01$ ). However, global life satisfaction did not significantly predict negative affect instability ( $\beta = -.04$ , 95% CI  $[-.09, .01]$ ,  $p = .10$ ). See Figure 2 for all effects.

### Desire regulation across adulthood

**Are older adults better at resisting desires than younger adults?**—To investigate how age and global life satisfaction influenced participants' ability to successfully resist desires, we computed a measure of successful emotion regulation. Importantly, we also included extent to which desires conflicted with personal goals and if others were present enacting the desires as covariates in order to more comprehensively measure the experience of desires. If a participant was experiencing a desire that they were attempting to resist and then consequently enacted the desire, that event was classified as an episode of unsuccessful regulation. Conversely, if they were experiencing a desire they were attempting to resist and did not enact it, that event was classified as an episode of successful regulation.

Using this binary variable as our outcome measure, we ran a multilevel logistic regression model allowing for random subject intercepts to test if age, positive affect, negative affect, global life satisfaction, strength of desire, extent that desire conflicts with personal goals, if others were present enacting the desire, positive and negative affect, and positive and negative affective instability influenced how likely participants were to successfully regulate desires (successful regulation =  $\beta_{0j} + \beta_{1j}(\text{age}_{ij}) + \beta_{2j}(\text{positive affect}_{ij}) + \beta_{3j}(\text{negative affect}_{ij}) + \beta_{4j}(\text{global life satisfaction}_{ij}) + \beta_{5j}(\text{desire strength}_{ij}) + \beta_{6j}(\text{extent desire conflicts}_{ij}) + \beta_{7j}(\text{others present}_{ij}) + \beta_{8j}(\text{negative affective instability}_{ij}) + \beta_{9j}(\text{positive affective instability}_{ij}) + \beta_{10j}(\text{age} \times \text{positive affect}_{ij}) + \beta_{11j}(\text{age} \times \text{negative affect}_{ij}) + \beta_{12j}(\text{age} \times \text{global life satisfaction}_{ij}) + \beta_{13j}(\text{age} \times \text{desire strength}_{ij}) + \beta_{14j}(\text{age} \times \text{extent desire conflicts}_{ij}) + \beta_{15j}(\text{age} \times \text{others present}_{ij}) + \beta_{16j}(\text{age} \times \text{positive affective instability}_{ij}) + \beta_{17j}(\text{age} \times \text{negative affective instability}_{ij}) + e_{ij}$ ;  $R^2 = .37$ ,  $n = 113$ ). In general participants were able to successfully resist their tempting desires when collapsing across age—91% of desire episodes were successfully regulated. Relatedly, participants experienced desires 99% of the time and attempted to regulate them 30% of the time. There was a main effect of age such that older adults were significantly more likely to successfully resist desires ( $\beta = .54$ , 95% CI  $[.22, .85]$ ,  $p < .001$ ). In addition, age interacted with global life satisfaction ( $\beta = -.48$ , 95% CI  $[-.77, -.18]$ ,  $p < .001$ ) such that younger adults with higher levels of global life satisfaction were more successful at resisting their desires than those with low global life satisfaction (Figure 3), but this pattern was not seen in older subjects. More specifically, individual differences in global life satisfaction did not account for older adults being able to resist desires—older adults were better at resisting their desires independent of global life satisfaction.

Participants experiencing greater desire strength ( $\beta = -.14$ , 95% CI  $[-.25, -.04]$ ,  $p = .04$ ) and desire with greater personal conflict ( $\beta = -.33$ , 95% CI  $[-.43, -.24]$ ,  $p < .001$ ) were significantly less likely to successfully resist desires. Surprisingly, older adults experiencing desires that greatly conflicted with personal goals were the least successful at regulating desires ( $\beta = -.11$ , 95% CI  $[-.22, -.01]$ ,  $p = .04$ ). Thus, despite overall greater ability to resist desires, older adults had a more selective challenge when resisting desires that were in conflict with their personal goals. In addition, participants experiencing higher levels of negative affect ( $\beta = -.5$ , 95% CI  $[-.77, -.24]$ ,  $p < .001$ ) were less likely to successfully resist desires. Age also interacted with negative affect such that older adults experiencing the highest levels of negative affect were worse at resisting desires ( $\beta = -.33$ , 95% CI  $[-.62, -.18]$ ,  $p < .001$ ). Adults experiencing more intense positive affect were also more successful at resisting desires ( $\beta = -.22$ , 95% CI  $[-.42, -.03]$ ,  $p = .02$ ), but this did not vary based on age ( $\beta = 0$ , 95% CI  $[-.21, .21]$ ,  $p = .99$ ). Thus, despite older adults being generally superior at resisting desires, they were particularly affected by deleterious effects of negative affect, but not positive affect, when resisting desires. See Figure 3 for all effects.

In contrast to the above significant effects, others being present enacting the desire ( $\beta = -.08$ , 95% CI  $[-.33, .17]$ ,  $p = .54$ ), positive affective instability ( $\beta = -.29$ , 95% CI  $[-1.63, 1.05]$ ,  $p = .67$ ), negative affective instability ( $\beta = .77$ , 95% CI  $[-.67, 2.21]$ ,  $p = .29$ ) and global life satisfaction ( $\beta = -.06$ , 95% CI  $[-.34, .23]$ ,  $p = .7$ ) were non-significant predictors of successful regulation of desires. Two-way interactions between others being present and age ( $\beta = -.05$ , 95% CI  $[-.32, .21]$ ,  $p = .69$ ), desire strength and age ( $\beta = -.07$ , 95% CI  $[-.22, .07]$ ,  $p = .32$ ), age and positive affective instability ( $\beta = .102$ , 95% CI  $[-.29, 2.32]$ ,  $p = .13$ ), and age and negative affective instability ( $\beta = -.139$ , 95% CI  $[-2.88, .11]$ ,  $p = .07$ ) were non-significant predictors of successfully resisting desires. See Figure 3 for all effects.

### **Do older adults experience and attempt to regulate desires more than younger adults?**

—The above logistic regression model demonstrated that older adults were more successful at resisting desires. This finding raises a question of whether older adults may experience desires more frequency or intensely. A multilevel logistic regression model allowing for random subject intercepts tested whether age and global life satisfaction influenced whether desires were present or not (desire presence =  $\beta_{0j} + \beta_{1j}(\text{age}_{ij}) + \beta_{2j}(\text{global life satisfaction}) + \beta_{3j}(\text{age} \times \text{global life satisfaction}) + e_{ij}$ ;  $R^2 = .94$ ,  $n = 117$ ). There were no significant age-related differences in desire presence ( $\beta = 26.50$ , 95% CI  $[-46.03, 99.03]$ ,  $p = .47$ ). In addition, global life satisfaction ( $\beta = 17.38$ , 95% CI  $[-.82.98, 48.22]$ ,  $p = .60$ ) and the interaction between age and global life satisfaction ( $\beta = -14.09$ , 95% CI  $[-68.17, 39.99]$ ,  $p = .61$ ) were non-significant predictors of whether participants were experiencing desires or not.

Similarly, we explored if older adults experienced more intense desires than younger adults. A multilevel regression model allowing for random subject intercepts tested whether age and global life satisfaction influenced desire strength (desire strength =  $\beta_{0j} + \beta_{1j}(\text{age}_{ij}) + \beta_{2j}(\text{global life satisfaction}) + \beta_{3j}(\text{age} \times \text{global life satisfaction}) + e_{ij}$ ;  $R^2 = 0.30$ ). Older adults reported experiencing significantly stronger desires ( $\beta = .21$ , 95% CI  $[-.06, .36]$ ,  $p = .01$ ). Global life satisfaction ( $\beta = .09$ , 95% CI  $[-.05, .24]$ ,  $p = .22$ ) and the interaction between age

and global life satisfaction ( $\beta = -.11$ , 95% CI  $[-.26, .04]$ ,  $p = .14$ ) were non-significant predictors of desire strength.

Finally, we tested if older adults were simply attempting to resist desires more than younger adults. A multilevel logistic regression model allowing for random subject intercepts tested whether age and global life satisfaction influenced how frequently participants attempted to resist desires (attempt to resist =  $\beta_{0j} + \beta_{1j}(\text{age}_{ij}) + \beta_{2j}(\text{global life satisfaction}) + \beta_{3j}(\text{age} \times \text{global life satisfaction}) + e_{ij}$ ;  $R^2 = 0.29$ ,  $n = 117$ ). Older adults attempted to resist desires less than younger adults ( $\beta = -.41$ , 95% CI  $[-.62, -.19]$ ,  $p < .001$ ). In addition, participants who were less satisfied with their lives attempted to resist desires more ( $\beta = -.36$ , 95% CI  $[-.58, -.15]$ ,  $p < .001$ ). The interaction between age and global life satisfaction ( $\beta = -.01$ , 95% CI  $[-.22, .2]$ ,  $p = .93$ ) did not predict whether participants attempted to resist desires or not.

## Discussion

In the current study, we examined how emotional experiences and regulation differ across adulthood in everyday life using experience sampling methods. Consistent with prior research, we show that older adults experience increased positive affect, decreased negative affect and are more stable in their affective experiences. In addition, we offer a novel finding demonstrating individual differences across adulthood in a key aspect of emotional regulation in everyday life. Specifically, we demonstrate that older adults and adults in general experiencing less intense affect are better at resisting temptation.

### Affective intensity and stability

The overall results are consistent with other evidence that emotional health improves across adulthood (Carstensen et al., 2010; Carstensen, Pasupathi, Mayr, & Nesselroade, 2000). Older adults experienced higher levels of positive affect and lower levels of negative affect—even after accounting for individual differences in global life satisfaction. Moreover, as expected, older adults with the highest levels of global life satisfaction experienced the lowest levels of negative affect. Individual differences in global life satisfaction did not influence the relationship between age and positive affect. Beyond age-related differences in mean levels of affect, older adults were additionally more stable in their affective experiences and fluctuated less between affective states. Collectively, these findings echo prior experience sampling research and document important ways in which older adults experience improved emotional health (Carstensen et al., 2010; Carstensen, Pasupathi, Mayr, & Nesselroade, 2000).

Importantly, prior research has more consistently demonstrated age-related differences in emotional experience through a decrease in negative affect across adulthood, as opposed to an increase in positive affect (e.g., Carstensen, Pasupathi, Mayr, & Nesselroade, 2000). However, here we found that older adults experienced *both* higher levels of positive affect and lower levels of negative affect. There may be some methodological differences that contribute to differences in the detection of increases in positive affect across studies. For example, some prior research has found that older adults experience an increase of low-arousal positive affect, but not high-arousal affect (Kessler & Staudinger, 2009). Nevertheless, the present findings strongly converge with prior literature demonstrating age-

related improvements in emotional experience, generally characterized as an increasing ratio of positive to negative affect (Carstensen & Mikels, 2005; Charles, Mather, & Carstensen, 2003; Diehl, Hay, & Berg, 2011; Reed, Chan, & Mikels, 2014; Mather & Carstensen, 2005).

### **Global life satisfaction**

We sought to examine how emotional experiences differ across adulthood when controlling for global life satisfaction. Though it is typical for empirical research to model global life satisfaction as an outcome (Hofmann, Luhmann, Fisher, Vohs, & Baumeister, 2014; Koval, Sütterlin, & Kuppens, 2016), here we used global life satisfaction as a covariate in models of daily affect in order to evaluate whether global life satisfaction eliminated or modified how emotional experiences differ across adulthood. We showed that older adults experience higher levels of positive affect, independent of how satisfied they are with their lives. Individual differences in global life satisfaction did, however, modify the effect of age on negative affect such that older adults with the highest levels of global life satisfaction experienced the lowest levels of negative affect.

### **Desire regulation**

Our analyses revealed that older adults are more successful at regulating their desires in everyday life than younger adults, despite there being no age differences in how frequently they experienced desires. Moreover, we show that older adults experienced stronger desires than younger adults, yet were still better at resisting those desires. Strikingly, even older adults who were not satisfied with their lives were highly successful at resisting tempting desires. However, younger adults who were the least satisfied with their lives struggled to resist desires. Individuals experiencing desires that conflicted with their personal goals were worse at resisting desires, and this was particularly true for older adults. These findings are in line with theoretical accounts of age differences in emotional experiences, suggesting that older adults are more focused on achieving goals that optimize well-being in the present (Carstensen, Isaacowitz, & Charles, 1999).

In general, adults experiencing more intense affect were less likely to successfully regulate their desires. While our methodology lacked the temporal precision to address the causal relationships here, the data are consistent with a greater difficulty resisting desires when experiencing intense emotions. This observation may also reflect co-occurring personality traits, rather than a specific impact of affect (Whiteside & Lynam, 2001). For example, research indicates that relationships between trait-positive and -negative affect and impulse buying are primarily explained by extraversion and neuroticism, rather than being narrowly driven by trait affect (Thompson & Predergast, 2015). Future research should investigate this possibility with a more temporally precise experimental design.

Taken together, these findings present novel evidence for how emotional experience is related to regulation across adulthood. By allowing people to naturally engage with a complex environment, we found that older adults were more successful at resisting tempting desires—a concrete measure of successful emotion regulation. Existing laboratory research has produced mixed findings, with some studies finding that older adults more successfully regulate their emotions (Magai, Consedine, Krivoshekova, Kudadjie-Gyamfi, & McPherson,

2006; Phillips, Henry, & Hosie, 2008), and others finding no age-related effects (Kunzmann, Kupperbusch, & Levenson, 2005). Here, we showed that older adults more successfully resisted desires when allowed to engage naturally. Interestingly, older adults were also more successful at regulating desires, despite experiencing somewhat more intense desires than younger adults. Importantly, older adults did not experience or attempt to regulate desires more frequently—rather they were overall more successfully regulating them when they occurred. These findings echo existing research that has attributed increased global life satisfaction and positive affect in old age to more successful emotion regulation (Sims, Hogan, & Carstensen, 2015; Urry & Gross, 2010).

These results are consistent with a wealth of research on emotional experience and aging. Older adults appeared to struggle to resist desires when feeling intensely negative or when experiencing a particularly conflicting desire. In addition, older adults attempted to resist desires less often than younger adults, but were better at resisting desires when they tried. It is possible that older adults experience less negative affect in general, but when they do experience intense negative affect, they are more vulnerable and struggle to regulate their emotions. Taken together, these findings appear in line with theoretical explanations of emotion regulation across adulthood that suggest that older adults struggle to effectively regulate when in intensely arousing states (Charles, 2010). Future research should attempt to identify the more general conditions under which older adults are able to successfully resist or more likely to fail to resist desires.

For the first time, we investigate individual differences in how older adults resist tempting desires in everyday life. How individuals resist desires is not only a naturalistic form of emotion regulation that is free of the confines of the laboratory, but a unique form of individuals down-regulating appetitive stimuli. When individuals experience desires, they are, by definition, motivated to approach stimuli in order to experience pleasure (Hofmann, Kotabe, Vohs, & Baumeister, 2015). However, the vast majority of regulation studies, both within and outside the laboratory, focus on how individuals reduce negative affect or increase positive affect, not how they resist tempting desires. Future work should continue to explore how this special form of regulation is different than others and varies across individuals and situations.

The current study centered on how tempting desires are regulated and did not attempt to capture differences in how and what desires are experienced across adulthood. Potential research should investigate the various types of desires experienced and how that may influence regulation. It is possible that age differences in the types of desires influence the ability to resist them. However, such an exploration requires a greater density of samples to ensure enough examples of each desire type. The design of the present study was not optimized to evaluate potential interactions with desire types. Importantly, we also did not address the techniques used to resist desires. The current study did not ascertain, for example, if individuals reframed the meaning of a desire, suppressed the emotional response without any type of reframe or simply distracted themselves. Future research should investigate how older adults choose to regulate in different ways. Similarly, future research should explore other forms of emotion regulation in the real world to understand differences in how older adults choose to regulate. For example, recent work has suggested that older

adults more frequently use strategies that intervene earlier in emotional experiences, such as simply changing or avoiding the stressful situation (Livingstone & Isaacowitz, 2019).

Future research would benefit from examining whether age-related differences in emotional experience are related to cognitive biases. For example, related studies have illustrated older adults preferentially process positive over negative information in cognitive tasks, known as the age-related positivity effect (Mathers & Carstensen, 2005). However, it is unclear how differences in such cognitive biases necessarily cause the improvements in emotional experience across adulthood or vice-versa (Isaacowitz & Blanchard-Fields, 2012).

There are several important limitations in the current study that should be addressed in future research. For example, one weakness of the current data was the limited range used in the Likert scales (Bishop & Herron, 2015; Lishner, Cooter, & Zald, 2008). Although Likert scales are ordered and often treated as interval, humans may not perceive levels of the scale as being equal distance from each other. It is recommended that future experience sampling studies use more continuous interval scales that better measure variance in emotional experience. Finally, a limitation of our research was that the sample was majority White participants. Future research should consider evaluating whether these effects replicate in more demographically representative samples and include people who may have common health problems.

## Acknowledgments

Financial support for this research was provided by National Institute on Aging grants R01-AG043458 to David H. Zald and Gregory R. Samanez-Larkin, R01-AG044838 to David H. Zald, and R00-AG042596 to Gregory R. Samanez-Larkin.

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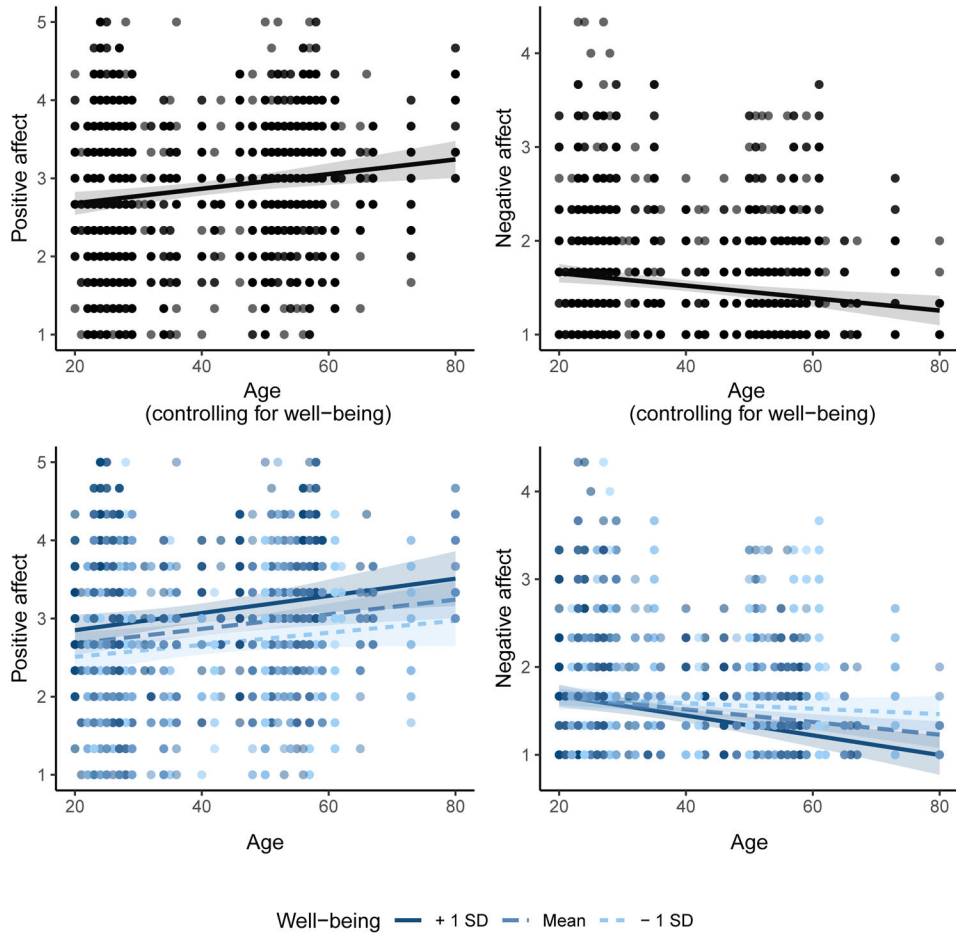
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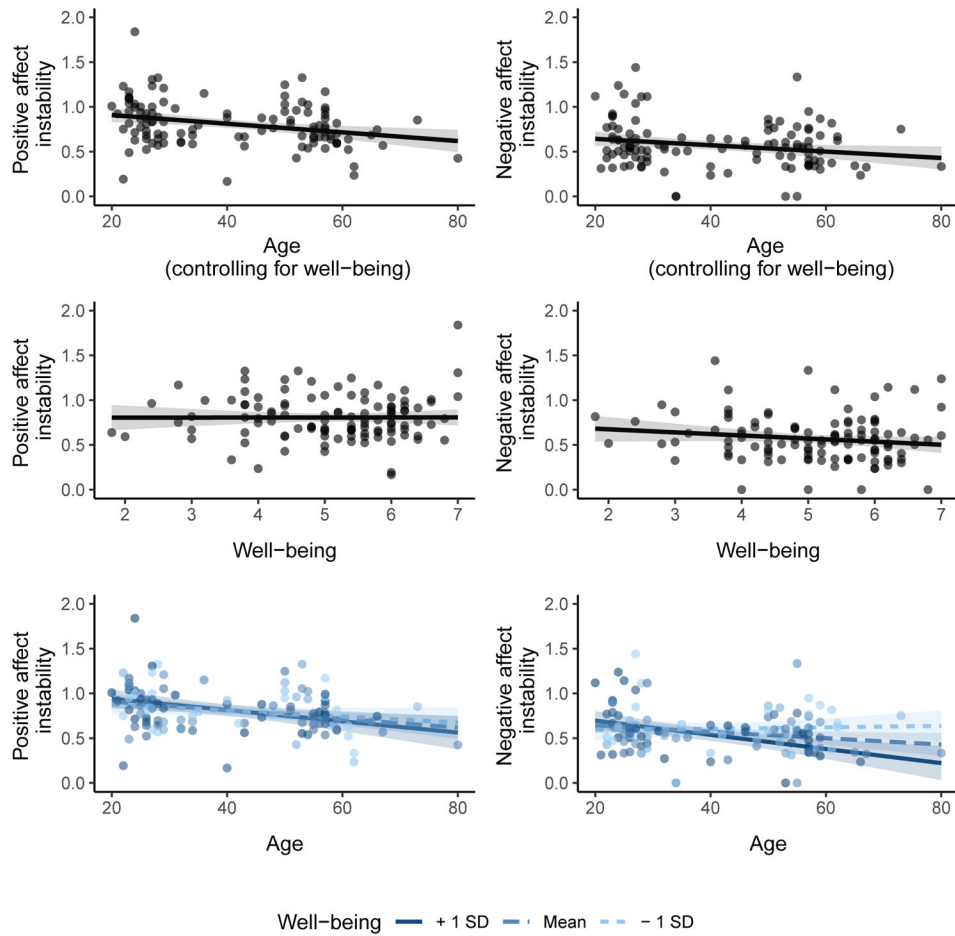
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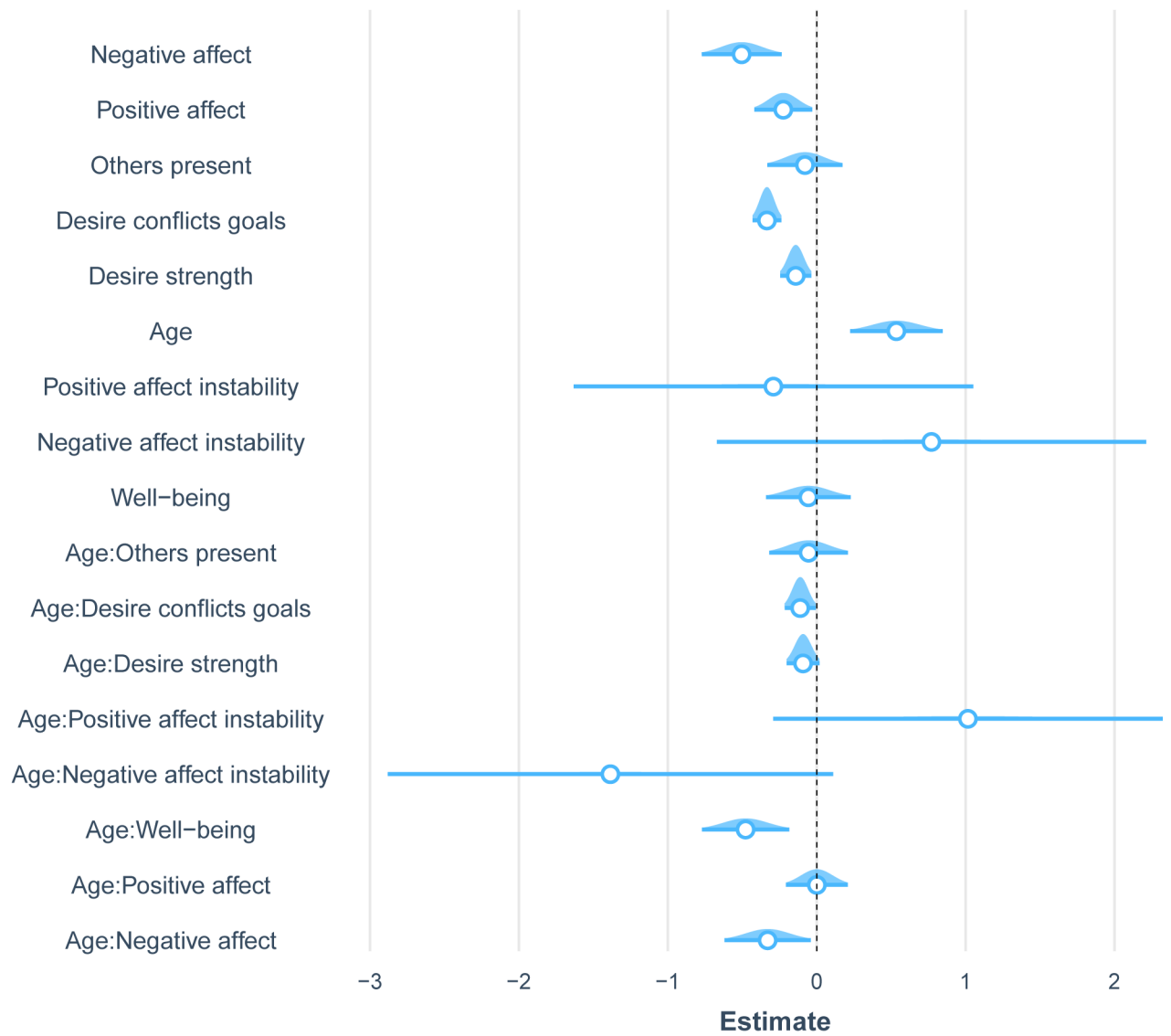
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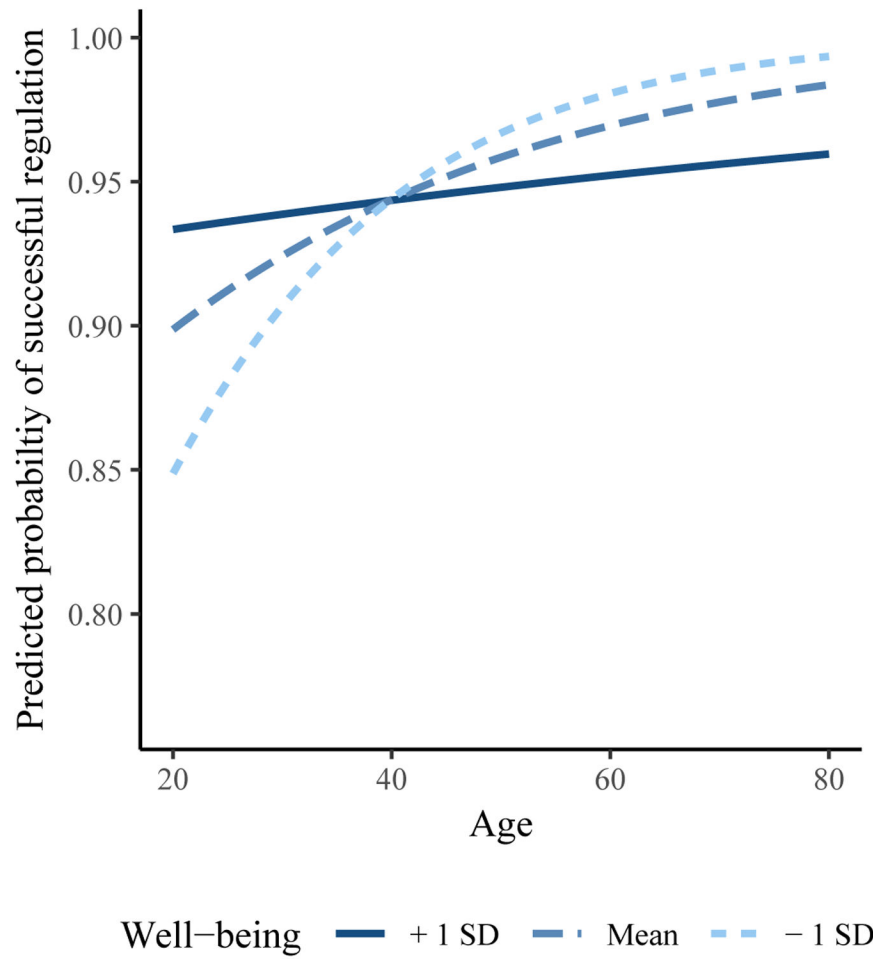
**Figure 1.** Effects of age and global life satisfaction (well-being) on positive and negative affect (n = 117). Top left: significant positive effect of age on positive affect after controlling for well-being. Top right: significant negative effect of age on negative affect after controlling for well-being. Bottom left: non-significant interaction between age and well-being on positive affect. Bottom right: significant interaction between age and well-being on negative affect. All predictor variables are mean centered for analysis. Well-being is based on mean Satisfaction With Life Scale. Regression lines are the model fit and shading represents the 95% confidence intervals.



**Figure 2.** Effects of age and global life satisfaction (well-being) on positive and negative affective instability ( $n = 113$ ). Top left: significant positive effect of age on positive affective instability after controlling for well-being. Top right: significant negative effect of age on negative affective instability after controlling for well-being. Middle left: non-significant effect of well-being on positive affective instability. Middle right: non-significant effect of well-being on negative affective instability. Bottom left: non-significant interaction between age and well-being on positive affective instability. Bottom right: significant interaction between age and well-being on negative affective instability. All predictor variables are mean centered for analysis. Positive and negative affect instability are based on the root mean squared successive differences of affect ratings across all measurement occasions. Well-being is based on mean Satisfaction With Life Scale. Regression lines are the model fit and shading represents the 95% confidence intervals.



**Figure 3.** Standardized (mean-centered) regression coefficients from multilevel logistic regression predicting successful regulation of desires (n = 113). Well-being is based on mean Satisfaction With Life Scale. Positive and negative affect instability are based on the root mean squared successive differences of affect ratings across all measurement occasions.



**Figure 4.** Effect of interaction between age and global life satisfaction (well-being) on probability of successful regulation from multilevel logistic regression predicting successful regulation of desires (n = 113). Well-being is based on mean Satisfaction With Life Scale.