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Self-Control Mediates Age-Related Differences in Psychological Distress

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Abstract:	The ability to over-ride or alter motivated responses, known as self-control, is crucial for goal-directed behavior and is a determinant of many consequential outcomes including physical health, psychological well-being, and mental health. Three studies examined the extent to which individual differences in self-control (i.e., trait self-control) account for age-related differences in psychological distress. In Study 1 participants (N = 622), predominantly from the United States, completed measures of self-control and psychological distress (i.e., depression, anxiety, and stress) via Amazon's Mechanical Turk. In Study 2, United Kingdom participants (N = 300) completed the same measures as Study 1 via Prolific Academic. In Study 3 a transnational sample of participants (N = 1,484) from the Human Penguin Project completed the same measure of self-control as Studies 1-2 along with a new measure of psychological distress (i.e., perceived stress). Across all 3 studies, utilizing varied measures of distress, older (relative to younger) participants reported reduced depression, anxiety, and stress (Studies 1-2) as well as reduced perceived stress (Study 3). These age-related differences in psychological distress were mediated by self-control. Taken together with past research, the current studies suggest that trait self-control may be a key mechanism driving healthy aging.

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Self-Control Mediates Age-Related Differences in Psychological Distress

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Highlights

- Self-control promotes psychological wellbeing and reduced psychological distress.
- Empirical research on self-control has largely been constrained to younger adults.
- In 3 studies (N = 2,406) self-control accounted for age-differences in distress
- Trait self-control may be a key mechanism driving healthy aging.

Self-Control Mediates Age-Related Differences in Psychological Distress

Abstract

The ability to over-ride or alter motivated responses, known as self-control, is crucial for goal-directed behavior and is a determinant of many consequential outcomes including physical health, psychological well-being, and mental health. Three studies examined the extent to which individual differences in self-control (i.e., trait self-control) account for age-related differences in psychological distress. In Study 1 participants (N = 622), predominantly from the United States, completed measures of self-control and psychological distress (i.e., depression, anxiety, and stress) via Amazon's Mechanical Turk. In Study 2, United Kingdom participants (N = 300) completed the same measures as Study 1 via Prolific Academic. In Study 3 a transnational sample of participants (N = 1,484) from the Human Penguin Project completed the same measure of self-control as Studies 1-2 along with a new measure of psychological distress (i.e., perceived stress). Across all 3 studies, utilizing varied measures of distress, older (relative to younger) participants reported reduced depression, anxiety, and stress (Studies 1-2) as well as reduced perceived stress (Study 3). These age-related differences in psychological distress were mediated by self-control. Taken together with past research, the current studies suggest that trait self-control may be a key mechanism driving healthy aging.

Keywords: Self-Control, Aging, Stress, Well-Being.

Self-Control Mediates Age-Related Differences in Psychological Distress

"Your 40s are good. Your 50s are great. Your 60s are fab. And 70 is fucking awesome!"

— Helen Mirren.

Two-hundred and fifty years ago life expectancy was approximately 30 years old. By that standard each of the authors of this paper would be considered a senior citizen. Since then life expectancy has more than doubled to approximately 72 years as of 2017 (Roser et al., 2013). As life expectancy continues to grow, so too does the need to understand the psychological ramifications of aging. As the opening quotation (and a corpus of research) suggests, aging may in fact be "awesome" insofar as it is associated with greater positivity and reduced negativity (Carstensen, 1993, 2006; Carstensen, Isaacowitz, & Charles, 1999). In the current research we test the extent to which self-control explains one aspect of this age-related positivity: lower levels of psychological distress.

Age and psychological distress

Stressful life events (e.g. divorce, death of loved ones, injury and illness) occur throughout our lives and have a substantial adverse effect on our psychological wellbeing, often leading to significant psychological distress (Holahan, Holahan, & Belk, 1984; Hardy, Concato, & Gill, 2002; McMahon, Creaven, & Gallagher, 2020). Psychological distress is a state of emotional adversity, commonly characterised by symptoms of depression, anxiety, and / or bodily suffering (e.g. poor sleep quality; lethargy; headaches) (Drapeau, Marchand, & Beaulieu-Prevost, 2012; Davison et al. 2020). Changes in psychological distress have been frequently linked to increasing age (Cairney & Krause, 2005; Davison et al. 2020) with the onset of mental disorders such as dementia on one hand (Cairney & Krause, 2005) but reduced symptoms of depression on the other (Cairney & Krause, 2005; Steptoe, Deaton, & Stone, 2015). Moreover, older populations tend to report stressful life events as less severe

than younger populations, and also report experiencing fewer stressors (Hardy, Concato, & Gill, 2002). Given increases in life-expectancy (Steptoe et al., 2015; Tesch-Römer & Wahl, 2017) and a larger proportion of older adults (Mitra, Brucker, & Jajtner, 2020), understanding the determinants of psychological wellbeing in aging populations is critical.

Age-related differences in wellbeing can be conceptualized through the lens of socioemotional selectivity theory (SST; Carstensen, 1993, 2006; Carstensen et al., 1999) and the age-related positivity effect. SST is a lifespan developmental theory of motivation which posits that individuals adjust their goals and motivations in order to maximize positive experiences and minimize negative experiences as they age because aging is inversely related to the time one has left to live. Flowing from SST, the age-related positivity effect refers to older adults' preferential attention and memory for positive stimuli (for a review see Reed & Carstensen, 2012). This effect is theorized to occur because the time pressures inherent in aging cause individuals to continually adjust their goals and motivations to maximize positive experiences and minimize negative experiences (Carstensen, 1993, 2006; Carstensen et al., 1999). In support of this idea, older (versus younger) adults preferentially attend to positive information (e.g., Kennedy, Mather, & Carstensen, 2004; Mather & Carstensen, 2005, Reed & Carstensen, 2012) and are more likely to avoid negative situations (Charles & Piazza, 2009; Charles, 2010). This behaviour may help to explain why older populations experience less stressful life events and rate the events as less severe. Research into the age-related positivity effect would suggest that this effect may be driven by age-related differences in seeking meaning in stimuli (Gong & Fung, 2020), whereby older (compared to younger) adults ignore the meaning of negative stimuli but process the positive meaning of positively reinforced stimuli. However, some research argues that this effect is more prominent in western cultures, as contrasted by research indicating eastern cultures show the same level of stimuli processing of positive and negative stimuli in all age groups (Fung, Gong, Ngo, &

Isaacowitz, 2019) although this finding is not definitive throughout research (Gong & Fung, 2020). Additionally, more recent research had proposed that this effect does not necessarily apply to real-life consequences (Rolison, 2019). Collectively, research and theory on the SST and age-related positivity effect has two implications for the current research. First, aging should be associated with reduced symptoms of psychological distress. Second, trait-level differences in the ability to flexibly modulate goals and motivations (i.e. self-control) should mediate reductions in psychological distress. In support of this second implication, the sections that follow highlight research and theory relevant to (a) the relationship between trait self-control and psychological distress and (b) age-related differences in self-control.

Trait self-control and psychological distress

The ability to over-ride or alter motivated responses, known as self-control, is crucial for goal-directed behaviour and is a determinant of many consequential outcomes including physical health, psychological well-being, and mental health (Baumeister, Galliot, DeWall, & Oaten, 2006; Tangney, Baumeister, & Boone, 2004; Vohs & Baumeister, 2016). Individuals high in trait self-control are better able to detect changes from an ideal emotional set-point, allowing them to be less affectively influenced by changes in the external environment (Chow et al., 2005; Daly, Baumeister, Delany, & MacLachlan, 2014). Upon perceiving changes from the set-point, self-control allows individuals to rapidly regulate their emotions (Chow et al., 2005; Daly et al., 2014). Other theorizing on self-control suggests that self-control is about proactively selecting situations to facilitate good outcomes (Ent, Baumeister, & Tice, 2014; Duckworth, 2016). Ultimately, individuals with high trait self-control can more effectively form habits that facilitate goal achievement (de Ridder & Gillebaart, 2017). Collectively, these lines of theorizing suggest that self-control may be a mechanism to reduce distress.

In support of self-control's role in reducing distress, research on the link between self-control and adaptive functioning is robust. Higher self-control is associated with higher grade point average, less psychopathology, higher self-esteem, better relationships and more optimal emotional responses (Tangney et al., 2004). Others report robust links between positive associations between self-control and psychological well-being (Cheung et al., 2014; Hofmann et al., 2014; Nielsen et al., 2019). These results are corroborated by meta-analytic work linking self-control to improved performance across a variety of life domains (e.g., work, relationships, well-being; see de Ridder et al., 2012).

In addition to increasing positive life outcomes, self-control is also associated with reduced psychological distress (Bowlin & Baer, 2012; Liu et al., 2016; Yeung 2019). More specifically, those higher in self-control have lower symptoms of depression (e.g., Boals et al., 2011; Bowlin & Baer, 2012; Isacescu et al., 2017; Maccann & Roberts, 2010; Valikhani et al., 2018; 2019), anxiety (Bowlin & Baer, 2012; Maccann & Roberts, 2010; Valikhani et al., 2019), and stress (Baldwin et al., 2018; Barber & Santuzzi, 2016; Boals et al., 2011; Bowlin & Baer, 2012; Hisler et al., 2019; Hofmann et al., 2014; Liu et al., 2018; Maccann & Roberts, 2010; Papova & Corbin, 2020; Valikhani et al., 2019; Zheng et al., 2019). Most of the research linking trait self-control to psychological distress noted above has come from adolescent and undergraduate samples with two notable exceptions. First, Papova and Corbin (2020) find that trait self-control is associated with reduced stress and included workers from MTurk, which offers more demographic and age diversity than undergraduate samples (Buhrmester et al., 2011). Second, Nielsen and colleagues (2020) systematically found trait self-control to be associated with reduced depression, anxiety, and stress in a large, demographically diverse sample of respondents from Germany, Poland, Sweden, and the United States. Although continued research in representative samples is needed, an emerging literature links trait self-control to reduced depression, anxiety, and stress.

Aging and Self-control

Empirical research on self-control has largely been constrained to younger adults as evidenced by meta-analytics research on both state (e.g., Hagger et al., 2010) and trait (e.g., de Ridder et al., 2012) self-control. Despite a paucity of research examining the intersection of self-control and aging, suggestive evidence for age-related increases in self-control come from several sources. Older adults are more effective emotion-regulators (Morgan & Scheibe, 2014) and tend to use ineffective strategies like expressive suppression less (e.g., John & Gross, 2004, Brummer et al., 2014). Expressive suppression has been shown to deplete executive functioning in older adults (Franchow & Suchy, 2017; Suchy et al., 2019) suggesting that older-adults' selection of emotion-regulation strategies may serve to boost self-control. Although, the link between trait self-control and executive functioning is complex and recent studies have found only a modest, if any, correlation between these variables (e.g., Saunders et al., 2018; Wennerhold & Friese, 2020), and so it is likely that older adults use other emotion strategies to the benefit of their executive function. Nonetheless, one might speculate that the development of trait self-control with age might be explained in part due to greater practice (Muraven, Baumeister, & Tice, 1999) of emotion-regulation strategies. Similarly, when self-control resources are depleted, younger adults (18-25) but not older adults (40-65) show a decrement in subsequent task performance (Dahm et al., 2011). This may be due to non-limited willpower beliefs among older adults (Job, Sieber, Rothermund, & Nikitin, 2018; Cardini & Freund, 2020) which may undermine ego-depletion effects (Job, Dweck, & Walton, 2010). In addition to willpower beliefs, older adults also report less conflict between desired outcomes and goals in large-scale experience sampling studies (Hofmann et al., 2012). Individual differences studies using age-representative samples find that age is associated with higher trait self-control using both multi-item (e.g., Daly et al., 2014; Masterson, 2016) and single-item measures of self-control (Daly et al.,

2015). Finally, self-control as conceptualized as a facet of conscientiousness (e.g., Roberts, Chernyshenko, Stark, & Goldberg, 2005) also increases with age (Costa et al., 2014; Jackson et al. 2009; Soto et al., 2011; Weiss & Costa, 2005). Collectively this research suggests that despite limited research on older adults, there is an emerging body of evidence linking aging to improved self-control.

The current investigation

Based on the research and theory discussed above, we predicted that older (relative to younger) participants would report lower levels of psychological distress. By extension, based on research demonstrating age-related increases in self-control (e.g., Daly et al., 2014) and self-control predicting reductions in psychological distress (e.g., Nielsen et al., 2020), we hypothesized that trait self-control would account for these age-related differences in psychological distress (see Figure 1). To test this hypothesis, we conducted 3 cross-sectional studies in which participants were asked to complete a measure of trait self-control (Tangney et al., 2004) and a measure of psychological distress.

Study 1

Method

This study was approved by the Northwestern University Internal Review Board.

Participants and Procedure

Six-hundred twenty-two participants were invited to participate in a study described as an investigation of the relationship between personality, mood, and behaviour on Amazon's Mechanical Turk (MTurk). Participants were 18-74 years old (M_{years} = 33.98, SD_{years} = 11.83) adults who were primarily female (N = 337, 54.18%), non-Hispanic (N = 552, 88.75%), White (N = 462, 74.28%), and from the United States (N = 529, 85.05%), see; Table 1). Participants completed measures of demographics, self-control, and psychological

distress (i.e., depression, anxiety, and stress) prior to completing an unrelated second study and were compensated $1.00 (USD) for their participation.

Trait Self-Control. Participants first completed the brief (13-item) version of the Self-Control Scale (BSCS; Tangney et al., 2004). The BSCS asks participants to rate the extent to which they identify with 13 statements about behavioural self-control (e.g., "I am good at resisting temptation") from 1 (Not at all like me) to 5 (Very much like me). In the current study, the possible range of total scores on the BSCS was 16–61 and the average total score was 40.89 (SD = 8.75, α = .82).

Depression, Anxiety, and Stress. The Depression, Anxiety, and Stress Scale short form (DASS-21; Lovibond, & Lovibond, 1995) asks participants to indicate to what extent each of 21 statements applies to them over the last week using a 4-point Likert scale from 0 (Did not apply to me at all) to 3 (Applied to me very much, or most of the time). The DASS-21 is formed of 3 subscales: a 7-item anxiety scale (e.g. "I was worried about situations in which I might panic and make a fool of myself"), a 7-item depression scale (e.g. "I couldn't seem to experience any positive feeling at all"), and a 7-item stress scale (e.g. "I found it hard to wind down"). For each subscale, the items are summed and then multiplied by two to make the measure comparable with the DASS long form (DASS-42). As a result, scores on each subscale of the DASS range from 0 to 42, with higher scores indicating greater depression/anxiety/stress ($M_{depression}$ = 10.62, $SD_{depression}$ = 10.57; $M_{anxiety}$ = 8.21, $SD_{anxiety}$ = 9.11; M_{stress} = 12.77, SD_{stress} = 10.27). The reliability (Cronbach's α) of the subscales ranged from .87 to .92. Finally, scores on the composite score ranged from 0 to 126 and the average total composite score was 31.60 (SD = 27.49, α = .96).

Results

Descriptive statistics and bivariate correlations

Bivariate correlations among age, self-control, and psychological distress revealed that age was associated with increased self-control (r =.18, p < .001), and decreased depression (r = -.16, p < .001), anxiety (r =-.19, p < .001), and stress (r = -.22, p < .001). Age was also associated with decreased general psychological distress as reflected by the DASS total score (r = -.20, p < .001). Descriptive statistics and bivariate correlations are reported in Table 2.

Main Analyses

Mediation. Next a mediation analysis using Model 4 of Hayes (2013) SPSS Process Macro was conducted to examine whether the association between aging and reduced symptoms of psychological distress was mediated by trait self-control. Completed parameter estimates are reported in Table 3. First, we observed that age was associated with decreased psychological distress, b = -.47, SE = .09, t = -5.19, p < .001, 95% CI [-.653, -.294]. Next, age was associated with increased self-control, b = .13, SE = .03, t = 4.57, p < .001, 95% CI [.076, .191][1]. Then, we observed that self-control was associated with reduced psychological distress, b = -1.36, SE = .11, t = -11.96, p < .001, 95% CI [-1.58, -1.13]. Finally, the indirect effect was also significant, b = -.18, SE = .04, 95% CI [-.263, -.104], as the confidence interval did not include zero. Further, an examination of the completed standardized indirect effect (Preacher & Kelley, 2011), b = -.08, SE = .02, 95% CI [-.113 -.045], suggests that the indirect effect we observed was moderate in size based on the effect size interpretation recommendations of Kenny (2018) for mediation.

We then repeated this analysis separately for depression, anxiety, and stress. These analyses showed significant indirect effects for depression (b = -.07, SE = .02, 95% CI [-.107, -.042]), anxiety (b = -.04, SE = .01, 95% CI [-.066, -.024]), and stress (b = -.06, SE = .01, 95% CI [-.093, -.036]). Further, an examination of the completed standardized indirect effects

[1]All confidence intervals reported throughout the manuscript are based on 10,000 bootstrap samples.

(Preacher & Kelley, 2011) suggests that the indirect effects were moderate in size for depression (*b* = -.08, *SE* = .02, 95% CI [-.120, -.047]), anxiety (*b* = -.06, *SE* = .01, 95% CI [-.086, -.031]), and stress (*b* = -.07, *SE* = .02, 95% CI [-.106, -.041]).

Moderated mediation. We carried out exploratory analyses to examine whether the mediated effects we reported were influenced by participant gender. Accordingly, we conducted moderated mediation analyses using Model 7 of Hayes (2013) Process Macro. The difference between conditional indirect effects for males and females was non-significant for psychological distress (*b* = -.01, *SE* = .08, 95% CI [-.166, .146]), depression (*b* = .00, *SE* = .03, 95% CI [-.065, .059]), anxiety (*b* = .00, *SE* = .02, 95% CI [-.039, .035]), and stress (*b* = -.00, *SE* = .03, 95% CI [-.056, .051]).

Alternative models. To determine whether a mediational model was the best fitting model for the associations among age, self-control, and psychological distress, we next conducted a moderation analyses using Model 1 of Hayes (2013) Process Macro to determine whether an alternative conceptualization fit the data better. These analyses revealed that trait self-control did not moderate the effect of age on psychological distress (*b* = .00, *SE* = .01, *t* = 0.10, *p* = .923, 95% CI [-.018,.020]), depression (*b* = .00, *SE* = .00, *t* = 0.16, *p* = .869, 95% CI [-.007,.008), anxiety (*b* = .00, *SE* = .00, *t* = 1.19, *p* = .233, 95% CI [-.003, .011]), or stress (*b* = .00, SE = .00, *t* = -1.01, *p* = .312, 95% CI [-.011, .004]).

Discussion

The aim of Study 1 was to examine the relationship among age, trait self-control, and symptoms of psychological distress. Consistent with the age-related positivity effect, we observed that older participants reported reduced psychological distress. Additionally, we replicate prior research demonstrating age-related increases in self-control (e.g., Daly et al., 2014) and self-control predicting reduced psychological distress (e.g., Nielsen et al., 2020). Finally, Study 1 produced the novel finding that trait self-control mediated (but did not

moderate) age-related differences in psychological distress. Further, this mediational effect was not moderated by participant gender, nor did self-control moderate the relationship between age and psychological distress. Collectively, these analyses suggest that age-related differences in psychological distress are due in part to increased trait self-control.

Study 2

Although Study 1 found evidence that self-control mediates age-related differences in psychological distress, it did not control for demographic variables that may influence the age-related positivity effect (e.g. income, education). Thus, the results of Study 1 leave us unable to determine whether self-control accounts for age-related differences in distress above and beyond relevant demographic variables. Study 2 was designed in part to address this limitation.

Method

Participants and Procedure

Three hundred fifteen (315) participants took part in an online study via the online platform Prolific (https://www.prolific.co). This web service allows access to approximately 40,000 screened participants (Palan & Schitter, 2018). Peer and colleagues (2017) compared Prolific to other crowdsourcing platforms (e.g., *Mturk*) and a university subject pool. The quality of data collected via Prolific is comparable in terms of reliability and effect sizes to that of data collected in behavioural laboratories. Moreover, Prolific participants are more naïve to common experimental research tasks, and more demographically (e.g., geographic location, age, ethnicity) than other crowdsourcing platforms or university subject pools.

Participants completed measures of demographics, self-control, and psychological distress (i.e., depression, anxiety, and stress) prior to completing an unrelated second study and were compensated £3.75 for their participation. Participants completed a demographic questionnaire, a measure of trait self-control (BSCS; Tangney et al., 2004), and a measure of

psychological distress (DASS-21; Lovibond, & Lovibond, 1995) in the context of a larger study on self-related processes.

Exclusions. Participants were excluded from the study if they did not complete either the self-control scale or DASS (N = 5). At the end of the study, participants were asked if we should use their data in the study. Participants who responded "no" to this question[2] (N = 10) were excluded from analysis. After these exclusions a final sample of 300 participants remained for analysis.

Participant demographics. Participants were 18-75 years old (M_{years} = 37.08, SD_{years} = 14.06) UK residents who were primarily female (N = 228, 76.00%), non-Hispanic (N = 298, 99.33%) and White (N = 276, 92.00%). We also asked participants to report on their marital status, education, employment, and income. The majority of participants have never been married (N = 185, 61.67%), hold a university degree (N = 165, 55.00%), are currently working (N = 188, 62.67%), and earn below the UK median income (N = 158, 52.67%). Complete demographics are reported in Table 4.

Sample size determination. Sample size for Study 2 was determined via the mediation power analysis tool MedPower (Kenny, 2018). We used estimates from the DASS total score mediational model of Study 1 to guide sample size determination for Study 2. Based on the standardized estimates for path a (β = .18), path b (β = -.43), and path c' (β = -.13) a sample of 239 participants is required to detect an indirect effect with 80% power with an α-level of .05.

Results

Descriptive statistics and bivariate correlations

[2] *It is vital to our study that we only include responses from people that devoted their full attention to this study. Otherwise, years of effort (the researchers' and the time of other participants) could be wasted. You will receive compensation for this study no matter how you answer this question. In your honest opinion, should we use your data in our analyses in this study?*

Bivariate correlations between age, self-control, and psychological distress indicated that age was associated with increased self-control (r =.13, p = .03), and decreased anxiety (r =-.21, p < .001), and stress (r = -.13, p = .02). There was no correlation between age and depression (r = -.04, p = .49). Age was also associated with decreased general psychological distress as reflected by the DASS total score (r = -.13, p = .02). Descriptive statistics and bivariate correlations are reported in Table 5.

Mediational Analysis

As before, we followed up this correlational analysis with a mediation analysis using Model 4 of Hayes (2013) SPSS Process Macro to examine whether the association between aging and reduced symptoms of psychological distress was mediated by trait self-control. Completed parameter estimates are reported in Table 3. First, we observed that age was associated with decreased psychological distress, b = -.26, SE = .11, t = 2.30, p = .022, 95% CI [.478, .037]. Next, age was associated with increased self-control, b = .09, SE = .04, t = 2.17, p = .031, 95% CI [.008, .170]. Then, we observed that self-control was associated with reduced psychological distress, b = -.96, SE = .15, t = -6.48, p < .001, 95% CI [-1.25, -.670]. Finally, the indirect effect was also significant, b = -.09, SE = .04, 95% CI [-.169, -.008], as the confidence interval did not include zero. Further, an examination of the completed standardized indirect effect (Preacher & Kelley, 2011), b = -.04, SE = .02, 95% CI [-.087, -.004] suggests that the indirect effect we observed was small to moderate in size based on the effect size interpretation recommendations of Kenny (2018) for mediation.

We then repeated this analysis separately for depression, anxiety, and stress. These analyses showed significant indirect effects for depression (b = -.04, SE = .02, 95% CI [-.077, -.002]), anxiety (b = -.02, SE = .01, 95% CI [-.033, -.001]), and stress (b = -.03, SE = .02, 95% CI [-.062, -.002]). Further, an examination of the completed standardized indirect effects (Preacher & Kelley, 2011) suggests that the indirect effects were small to moderate in size for

depression (*b* = -.05, *SE* = .02, 95% CI [-.091, -.003]), anxiety (*b* = -.03, *SE* = .01, 95% CI [-.055, -.002]), and stress (*b* = -.04, *SE* = .02, 95% CI [-.087, -.002]).

Moderated mediational analysis

As in Study 1, we carried out exploratory analyses to examine whether the indirect effects we reported were influenced by participant demographics. Again, we used Model 7 of Hayes (2013) SPSS Process Macro**.** The indirect effect of self-control on psychological distress was not moderated by gender[3] (*b* = -.01, *SE* = .10, 95% CI [-.218, .188]), marital status[4] (*b* = -.15, *SE* = .11, 95% CI [-.381, .051]), employment[5] (*b* = -.02, *SE* = .08, 95% CI [-.186, .133]), income[6] (*b* = -.10, *SE* = .08, 95% CI [-.256, .067]), and education[7] (*b* = -.02, *SE* = .08, 95% CI [-.188, .141]).

The indirect effect of self-control on depression was not moderated by gender (*b* = -.01, *SE* = .05, 95% CI [-.098, .085]), marital status (*b* = -.07 *SE* = .05, 95% CI [-.166, .022]), employment (*b* = .01, *SE* = .04, 95% CI [-.086, .061]), income (*b* = -.04, *SE* = .04, 95% CI [-.121, .031]), and education (*b* = -.01, *SE* = .04, 95% CI [-.086, .066]). The indirect effect of self-control on anxiety was not moderated by gender (*b* = -.00, *SE* = .02, 95% CI [-.040, .035]), marital status (*b* = -.03 *SE* = .02, 95% CI [-.074, .009]), employment (*b* = -.00, *SE* = .02, 95% CI [-.036, .026]), income (*b* = -.02, *SE* = .02, 95% CI [-.051, .013]), and education (*b* = .00, *SE* = .02, 95% CI [-.040, .026]). Finally, the indirect effect of self-control on stress was not moderated by gender (*b* = .00, *SE* = .04, 95% CI [-.078, .067]), marital status (*b* = -.05 *SE* = .04, 95% CI [-.136, .019]), employment (*b* = -.01, *SE* = .03, 95% CI [-.068, .052]),

[3]Analyses including gender compared males (*N* = 72, 24.00%) to females (*N* = 228, 76.00%).
[4]Analyses including marital status compared participants who had never been married (*N* = 185, 67.77%) to married participants (*N* = 88, 32.23%).
[5]Analyses including employment compared currently working (*N* = 188, 62.67%) participants to those who reported not working (*N* = 109, 36.33%).
[6]The median U.K. household income is £29,600 (Office of National Statistics, 2020) as a result we compared the *below the median income* (*N* = 158, 52.67%) to those *above the median income* (*N* = 142, 47.33%).
[7]For education we compared those without a university degree (*N* = 135, 45.00%) to those with a university degree (*N* = 165, 55.00%).

income (*b* = -.04, *SE* = .03, 95% CI [-.096, .028]), and education (*b* = -.01, *SE* = .03, 95% CI [-.071, .052]).

Alternative models. To determine whether a mediational model was the best fitting model for the associations among age, self-control, and psychological distress, we next conducted a moderation analyses using Model 1 of Hayes (2013) Process Macro to determine whether an alternative conceptualization fit the data better. These analyses revealed that trait self-control did not moderate the effect of age on psychological distress (*b* = .00, *SE* = .01, *t* = -0.37, *p* = .710, 95% CI [-.024,.016]), depression (*b* = .00, *SE* = .00, *t* = -0.79, *p* = .429, 95% CI [-.012,.005), anxiety (*b* = .00, *SE* = .00, *t* = -0.15, *p* = .883, 95% CI [-.007, .006]), or stress (*b* = .00, SE = .00, *t* = 0.05, *p* = .962, 95% CI [-.007, .007]).

Discussion

Study 2 provided an adequately powered replication and extension of Study 1. As in Study 1, age-related differences in psychological distress were mediated (rather than moderated) by self-control. Furthermore, a series of moderation-mediation analyses demonstrated that key demographic variables (gender, marital status, employment, income, and education) did not influence self-control's indirect effect on reduced psychological distress. Of note, the relationships between trait self-control and the DASS variables were weaker in the UK (Study 2) than in the US (Study 1), a pattern similarly observed in Nielsen et al. (2020). Perhaps there are important structural and/or cultural differences between the UK and US that could make trait self-control more significant for minimizing psychological distress in the US compared to the UK. With consideration for the age-related positivity effect, one might speculate that this is due in part to a difference in the processing of hedonic meaning behind positive and negative stimuli. So far, we have primary utilized US (Study 1) and UK (Study 2) participants which limits the generalizability of our results to English

speaking western individuals. Thus, we sought to conduct a third study to expand beyond this culturally narrow sample.

Study 3

The purpose of Study 3 was twofold. First, we sought replicate our findings above in a more geographically diverse sample. Second, we sought to conceptually replicate our finding from Studies 1-2 with an alternative conceptualization of psychological distress. Study 3 used the same measure of self-control as Studies 1-2 but implemented an alternative measure of psychological distress in a large, transnational sample.

Method

Participants and Procedure

Study 3 included 1,523 participants from 15 test sites across 11 countries from the Human Penguin Project (Hu, Yin, Lindenberg, et al. 2019, see https://osf.io/2rm5b). Participants were excluded from analyses if they did not report their age, complete the self-control measure or the perceived stress scale (N = 39, 2.6%). This left 1484 participants for the analyses reported below. See Hu, Yin, Lindenberg, et al. (2019; https://osf.io/2rm5b) or further details of data collection.

Demographics. Participants were between 21 - 97 years old (M_{years} = 28.04, SD_{years} = 8.44) predominantly female (N = 1043, 70.28%), in a romantic relationship (N = 825, 55.59%), and English speaking (N = 523, 35.24%). Additionally, participants' self-reported health, assessed on a 5-point scale from 1 (poor health) to 5 (excellent health) was good (M = 3.29, SD = 0.92). Complete demographics are reported in Table 6.

Perceived Stress Scale. Study 3 implemented the perceived stress scale (PSS; Cohen, Kamarck, & Mermelstein, 1983) to measure psychological distress. The PSS asks participants the frequency with which they have experienced 14 stressful situations (e.g. "How often are you upset because of something that happened unexpectedly?") from 1 (Never) to 5 (Very

Often). In the current study, the possible range of scores on the PSS was 19–63 and the average total score was 40.89 (*SD* = 7.04, α = .84).

Results

Descriptive statistics and bivariate correlations

Bivariate correlations between age, self-control, and psychological distress showed that aging was associated with increased self-control (*r* = - 10, *p* < .001), and decreased stress (*r* = -.08, *p* = .002). Self-control and perceived stress were negatively correlated (*r* = - 40, *p* < .001).

Mediational analysis

As before, we followed up this correlational analysis with a mediation analysis using Model 4 of Hayes (2013) SPSS Process Macro to examine whether the association between aging and reduced perceived stress was mediated by self-control. Complete parameter estimates are reported in Table 7. First, we observed that age was associated with reduced psychological distress, *b* = -.07, SE = .02, *t* = -3.04, *p* = .002, 95% CI [-.108, -.023]. Next, age was associated with increased self-control, *b* = .10, *SE* = .03, *t* = 3.95, *p* < .001, 95% CI [.051, .150]. Then, we observed that self-control was associated with reduced psychological distress, *b* = -.34, SE = .02, *t* = -16.71, *p* < .001, 95% CI [-.378, -.299]. Finally, the indirect effect was also significant, *b* = -.03, SE = .01, 95% CI [-.051, -.018], as the confidence interval did not include zero. See Figure 2. Further, an examination of the completed standardized indirect effect (Preacher & Kelley, 2011), *b* = -.04, *SE* = .01, 95% CI [-.061, -.022] suggests that the indirect effect we observed was small to moderate in size based on the effect size interpretation recommendations of Kenny (2018) for mediation.

Alternative models. To determine whether a mediational model was the best fitting model for the associations among age, self-control, and perceived stress, we next conducted a moderation analyses using Model 1 of Hayes (2013) Process Macro to determine whether an

alternative conceptualization fit the data better. These analyses revealed that trait self-control did not moderate the effect of age on perceived stress (b = .01, SE = .01, t = 1.94, p = .053, 95% CI [.000,.010]).

Moderated mediation analysis

To examine the extent to which the mediational models described above were influenced by participant demographics, we next conducted a series of moderated-mediation analyses using Model 7 of Hayes (2013) SPSS Process Macro. These analyses revealed that gender (b = -.02, SE = .02, 95% CI [-.057, .010]), relationship status (b = .03, SE = .02, 95% CI [-.005, .060]) and health (b = .00, SE = .01, 95% CI [-.018, .018]) did not moderate self-control's indirect effect. Moreover, the condition indirect effect was similar for those speaking an Indo-European language (e.g., English, German) compared to those speaking a Ural Altaic language (i.e., Turkish), b = -.01, SE = .05, 95% CI [-.107, .081], or a Sino-Tibetan language (i.e., Mandarin), b = -.01, SE = .05, 95% CI [-.187, .013].

Discussion

Study 3 conceptually replicated the results of Studies 1-2 by showing that self-control mediated the relationship between age and another measure of psychological distress (i.e., perceived stress). Furthermore, these results were not modulated by participant demographics such as gender, relationship status, or subjective health, and the indirect effects were similar in size for participants who spoke Indo-European, Ural Altaic, and Sino-Tibetan languages, which provide a proxy for cross-cultural differences.

General Discussion

Summary

Chronological age is unsurprisingly negatively correlated with the amount of time left to live. From the perspective of socioemotional selectivity theory (SST; Carstensen, 1993, 2006; Carstensen et al., 1999), this changing time perspective causes individuals to adjust

their goals and motivations in order to maximize positive experiences and minimize negative experiences. Inspired by SST, the present research tested and found evidence for the hypothesis that increasing chronological age is associated with decreased psychological distress across three studies (N = 2,402). We extended research on age-related positivity effects by showing, for the first time, that decrements in psychological distress were accounted for by self-control.

Implications for self-control

Tangney and colleagues (2004) Self-Control Scale is the most widely utilized measure of self-control, and meta-analyses link higher scores on this measure to a wide range of positive outcomes, albeit primarily in undergraduate samples (de Ridder et al., 2012). Consistent with the age-related differences in emotion-regulation (Charles & Luong, 2013; Nielsen, Gwozdz, & de Ridder, 2019), we also show that aging is associated with higher scores on the Brief Self-Control Scale. This finding has only been reported in two other empirical investigations of self-control (Daly et al., 2014; Masterson, 2016, Study 2) and the results of the current study represent that largest empirical investigation to report this finding to date. As previous research on trait self-control has been predominately constrained to undergraduates and adolescents, questions about generalizability have clouded reported associations between self-control and symptoms of psychological distress. Not only do we show that the relationship between self-control and psychological distress is generalizable across the lifespan, we also show that it positively covaries with age.

Self-control is conceptualized as conflict between desire strength and control strength (Inzlicht & Schmeichel, 2012; Inzlicht, Schmeichel, & Macrae, 2014; Kelley et al., 2019; Schmeichel & Zell, 2007). Consistent with this viewpoint and age-related increases in self-control, older adults report less conflict between desires and goals in large-scale experience sampling studies (Hofmann et al., 2012). However, is this reduced desire-goal conflict due to

decreased desire strength, increased control strength, or both? Future studies should consider how these discrete pathways may account for self-control's role in reduced age-related differences in psychological distress.

Implications for aging

The current research identified self-control as a mechanism explaining age-related differences in psychological distress, suggesting that self-control may be a key mechanism explaining age-related positivity effects. Older adults preferentially attend to positive information (e.g., Kennedy, Mather, & Carstensen, 2004; Mather & Carstensen, 2005, Reed & Carstensen, 2012) and are more likely to avoid negative situations (Charles & Piazza, 2009; Charles, 2010). Future correlational and experimental studies should continue to explore the extent to which self-control explains a wide range of thoughts, feelings, and behaviors encompassed by the age-related positive effect.

Future research should continue to examine self-control from the perspective of socioemotional selectivity theory. Experimental findings in support of socioemotional selectivity theory report that older adults preferentially attend to positive information (e.g., Kennedy, Mather, & Carstensen, 2004; Mather & Carstensen, 2005, Reed & Carstensen, 2012) and are more likely to avoid negative situations (Charles & Piazza, 2009; Charles, 2010). In a similar vein, trait self-control is associated with preferential attention toward positive information (i.e., optimism, see Kelley & Schmeichel, 2015) and avoidance of negativity (i.e., positivity biases in visual attention, see Kelley et al., 2014) in undergraduate samples. Given these parallel modes of operation, future studies should examine the extent to which trait self-control moderates these experimental effects, as testing for moderation by individual differences is an accepted method for elucidating processes underlying experimental effects (Gohm & Clore, 2000; Underwood, 1975).

Aging is often but not always associated with positive outcomes. In contexts like bereavement (e.g., Lund et al., 1989) and chronic illness (e.g., Smith et al., 2003), aging is associated with reduced psychological well-being. Despite the ability of chronic health conditions to undermine wellbeing during aging, some researchers highlight that successful aging and disease can coexist within the same individual when compensatory psychological mechanisms are in place (Young et al., 2009). Self-control may function as a compensatory mechanism driving increased well-being even in cases of chronic illness, though future research is needed to test this possibility. In cases where successful aging and disease cannot coexist, could targeted interventions to boost self-control course correct psychological well-being in the context of bereavement or chronic illness? Meta-analytic evidence suggests that self-control training produces moderate effects (Friese et al., 2017) and recent research suggests that in addition to boosting self-control, training may also alleviate depressive symptoms (Yang et al., 2018). As this work was conducted in undergraduates, future studies should explore the viability of self-control training for alleviating symptoms in older adults. Taken together these potential lines of inquiry suggest that self-control research and theory may play a central role in the future of aging research.

Limitations

Despite the implications of this work, the current study has several limitations. First, due to the nature of the cross-sectional correlational design of all three studies, while we can examine if self-control mediates age-related differences in psychological distress, we are unable to speak to age-related *changes* in psychological distress. In other words, due to the cross-sectional nature of these studies, the conclusions that can be drawn from this work are somewhat limited. While we can conclude that higher chronological age is associated with higher levels of self-control, we are unable to say that *aging* is associated with increased self-control. Aging implies that as people get older, their self-control increases. Future studies

employing longitudinal designs will be equipped to examine within-person changes in associations between self-control and psychological distress throughout normative aging. Second, the current study was limited in scope, only considered self-control as a potential mediating mechanism, and did not consider other personality correlates that covary with self-control (e.g., conscientiousness, agreeableness; see Jensen-Campbell et al., 2002). Future studies should examine whether the mediating effect of trait self-control is still present after controlling for other relevant cognitive and personality factors. Additionally, we did not examine the exact strategies older adults who are higher in trait self-control use regulate their emotions and reduce psychological distress. Future research should examine differences in strategy use by age and trait self-control to further understand how older adults achieve less psychological distress. Next, it is important to note that the indirect effect sizes found in this research were small to moderate. This may be indicative of other psychological and non-psychological factors unaccounted for that could also influence the link between age and psychological distress (e.g. practice; Muraven, Baumeister, & Tice, 1999).

Conclusion

The current research identified trait self-control as a mechanism explaining age-related decreases in psychological distress (i.e., depression, anxiety, and stress). Taken together with past research, these results suggest that the development and maintenance of self-control may put individuals on a path toward healthy aging.

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Table 1. Demographic characteristics of Study 1.

		N	%
Gender	Female	337	54.18
	Male	276	44.37
	Transgender	8	1.29
	Not male, female or transgender	1	0.16
Ethnicity	Hispanic	66	10.61
	Non-Hispanic	552	88.75
	Missing	4	0.64
Race	American Indian/Alaskan Native	6	0.96
	Asian	64	10.29
	Black	44	7.07
	Native Hawaiian/Pacific Islander	3	0.48
	White	462	74.28
	Multi-racial	32	5.14
	Missing	11	1.77
Nationality	United States	529	85.05
	Canada	52	8.36
	Europe	10	1.61
	South America	8	1.29
	Asia	7	1.13
	Caribbean	6	0.96
	Africa	5	0.80
	Oceania	4	0.64
	Middle East	1	0.16

Table 2. Descriptive statistics and bivariate correlations (Study 1).

Variable	M (SD)	1	2	3	4	5
1. Age	33.98 (11.83)	-				
2. BSCS	40.89 (8.75)	.18***	-			
3. DASS-D	10.62 (10.57)	-.16***	-.47***	-		
4. DASS-A	8.21 (9.11)	-.19***	-.34***	.72***	-	
5. DASS-S	12.77 (10.27)	-.22***	-.43***	.78***	.78***	-
6. DASS-T	31.60 (27.49)	-.20***	-.45***	.92***	.90***	.93***

Note: BSCS = Brief Self-control Scale; DASS = Depression, Anxiety and Stress Scale; D = Depression, A = Anxiety, S = Stress, T = Total Score. *** = $p < .001$.

Table 3. Indirect effect of age on distress-related outcomes (Studies 1-2).

Outcomes	Study 1		Study 2	
	Effect (SE)	95% CI	*Effect (SE)*	95% CI
Psychological Distress				
a	0.133 (0.029)***	[0.076, 0.191]	0.088(0.041)*	[0.008, 0.170]
b	-1.356 (0.113)***	[-1.578, -1.133]	-0.962 (0.148)***	[-1.254, -0.670]
Indirect Effect (*ab*)	-0.181 (0.041)	[-0.263, -0.103]	-0.085 (0.043)	[-0.171, -0.004]
Direct Effect (*c'*)	-0.293 (0.084)***	[-0.457, -0.128]	-0.172 (0.106)	[-0.380, 0.037]
Depression				
a	0.133 (0.029)***	[0.076, 0.191]	0.088(0.041)*	[0.008, 0.170]
b	-0.554 (0.043)***	[-0.639, -0.468]	-.435 (0.064)***	[-0.561, -0.308]
Indirect Effect (*ab*)	-0.074 (0.017)	[-0.107, -0.042]	-0.039 (0.019)	[-0.077, -0.002]
Direct Effect (*c'*)	-0.066 (0.032)*	[-0.130, -0.003]	0.005 (0.046)	[-0.086, 0.095]
Anxiety				
a	0.133 (0.029)***	[0.076, 0.191]	0.088(0.041)*	[0.008, 0.170]
b	-0.325 (0.040)***	[-0.403, -0.247]	-0.175 (0.047)***	[-0.269, -0.082]
Indirect Effect (*ab*)	-0.043 (0.011)	[-0.065, -0.024]	-0.016 (0.008)	[-0.034, -0.001]
Direct Effect (*c'*)	-0.104 (0.029)***	[-0.161, -0.046]	-0.112 (0.034)***	[-0.179, -0.046]
Stress				
a	0.133 (0.029)***	[0.076, 0.191]	0.088(0.041)*	[0.008, 0.170]
b	-0.478 (0.043)***	[-0.562, -0.394]	-0.352 (0.054)***	[-0.458, -0.245]
Indirect Effect (*ab*)	-0.064 (0.014)	[-0.107, -0.042]	-0.031 (0.015)	[-0.062, -0.002]
Direct Effect (*c'*)	-0.123 (0.032)***	[-0.130, -0.003]	-0.064 (0.039)†	[-0.140, 0.012]

Note: Parameter estimates are unstandardized. Standard errors and 95% confidence intervals for the indirect effect were calculated with the percentile bootstrap approach based on 10,000 bootstrap samples (Hayes, 2018). For *a*, *b*, and *c'* paths, we used the following schema to indicate significance: $^{\dagger}p < .10$; $*p < .05$; $**p < .01$; $***p < .001$.

Table 4. Demographic characteristics for Study 2

		N	%
Gender	Female	228	76.00
	Male	72	24.00
Ethnicity	Hispanic	2	0.67
	Non-Hispanic	298	99.33
Race	Asian	6	2.00
	Black	7	2.33
	White	276	92.00
	Multi-racial	8	2.67
	Other	2	0.67
	Missing	1	0.33
Marital Status	Married	88	29.33
	Widowed	3	1.00
	Divorced	20	6.67
	Separated	4	1.33
	Never Married	185	61.67
Education	Less than high school degree	9	3.00
	High school graduate (high school diploma or equivalent)	50	16.67
	Some college but no degree	76	25.33
	Associate degree in college (2-year)	16	5.33
	Bachelor's degree in college (4-year)	106	35.33
	Master's degree	34	11.33
	Doctoral degree or Professional Degree	9	3.00
Employment	Working (paid employee)	152	50.67
	Working (self-employed)	36	12.00
	Not working (temporary layoff from a job)	2	0.67
	Not working (looking for work)	22	7.33
	Not working (retired)	27	9.33
	Not working (disabled)	11	3.67
	Not working (other)	47	15.67
	Prefer not to answer	3	1.00
Income	Less than £10,000	34	11.33
	£10,000 to £19,999	58	19.33
	£20,000 to £29,999	66	22.33
	£30,000 to £39,999	43	14.33
	£40,000 to £49,999	37	12.33
	£50,000 to £59,999	17	5.67
	£60,000 to £69,999	11	3.67
	£70,000 to £79,999	9	3.00
	£80,000 to £89,999	5	1.67
	£90,000 to £99,999	6	3.00
	£100,000 to £149,999	11	3.67
	£150,000 or more	3	1.00

Table 5. Descriptive statistics and bivariate correlations for Study 2.

Variable	M (SD)	1	2	3	4	5
1. Age	37.18 (14.14)	-				
2. BSCS	53.37 (10.01)	.13*	-			
3. DASS-D	13.59 (11.86)	-.04	-.37***	-		
4. DASS-A	8.70 (8.51)	-.21***	-.23***	.64***	-	
5. DASS-S	13.99 (10.01)	-.13*	-.36***	.77***	.75***	-
6. DASS-T	36.28 (27.43)	-.13*	-.36***	.91***	.86***	.93***

Note: BSCS = Brief Self-control Scale; DASS = Depression, Anxiety and Stress Scale; D = Depression, A = Anxiety, S = Stress, T = Total Score. *** = $p < .001$, * = $p < .05$.

Table 6. Demographic characteristics for Study 3

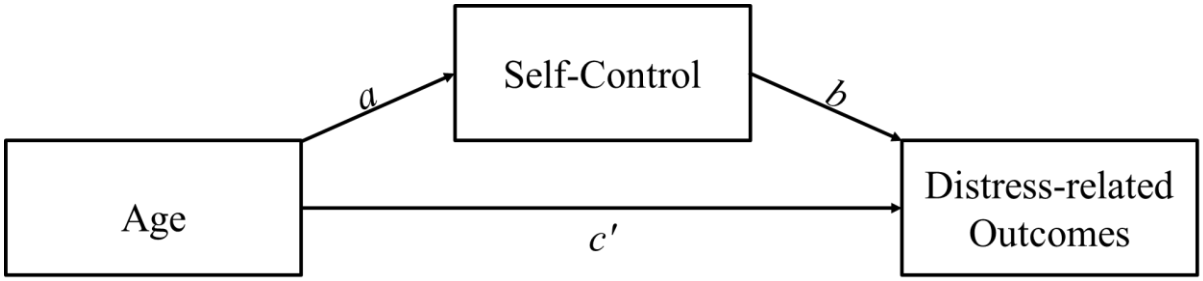
		N	**%**
Gender	Female	1043	70.28
	Male	441	29.72
Country	United States	380	25.61
	Turkey	181	12.20
	China	174	11.73
	Serbia	163	10.98
	United Kingdom	143	9.64
	Germany	142	9.57
	Poland	131	8.83
	Norway	83	5.59
	Switzerland	37	2.49
	Chile	33	2.22
	Portugal	17	1.15
Language Family	Indo European	1129	76.08
	Ural Altaic	181	12.20
	Sino Tibetan	174	11.73
Language	English	523	35.24
	Turkish	181	12.20
	German	179	12.06
	Mandarin	174	11.73
	Serbian	163	10.98
	Polish	131	8.83
	Norwegian	83	5.59
	Spanish	33	2.22
	Portuguese	17	1.15
Relationship Status	In a romantic relationship	825	55.59
	Not in a romantic relationship	659	44.41
In general, how would you rate your overall health now?	Excellent	120	8.09
	Very good	509	34.30
	Good	565	38.07
	Fair	256	17.25
	Poor	33	2.22
	Missing	1	0.07

Table 7. Indirect effect of age on perceived stress via self-control (Study 3).

	Effect (SE)	95% CI
a	0.101 (0.025)***	[0.051, 0.150]
b	-0.338 (0.020)***	[-0.378, -0.299]
Indirect Effect (*ab*)	-0.034 (0.008)	[-0.051, -0.019]
Direct Effect (*c'*)	-0.032 (0.020)	[-0.071, 0.008]

Note: Parameter estimates are unstandardized. Standard errors and 95% confidence intervals for the indirect effect were calculated with the percentile bootstrap approach based on 10,000 bootstrap samples (Hayes, 2018). For *a*, *b*, and *c'* paths, we used the following schema to indicate significance: $^{\dagger}p < .10$; $*p < .05$; $**p < .01$; $***p < .001$.

Figure 1. Hypothesized model of age, self-control, and distress-related outcomes.



Note: In Studies 1-2 distress was measured with the Depression, Anxiety, and Stress Scales (DASS; Lovibond & Lovibond, 1995). In Study 3, distress was measured with the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). Parameter estimates for *a*, *b, c'* paths and indirect effects (*ab*) are reported in Table 3 (Studies 1-2) and Table 7 (Study 3).

UNIVERSITY OF
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Dear Section Editors,

Enclosed is our manuscript entitled "Self-Control Mediates Age-Related Differences in Psychological Distress " (Butterworth, Finley, Baldwin, & Kelley). Please consider this manuscript for publication as a multi-study article in *Personality and Individual Differences*. The manuscript is 38 pages in length and contains 6,447 words in the main text along with 7 tables and 1 figure. All participants in this research were treated in an ethical manner, in accordance with Ethics policies and procedures at Northwestern University and the University of Southampton. None of the authors report any conflicts of interest. This work has not been published and is not under consideration for publication elsewhere.

Here we present the results of three studies (one of which included participants from 11 countries) asking to what extent self-control accounts for age-related differences in psychological distress. Empirical research on self-control has largely been constrained to younger adults as evidenced by meta-analytics research on both state (e.g., Hagger et al., 2010) and trait (e.g., De Ridder et al., 2012) self-control. Similarly, research linking self-control to psychological distress has also primarily come from undergraduate and adolescent populations.

Thank you in advance for your consideration!

Sincerely,

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