

Supplemental Material

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A. Detailed methods of study

Participants and procedure

Participants. Participants were recruited from multiple sources, including flyers posted in the Los Angeles community (e.g., libraries, senior centers), advertisements in local newspapers, mailers to participants in prior studies and patients from the UCLA Geriatrics Clinic who had consented to learn about future studies. Interested participants were screened for eligibility using a structured telephone interview. Inclusionary criteria included: 1) being a healthy female 60 years of age or older, 2) fluency in English, and 3) access to the Internet and a computer to complete the weekly study sessions.

Given that there are sex differences in generativity (e.g., women generally feel more obligated to assist social institutions and other people; Keyes & Ryff, 1998), generativity interventions may be differentially impactful on women than men. Because it has been proposed that older women may particularly benefit from new outlets to promote generative activity (Carlson, Seeman, & Fried, 2000) and may have the most to gain from a generativity intervention, we decided to solely recruit women for this innovative, exploratory pilot intervention.

Additionally, in order to maximize our ability to detect increases in self-reported generativity in response to the intervention, eligible participants were screened for current perceptions of generativity. Potential participants were asked to answer 7 questions about how generative they wished to be (i.e., generative desire; e.g., “I want to do something that will be valuable to others for a long time”) and 6 questions about how generative they currently felt (i.e., current generative achievement; e.g., “right now, I feel like I do things that will exist for a long time”) using the Generativity Scale (Gruenewald et al., 2015). Answers to items on the scale

were measured on a 6-point Likert scale (1 to 6; “disagree strongly” to “agree strongly”) and averaged for each subscale (desire and achievement). Participants were deemed eligible if the difference between their desire and achievement subscale scores (i.e., generative desire – generative achievement) was .20 or higher, indicating that they wished to be more generative than they currently felt.

Prospective participants with the following conditions were excluded: chronic physical or mental health problems that may have impacted the study’s physiological or psychological outcomes (e.g., rheumatoid arthritis, cancer, major depression); regular use of certain prescription medications that may have impacted the study’s physiological outcomes (e.g., immune-modifying drugs, opioids, steroids, psychotropic medications to treat major depression or anxiety); cognitive impairment (Brief Alzheimer Screen less than 26; Mendiondo, Ashford, Kryscio, & Schmitt, 2003); BMI greater than 35; current smoker or excessive caffeine user; or recent nightshift work or time zone shifts (>3 h).

Seventy eight older women (mean age 70.9 ± 6.3 years) enrolled in the study and were randomized into either a 6-week generativity (n=40) or control (n=38) condition. Five participants (n=2 in the generativity condition, n=3 in the control condition) did not complete the study. Two of these participants were removed by the study investigators for not meeting study eligibility criteria; two participants dropped before completing the post-intervention assessment due to scheduling conflicts; and one participant did not receive the full manipulation due to technical issues. Thus, the final sample that was analyzed consisted of 73 participants.

Study overview. During Week 1 of the study, participants completed an in-person pre-intervention assessment. During Weeks 2-7 of the study, participants completed the intervention

from home. During Week 8 of the study, participants returned for an in-person post-intervention assessment.

Pre-intervention assessment. The study was conducted between January 2016 and March 2017 using a randomized, double-blind design. Participants began the study at the UCLA Clinical and Translational Research Center (CTRC) where a phlebotomist, who was blind to condition, drew blood in order to assess inflammatory outcomes (for outcomes not discussed here). Participants then completed self-report measures of generativity, social well-being, and mental and physical health. Finally, the study coordinator, who was blind to condition throughout the entirety of the study, gave participants general instructions for the writing portion of the study and broadly familiarized them with the online survey and writing format.

Intervention.

General procedures.

Beginning the week after the pre-intervention assessment, all participants received an email, once weekly for six weeks, with a link to log in to an online system (SurveyMonkey) to receive their instructions and complete their writing. Participants in both conditions were asked to write once weekly and to write about various topics each week based on recommendations for maximizing efficacy of positive psychological interventions (Layous, Nelson, & Lyubomirsky, 2012; Lyubomirsky & Layous, 2013). All prompts from both conditions are included below.

Across both conditions, participants were instructed not to begin their weekly session until they were able to sit quietly, alone, without distraction and complete the writing in one, uninterrupted session each week. Participants were asked to write for however long they desired, as long as they spent at least ten minutes writing for each session. They were reminded each week that the writing portion of the study was important and that they should “really try to get

into the writing experience.” All participants were told not to worry about grammar, spelling, or sentence structure in order to allow them to fully immerse themselves in the writing experience. Participants were also told that their writing would be confidential and only identifiable by an anonymous study identifier, not their personal information.

Importantly, none of the subjects knew there were two experimental groups in the study. That is, the control group was not aware that there was another experimental group or option in the study (and vice versa). When recruited to the study, all potential subjects were told they would be writing about their experiences, and that we were interested in how writing about experiences might impact health. The language was kept purposefully vague so that both groups’ writings would fit the description of “experiences” if the subjects were eligible for the study. After the subjects were deemed eligible and randomized into the study, they received a different consent form depending on the group they were randomized into. The generativity group was asked to consent to having their writings anonymously shared with others; the control group had no mention of this in their consent form. Because the two groups were essentially treated as subjects in two different studies, there was not the potential for control subjects to be disappointed that they were not randomized into the more “interesting” writing condition. (At the final study session, when subjects were debriefed, all subjects were informed that there were actually two groups.)

Generativity condition.

Participants in the generativity condition were asked to respond to prompts asking them to share their experiences and advice with others. Pilot testing of the generativity prompts revealed that some older adults found it hard to connect with a much younger generation (e.g., people in their twenties), both because of age and generational differences. In response to this

pilot testing, the target audience to receive the wisdom and advice from the generativity participants was middle-aged adults. Participants in the generativity condition were asked to provide responses to the 6 generativity prompts included below.

In order to create a concrete target of generativity for the participants, so that the exercise was not merely a journaling intervention, participants in the generativity condition were told prior to the first writing assignment that their responses for the next 6 weeks would be compiled (anonymously, with all names and identifying information removed) into a book or website dedicated to helping middle-aged adults gain valuable insights and advice from older adults.

In order to convince participants of the value, importance, and relevance of learning from the life experiences of older adults, we informed participants in the generativity condition about the Cornell Legacy Project (Pillemer, 2011), which is a published collection of advice and life experiences obtained from over 1500 older adults. Participants were shown the positive response to this project (e.g., quotes from reviews and high ratings from readers on Amazon.com and Goodreads.com). The positive reviews of the book (e.g., “I can’t imagine anyone whose life will not be enriched by this”) suggesting that individuals have benefited from the experiences shared by these older adults were shared with participants in the generativity condition in order to bolster the idea that people would like to read about the life experiences of older adults. This piece was added to the intervention after pilot testing revealed that older adults may be uncertain of the market for and impact of their life stories and advice. Furthermore, this was used to emphasize to the participants that the readers of their writings would greatly appreciate the experiences, feelings, and advice that they share.

Each week, participants in the generativity condition were reminded that their writings would be shared with middle-aged adults looking for advice and insight about growing older and

that the middle-aged adults reading about their experiences and wisdom would really value and benefit from their contributions.

In order to further bolster the sense that participants were impacting others with their life experiences and advice, participants in the generativity condition were given feedback about their writings after the first week of the intervention. As each participant in the generativity condition completed their first week of writing, their writings (after being made anonymous) were shared with others.

Because the data from the audience needed to be collected quickly, this part of the study was done using Amazon Mechanical Turk (MTurk). MTurk has been established as a source of high-quality data that can be obtained inexpensively and quickly from a diverse sample of people who tend to be internally motivated to complete the studies (Buhrmester, Kwang, & Gosling, 2011). These characteristics of MTurk made it ideal for this portion of the study.

Each MTurk worker was asked to read one writing sample and then rate the writing on its impact and helpfulness (e.g., “I found the writing inspiring,” “The writing provided a valuable life lesson”) using a 4-point scale of “strongly disagree” to “strongly agree.” Five to nine workers rated each sample. Overall, the MTurk workers rated the writings very positively. For example, nearly 80% agreed or strongly agreed that the writing samples from the generativity participants was inspiring and nearly 85% found that the writings provided valuable life lessons.

The research team then selectively picked some of these reactions to share with the participants in the email to the participants during their second week of the intervention. For example, a participant would receive this type of paragraph (which was slightly different for each subject based on their MTurk feedback) before their email instructions for their second week of writing: “Before you complete today’s session (instructions below), we just wanted to

let you know that several people have already read your writing from last week, and they said they found it very inspiring and also mentioned that it provided valuable life lessons. We're sure even more people will benefit from reading about your experiences and advice from this week and the rest of the study. Thank you so much for contributing to this study so that people can learn from your lifetime of experiences!" This was done so that the participants received immediate positive feedback on the impact of their life stories and advice as they began the study.

Control condition.

Participants in the control group were asked to write about topics that were intended to be neutral and descriptive in nature. They were instructed not to think of or describe social features or psychological thoughts linked to the topics. Participants in the control condition were asked to provide responses to the 6 control prompts included below. Participants in the control condition were also never told their writing would be shared with others.

Because the generativity group received positive feedback after their first week of writing, and we did not want the feedback to drive the between-group effects, we provided the control condition participants with feedback as well. However, the feedback was unrelated to feelings of generativity and read: "Because last week was your first week in the study, we wanted to make sure that we communicated our instructions clearly to you. A member of our staff took a quick look over your responses to last week's at-home session and they looked totally fine. Thank you so much for following the instructions!"

Post-intervention assessment. Similarly to the pre-intervention assessment, participants had blood drawn and completed self-report measures. Participants were debriefed and paid at a later experimental session not discussed here.

B. Justification of sample size

As reported previously (Moieni et al., in press) “The target sample size was based largely on three considerations: 1) the power analysis and sample size calculation, 2) the sample size needed to obtain significant between-group differences in gene expression, and 3) the per participant protocol costs. A power analysis using G*Power was conducted to determine the appropriate sample size. Using calculations for an ANOVA pre- to post- design for two randomized groups, calculating power of the interaction of condition by time, the sample size estimate is a total sample of 54, or 27 subjects per group (at a 0.05 significance level, 80% power for a medium effect size). A medium effect size was calculated because prior positive psychological interventions using weekly prompts have found medium effect sizes in changes of self-reported psychological well-being (e.g., affect) and physical health (e.g., sleep) (Wood, Froh, & Geraghty, 2010). Furthermore, prior psychological interventions have demonstrated significant reductions in proinflammatory gene expression in samples of 20 (Creswell et al., 2012) to 40 participants per group (Antoni et al., 2012). Thus, we aimed to recruit 35 participants per group in order to obtain usable data for 30 participants per group.”

C. Demographics table

Data are shown as mean (SD), unless otherwise indicated.

	Control condition (n=35)	Generativity condition (n=38)
Sex (female)	100%	100%
Race (% white vs. non-white)	77.1%	84.2%
Age (years)	70.9 (5.6)	70.9 (7.3)
Expectations Regarding Mental Health Score (Baseline)	75.5 (19.2)	80.0 (17.0)
UCLA Loneliness Score (Baseline)	38.8 (9.5)	38.1 (8.7)
Social Provisions Scale Score (Baseline)	83.6 (9.6)	84.1 (8.4)

D. Methods: All 4 items from ERA – Mental Health Scale

- I expect that as I get older I will spend less time with friends and family
- Being lonely is just something that happens when people get old
- Quality of life declines as people age
- It's normal to be depressed when you are old

E. Statistical analyses & results: Main effect of intervention on social support and loneliness

Analytic strategy: As reported previously (Moieni et al., in press), to test the main effect of the generativity intervention on perceptions of social support and feelings of loneliness, analysis of covariance (ANCOVA) was used, which is the recommended analytic strategy for randomized studies (Van Breukelen, 2006). Thus, analyses tested the effect of condition (generativity vs. control) on post-intervention values of social support and feelings of loneliness, controlling for pre-intervention values.

Results: As described previously (Moieni et al., in press), there was no effect of the generativity intervention on post-intervention perceptions of social support ($F(1,70)=2.52, p > .1$) or feelings of loneliness ($F(1,70)=.273, p > .6$), controlling for pre-intervention values.

F. Results: Adherence of groups to intervention

As reported previously (Moieni et al., in press), “There was a high completion rate of the intervention, with 72 out of the 73 participants completing 100% of the weekly writing assignments (the remaining participant completed five out of six assignments). There were no between-group differences in the number of words written each week ($F(1,71)=.58, p = .45$; generativity mean = 364; control mean = 395).”

G. Results: Momentary feelings of generativity

As reported previously (Moieni et al., in press), “To assess participants’ momentary feelings of generativity post-writing, they were asked immediately post-writing to indicate how they “feel right now” in response to three words reflective of generativity (i.e., “helpful,” “caring,” and “useful”) among other distractor words. Responses were on a scale of 0 (“not at all”) to 4 (“extremely”) and means were taken across these three items to create a momentary generativity scale ($\alpha = .79$, assessed at the first week). Higher scores indicate greater feelings of generativity post-writing.... We examined differences in participants’ feelings of momentary generativity immediately post-writing. The generativity group reported feeling more generative (Figure 1; $F(1,70)=19.54, p < .001; \eta^2 = .21, p_{\text{Simes}}=.004$) post-writing, averaged across all 6 weeks.”

H. Methods & results: Moderating effect of expectations regarding physical health and cognitive functioning on social support and loneliness

Methods: On the Expectations Regarding Scale, there are four items assessing beliefs about aging and physical health (e.g., “having more aches and pains is an accepted part of aging”) and four items assessing beliefs about aging and cognitive functioning (e.g., “forgetfulness is a natural occurrence just from growing old”). Participants rated how much they believe the statements to be true on a scale of 1 (“definitely true”) to 4 (“definitely false”). Because expectations regarding aging may be domain-specific (Kornadt & Rothermund, 2015) and the outcomes of interest were social- and mental-health related, we expected only the mental health domain of expectations regarding aging to be relevant. Physical health and cognitive functioning were included to show specificity of the mental health domain. As with the mental health domain, scores were created for expectations regarding aging in the physical and cognitive domains by summing across the four items in each scale and translating to a 0-100 scale. Higher scores indicate more positive expectations regarding aging.

The two groups were not different at baseline in expectations regarding cognitive or physical health (p 's > .5).

To test whether the effects of expectations regarding aging were domain-specific, we also tested the moderating effect of expectations regarding physical health and cognitive functioning on perceptions of social support and feelings of loneliness.

As hypothesized, there was no significant interaction between condition (generativity vs. control) and expectations regarding physical health for social support ($B = .064$, $SE = .050$, 95%

CI = [-.036, .163], $t = 1.28$, $p > .2$) or feelings of loneliness ($B = -.056$, SE = .039, 95% CI = [-.134, .023], $t = -1.42$, $p > .1$). There was also no significant interaction between condition (generativity vs. control) and expectations regarding cognitive functioning for social support ($B = .036$, SE = .058, 95% CI = [-.079, .151], $t = .620$, $p > .5$) or feelings of loneliness ($B = -.053$, SE = .044, 95% CI = [-.140, .035], $t = -1.21$, $p > .2$).

I. All writing prompts from study

Writing Prompts in Generativity Condition:

- 1) What are some of the most important lessons you feel you have learned over the course of your life? If a middle-aged person asked you “what have you learned in your ____ years in this world,” what would you tell him or her? You can think and write about any aspect of life you think would be important to share with middle-aged adults looking for advice. You can also focus on one lesson or several lessons.

- 2) A large percentage of middle-aged adults worry about how to best live their lives so that they don't have many regrets when they grow older. What have you learned are the most important things in life? If a middle-aged person looking for advice asked you to think back on your life and think about which parts of your life stick out for you as the most valuable, what would you tell him or her that you think may be helpful?

- 3) What would you say you know now about living a happy and successful life that you didn't know when you were younger? If a middle-aged person who wasn't sure what components are key for leading a happy and successful life asked for your advice on this, what would you tell him or her? You could choose to focus on one thing or write about multiple things – whatever you think would be best.

- 4) Middle-aged adults often have many worries, including about making the right decisions and learning from mistakes and stressful experiences. If you could tell your middle-aged self something, what would you say? Think about what kind of advice you would give yourself when

you were middle-aged. For example, is there anything you wish you had done? Or something you are really happy that you did do? You could also think about what you would say to another middle-aged person if they asked you about this.

5) What advice would you give to people about growing older? If a middle-aged person asked you “what would you say you’ve learned about growing older?” what would you tell him or her? This can be about any part of growing older. For example, you could talk about lessons you’ve learned about staying in good health, maintaining friendships, marriage, raising children, or any other topic you think would be beneficial for middle-aged adults worried about growing older.

6) What have been the most fulfilling activities or experiences in your life? If a middle-aged person concerned about finding meaning in their life asked you “what aspects of your life have been the most meaningful and why?” what would you tell him or her that you think may be helpful? As in previous weeks, feel free to focus on any domain of life (e.g., relationships, career) and talk about one thing or multiple things.

Writing Prompts in Control Condition:

1) Now, please take a moment to look around the room you are in at this moment and notice all of the details. In the space provided below, please describe the features of the room in which you are sitting right now. What do you see when you look around? How is the temperature in this room? How does your body feel sitting where you are seated? What kinds of activities can you do in this room? Feel free to describe what the room looks like in general (colors, size), the kinds of objects that are in the room, and other specific details that you notice as you are observing the

visual properties of the room. Please try to focus on the details of what the room looks like as opposed to who is in the room with you or what you are currently thinking about. Use this writing session as an opportunity to paint a detailed picture of what you see in the room you are currently in, including as much specific information as you can.

2) Think about a kind of food or dish that you enjoy making or are able to make. It may be a dish you make for breakfast, lunch, dinner, dessert, or as a snack. In the space provided below, please describe the steps that you take to make this dish. This would include all the different steps that you would go through to create this dish, much like you might see in a cooking magazine or recipe book. Please describing everything from preparing all of the ingredients, going through all of the steps to cook or bake the dish, to getting to the final finished product. Please try to focus on the details of what you do as you prepare this dish (e.g., cutting the vegetables, getting out the bowls, etc.) as opposed to who you are typically with while cooking or eating this dish or what you are typically thinking about as you prepare this dish. Use this writing session as an opportunity to paint a detailed picture of what you enjoy making or are able to make, including as much specific information as you can recall.

3) In the space provided below, please describe your daily routine for getting ready to go to sleep at night. Think about the steps that you go through each night prior to falling asleep (e.g., getting changed, brushing teeth, washing face, reading, or whatever it is that you do) and then write about these different steps that you generally go through as you are getting ready for bed. We would just like you to think back and walk us through this process, describing the details of what you do during this time. Please try to focus on the details of what you do as you get ready to go

to sleep (e.g., pulling back the covers, turning on a fan, turning off a light) as opposed to who you are typically with or what you are typically thinking about during this time. Use this writing session as an opportunity to paint a detailed picture of what do before going to sleep, including as much specific information as you can recall.

4) Think about the longest distance that you walked today. In the space provided below, please describe the longest distance that you walked today and what you saw along the way. Your writing can reference any sort of distance that you walked and it is fine if the longest distance that you walked was not terribly far. We would just like you to think back about what you saw along this walk and try to describe the features of what you noticed along the way. Please try to focus on the details of the types of things that you saw along your walk, rather than on who you were with or what you were thinking about during this time. Use this writing session as an opportunity to paint a detailed picture of what you experienced visually along your walk, including as much specific information as you can recall.

5) In the space provided below, please describe what you had for lunch today—what it looked like, how it tasted. If you did not have lunch today, write about the most recent lunch you did have. In your writing, please try to focus on the details of what you ate, how it looked, and how it tasted, rather than on who you were with or what you were thinking about during this time. Use this writing session as an opportunity to paint a detailed picture of your lunch, including as much specific information about the food as you can recall.

6) Throughout the day, we spend time in rooms with many different physical features and attributes. Think about the room you spent the majority of your time in today. In the space provided below, please describe the features of that room in which you spent most of your time in today. You can describe what the room looks like in general (i.e., colors, size, etc.), the kinds of objects that are in the room, and other specific details that you notice as you are thinking about the visual properties of the room. Please try to focus on the details concerning the physical elements of the room (e.g., the configuration of furniture, the textures of the walls, the contents of the space) as opposed to who you are typically with or what you are typically doing while in this room. Use this writing session as an opportunity to paint a detailed picture of what you saw while in that room, including as much specific information as you can recall.

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