



Psychological Obsolescence and Subjective Remaining Life Expectancy are Predictors of Generativity in a Six-Year Longitudinal Study

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Abstract

In this research, we explore associations between (changes in) perceived generativity, subjective remaining life expectancy (SRLE), and psychological obsolescence in a longitudinal sample. We hypothesized a higher SRLE and a weaker obsolescence would be concomitants of higher perceived generativity. We also hypothesized that generativity would exhibit intraindividual fluctuation over time, which should relate to intraindividual fluctuation in the respective concomitants. Using multilevel modeling, several concomitants of generativity were investigated. The sample consisted of 518 German participants (aged 18–88 years) who took part in at least two of four measurement waves of the Ageing-as-Future online study spanning over 6 years. There was no mean-level increase or decrease in generativity over the 6-year study period. Despite this absence of linear time trends, individual perceived generativity still fluctuated considerably over time. The model showed that higher individual average SRLE and lower individual average psychological obsolescence resulted in higher average perceived generativity. Individual fluctuations in those constructs coincided likewise, implying that when individual SRLE increased and individual obsolescence decreased between two time points, perceived generativity tended to increase as well. There were significant quadratic, but no linear age effects. The findings suggest that perceived generativity depends not only on chronological age but several other time-related factors. Based on such results, we discuss implications for interventions and future research.

Keywords Subjective remaining life expectancy · Psychological obsolescence · Generativity

Introduction

The concept of generativity, as first introduced in Erik Erikson's *Eight Stages of Man* (Erikson, 1950), has stimulated much research on the possible positive outcomes of developing an “interest in establishing and guiding the next generation” (Erikson, 1950, p. 231) across midlife and old age. While Erikson considered generativity to be a critical phase in the adult course of life (mostly middle to late adulthood), more recent approaches suggest that generativity reflects a construct that depends on contextual influences which may occur at various life phases, and which may also

undergo change in the course of adulthood (McAdams & de St. Aubin, 1992; Kim et al., 2017). When reaching old age and considering leaving something behind or passing one's knowledge on to other people, adults may become aware of the scarcity of time left in life, and what can be achieved. Thus, changes in generativity may also be associated with time-related constructs that reflect an individual's lifetime position in relation to her or his end of life.

Consolidating the image of generativity as a lifelong endeavor involving both perceived and behavioral components, McAdams and de St. Aubin (1992) introduced the Loyola Generativity Scale (LGS), six items from this scale were used in the current study. Using extensive MIDUS data (Midlife in the United States), Einolf (2014) came to the conclusion that LGS scores are stable over long periods of time but can undergo small fluctuations. As opposed to Erikson's suggestion that life events such as marriage or parenthood may determine generativity, Einolf (2014) did not find that family status was related to higher LGS scores in a ten-year longitudinal sample. Rothrauff and Cooney (2008) concluded

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that there were no differences between parents and childless adults regarding the relationship between generativity and psychological well-being. Nonetheless, there are several studies reporting generativity as an age-related construct, usually with an inverted u-shaped relation implying higher generativity in midlife (Nelson & Bergeman, 2020, 2021).

We expect generativity and the desire to leave a trace after one's death to be depending on time-related experience because this often involves a perception of the passage of time and of running out of time. The concept of time left in life has been operationalized with several psychological constructs such as *Future Time Perspective* (FTP) and *Subjective Remaining Life Expectancy* (SRLE). For instance, Lang and Carstensen (2002) reported the prioritization of emotion-related goals in participants with limited FTP, which usually occurs when individuals start realizing the finiteness of their lives. SRLE was observed to be associated with life decisions and planning (Brandtstädter, 2009), for example housing relocations (Beyer et al., 2017) and engaging in preparatory activities for late life (Kim-Knauss & Lang, 2021; Kornadt et al., 2018). Perceived time left in life is a key factor for the commitment to one's environment and has been studied in different settings across all ages (e.g., school students in Peetsma, 2000; older employees in Zacher & Frese, 2009). In our research, we explored the associations between SRLE and perceived generativity. Being generative is in itself a form of commitment to one's social surroundings, therefore having a higher SRLE should coincide with perceiving more opportunities for generativity. In return, noticing an opportunity to be generative might expand a formerly limited SRLE.

Shorter time horizons have also been reported to coincide with an accelerated experience of time (John & Lang, 2015). Considering the previous ten years, Wittmann and Lehnhoff (2005) found an accelerated experience of time in older participants compared to younger ones. According to this study, time passed slowly during childhood and then sped up until the age of 50, after which the impression of time passing quickly remained. John and Lang (2015) reported an accelerated time experience when planning on accomplishing tasks the next day, this effect was stronger in older participants. They argued that with accelerated time perception, individuals might prioritize actions with short-term benefits over those with long-term benefits. Individuals with shorter time horizons could perceive everyday time as accelerated and thus as a limited resource, leading to the prioritization of short-term over long-term benefit activities, the latter including generativity. Perceiving time progression as slower might hence indicate a wider time horizon (equal to a higher SRLE) and therefore result in higher generativity.

According to the Theory of Socioemotional Selectivity (SST; Carstensen et al., 1999), different goals are prioritized depending on the perception of time left in life. In this context, Carstensen et al. (1999) differentiated between

knowledge- and emotion-related goals. Although those categories are not completely disjunct, individuals with a more constraint time horizon tend to choose emotion-related goals over knowledge-related ones. While generative actions often require a person's knowledge or the desire to pass that knowledge on to others, we think of generativity goals as mainly emotion-related (Lang & Carstensen, 2002). Chu et al. (2018) reported more generativity goals in participants with a shorter (induced) time horizon, supporting our placement of generativity within the emotion category.

Another predictor of perceived generativity might be psychological obsolescence. The construct of obsolescence has been defined in different ways in various fields of behavioral and cognitive research. While some focus on comparing one's skills, knowledge or capabilities to colleagues working in the same field (Ferdinand, 1966; Shearer & Steger, 1975), others describe it as "a decline over time in the validity or utility of information" (Line & Sandison, 1974, p. 283). In the context of our study, we define *psychological obsolescence* as a sense of falling out of time or not being able to keep up with the pace of the world around oneself (according to Brandtstädter & Wentura, 1994). Such feelings can heavily influence an individual's outlook on life (Rothermund & Brandtstädter, 2003). Whereas mostly researched in the workplace (Allen & Grip, 2012; Burke, 1969), obsolescence is also relevant for many other aspects of life. For example, role changes like the transition from adolescence to adulthood (as described in Lenz, 2001) can spark feelings of no longer fitting a group of younger people or not being able to participate anymore. When kids move out, parents may experience an *empty nest* (Borland, 1982; Mitchell & Lovegreen, 2009), the same thing may also happen to grandparents when their grandchildren grow out of feeling a need for them to serve as playmate, companion, supervisor, or mentor. Unrelated to successive generations, feelings of obsolescence can occur as a result of the increased loss of abilities that might come with old age (Lachman & Agrigoroaei, 2010). Furthermore, abilities can become outdated, e.g., due to new inventions and products or rapid changes in the cultural or social environment. The resulting perceptions of not being needed anymore, being left behind, or no longer having anything useful to give may reduce the effort that one puts into behaving generative. Alternatively, finding and taking opportunities for generativity might reduce feelings of obsolescence. Specifically, being generative might allow an individual to feel needed, appreciated, and able to contribute.

Present Research

When speaking of generativity, most studies refer to self-reported generativity. Operationalizations like the Loyola Generativity Scale (McAdams & de St. Aubin, 1992)

define generativity to be subjective as it depends on the individuals' perception of their own actions and feelings. Consequently, we refer to this construct as *perceived generativity*. The counterpart, behavioral generativity, consists of non-subjective information, for instance being a parent or working as a teacher.

Based on the theories and findings mentioned above, we expect that the individual's perceived generativity fluctuates over time. Furthermore, we suggest that overall levels of perceived generativity are related to overall levels of psychological obsolescence, and SRLE. Since generativity and these concomitants all change over the course of life, we hypothesize that they fluctuate interdependently.

Method

Sample

Participants included 518 German adults who took part in the Ageing-as-Future online study at least twice during the four measurement waves (t1–t4, two-year time intervals between 2012 and 2018). New participants were invited for participation via social media advertisement, flyers, newsletters and posts on websites designated for older adults. Previous participants and participants from related studies were invited via e-mail. Participants were offered monetary compensation in the form of Amazon vouchers or bank transfers (10–25€) and could choose to donate their compensation to charity. Questionnaires were conducted via LimeSurvey and SoSci Survey (t4 only).

The sample used in the following analyses consists of 334 woman and 184 men. Table 1 gives a detailed overview of participations. The mean age was 48.07 years ($SD = 18.52$) with a range from 18 to 88 years at the first participation. 42.1% were younger than 45 years, 35.9% were between 45 and 64 years and 22.0% were 65 years or older. 38.0% lived alone, 36.1% were married and 51.0% had one or more children. 70.1% of the participants had at least the German equivalent to a high school diploma. A more detailed description of the study and sample can be found in Rupprecht and Lang (2020).

Measures

Perceived Generativity was measured with six items from the Loyola Generativity Scale (LGS; McAdams & de St. Aubin, 1992): (1) "I try to pass along the knowledge I have gained through my experiences," (2) "I do not feel that other people need me" (reversely coded), (3) "People come to me for advice," (4) "I have important skills that

Table 1 Number of participants over all four measurement waves

Measurement wave	Number of participants
t1	305
t2	350
t3	401
t4	410
t1 & t2	251
t1 & t3	208
t1 & t4	218
t1 & t2 & t3	180
t1 & t3 & t4	176
t1 & t2 & t3 & t4	150
t2 & t3	259
t2 & t4	254
t2 & t3 & t4	208
t3 & t4	338

I try to teach others," (5) "I feel as though my contributions will exist after I die," and (6) "In general, my actions do not have a positive effect on other people" (reversely coded). Only six items of the 20 LGS items were used for reasons of parsimony. Items were chosen based on face validity in order to best represent the variety of generative concern. Participants answered each item on a scale from 1 (*does not apply at all*) to 7 (*applies very much*). Internal consistencies assessed with Cronbach's alpha were acceptable and ranged from minimum .74 (third measurement wave) to maximum .81 (first measurement wave). In order to ensure that the items apply to all ages, we calculated measurement invariance using three age groups (under 45 years, 45 to 64 years, 65 and older). The six items achieved acceptable measurement invariance [$\chi^2 (df = 37, N = 518) = 94.69, p = .484; CFI = 0.96; RMSEA = 0.08, CI_{90\%} (0.06, 0.11)$].

Subjective Remaining Life Expectancy (SRLE) was calculated by subtracting the current age from the participant's expected lifetime, assessed by the question "To what age do you expect to live?". Expected lifetime was slightly correlated with both chronological age ($r = .19, p < .001$) and subjective health ($r = .22, p < .001$). Higher scores of SRLE reflect that respondents perceive to have more time left in life, whereas lower scores reflect a more limited time left in life.

For *Psychological Obsolescence*, three items by Brandtstädter and Wentura (1994) were used: "I have increasingly less sympathy for the views of the younger generation," "I increasingly feel that I have lost touch with today's time," and "It is becoming increasingly difficult for me to deal with today's way of life." Every item was rated on a scale from

Table 2 Means, standard deviations, and correlations averaged over all four measurement waves

Variable	<i>M</i>	<i>SD</i>	1	2	3	4	5	6	7
1. Age	48.07	18.52							
2. Expected Lifetime	83.48	10.22	.21**						
3. Gender (Female)	1.64	0.48	.00	.07					
4. Parenthood	0.51	0.50	.66**	.18**	-.02				
5. Social Satisfaction	5.33	1.24	.10*	.19**	.05	.11*			
6. SRLE	33.57	18.70	-.87**	.26**	.01	-.56**	.00		
7. Obsolescence	2.09	0.74	-.12**	-.22**	-.10*	-.16**	-.37**	.00	
8. Generativity	5.04	0.87	.11*	.23**	.09*	.27**	.33**	.01	-.41**

M and *SD* are used to represent mean and standard deviation, respectively. Expected Lifetime was assessed by the question “To what age do you expect to live?”

SRLE subjective remaining life expectation. *Indicates $p < .05$. **Indicates $p < .01$. The correlation between age and obsolescence should be handled with caution. The actual relationship between age and obsolescence is a quadratic correlation ($r = -.15$, $p < .001$), meaning that midlife adults reported higher obsolescence than younger or older adults did

1 (*does not apply at all*) to 5 (*applies completely*). Internal consistencies for these items ranged from minimum .67 (second measurement wave) to maximum .76 (first measurement wave). The three items achieved acceptable measurement invariance across the aforementioned age groups [χ^2 ($df = 4$, $N = 518$) = 2.75, $p = .601$; $CFI = 1.00$; $RMSEA = 0.00$, $CI_{90\%}$ (0.00, 0.00)].

To measure *Social Satisfaction*, we combined two items that asked about satisfaction with relationships with family and friends (as in Lang & Carstensen, 2002, and Rupprecht & Lang, 2020). The questions “How satisfied are you with your relationship to your family?” and “How satisfied are you with your network of friends?” were each answered on a scale from 1 (*not at all satisfied*) to 7 (*very satisfied*). For every individual, a mean score was calculated of both those answers, indicating the individual’s satisfaction with their close social environment. The two items correlated lowest in the first ($r = .34$, $p < .001$) and highest in the last measurement wave ($r = .46$, $p < .001$).

Parenthood was measured by the single question “How many (biological) children do you have?” and was recoded to a binary level (children or no children). Additionally, we considered *Marital Status*, *Living Situation*, *School Education Level*, and *Subjective Health* as possible covariates of generativity. The first two variables were each recoded to a binary level, therefore only providing information on whether the participant was married or was living alone. For school education, participants could choose between several German graduation levels, the highest achieved was to be checked. The higher the value, the longer the participant stayed in school. Subjective health was measured by the question “How would you describe your current health?”. Participants answered on a 5-point Likert scale, 1 being *bad* and 5 being *excellent*. For all variables in this paragraph, we used the information provided during the earliest available measurement point for each participant.

Statistical analyses were conducted using R (version 4.1.0; R Core Team, 2021), especially the packages *lme4* (Bates et al., 2015) and *lmerTest* (Kuznetsova et al., 2017).

Results

Table 2 gives an overview on means, standard deviations, and correlations among the constructs. Overall, mean perceived generativity was higher in older adults, women, parents, and individuals with higher social satisfaction. Higher perceived generativity coincided with less obsolescence but showed no significant correlation with SRLE. On average, participants reported relatively high social satisfaction and perceived generativity, whereas they scored relatively low on the obsolescence scale. For the following analyses, all interval-scaled variables were mean centered. The intraclass correlation coefficients for generativity and SRLE were moderate (both $ICC = .64$, $p < .001$) and high for obsolescence ($ICC = .93$, $p < .001$).

Inter- and intraindividual variance in perceived generativity were analyzed with a multilevel model defining individuals on Level 2 and the two to four measurement points nested within individuals on Level 1. Sixty-four percent of variance in generativity was observed between individuals, 36% of variance was observed within individuals. Generativity thus fluctuated considerably within individuals over the 6 years of the study period.

A linear time trend did, however, neither reach significance ($\gamma^1 = -0.02$, $p = .271$) nor did it change the variance components and was thus added to the null model (Table 3). Including a random slope for time (Table 4)

¹ γ is a common term used for regression coefficients in multilevel modeling, see Hair & Fávero (2019).

Table 3 Unstandardized regression coefficients (γ), significance levels, standard errors and t values for all variables in different models predicting perceived generativity

Level and variable	Null model			Model with interindividual covariates			Model with interindividual predictors			Model with intraindividual predictors		
	γ	se	t values	γ	se	t values	γ	se	t values	γ	se	t values
Level 2												
Intercept	5.07***	(0.05)	111.08	5.19***	(0.06)	88.74	5.18***	(0.06)	91.84	5.15***	(0.06)	89.94
Age				-0.01*	(0.00)	-2.16	0.00	(0.00)	1.08	0.01	(0.00)	1.17
Age ²				-0.00**	(0.00)	-3.10	-0.00**	(0.00)	-3.00	-0.00**	(0.00)	-3.02
Gender (Female)				0.14	(0.07)	1.91	0.09	(0.07)	1.34	0.09	(0.07)	1.38
Parenthood				0.52***	(0.09)	5.61	0.47***	(0.09)	5.32	0.47***	(0.09)	5.29
Subjective Health				0.08*	(0.04)	2.13	0.00	(0.04)	0.07	0.00	(0.04)	0.09
Social Satisfaction				0.21***	(0.03)	7.27	0.14***	(0.03)	4.93	0.14***	(0.03)	4.95
SRLE							0.01**	(0.00)	3.19	0.01**	(0.00)	3.19
Obsolescence							-0.30***	(0.05)	-6.16	-0.30***	(0.05)	-6.16
Level 1												
Time	-0.02	(0.02)	-1.10	-0.01	(0.02)	-0.55	-0.01	(0.01)	-0.51	0.02	(0.02)	0.93
SRLE										0.01**	(0.00)	2.99
Obsolescence										-0.14***	(0.04)	-3.62
Variance components												
Interindividual variance	0.61			0.46			0.41			0.42		
Intraindividual variance	0.34			0.34			0.34			0.33		
Additional Info												
ΔR^2 between				24.3%			32.8%			-		
ΔR^2 within				-			-			2.4%		
ΔR^2 total				15.6%			21.2%			21.7%		

SRLE subjective remaining life expectation.*Indicates $p < .05$. **Indicates $p < .01$. ***Indicates $p < .001$. Individual average scores were used as predictors on level 2, intraindividual deviations from these average scores were used as predictors on level 1

There was a significant correlation between age and SRLE ($r = -.87$, $p < .001$). All VIF values were below 10, the highest values were for age ($VIF = 5.39$) and SRLE ($VIF = 4.86$). By omitting age from the model, there was no change in which variables had significant effects. By omitting SRLE from the model, the age effect turned out to be significant ($\gamma = -.01^*$, $SE = 0.00$). As there were no problems with running the model including all variables, we chose to keep both constructs in the model. For interpretation of the results, SRLE might be a more valuable predictor than age as it seems to explain the effect

did not improve the model fit which indicates that there is no evidence for consistent linear increase or decrease on an intraindividual level. As there was no random slope for time, testing interactions with the time effect (e.g., obsolescence*time) would not allow for meaningful results (Heisig & Schaeffer, 2019). Furthermore, intercorrelations of generativity (Table 5) indicate high rank-order stability and over-time consistency. Correlations for the 2-year intervals ranged from .64 to .69, 4-year intervals related .61 or .67 to each other. The 6-year interval between first and last measurement wave showed the highest correlation with .70, indicating long-term stability in generativity. There was no mean-level linear rise or decline in generativity over the course of the 6-year study on the sample level and the individual level. Nonetheless, the high amount of intraindividual variance in generativity indicates meaningful non-linear, intraindividual fluctuations in generativity over time.

In a second step, we added demographic and non-demographic covariates to the model. Marital status, living situation, and school education did not show significant effects and were excluded from further analyses for reasons of parsimony. There was a linear age effect ($\gamma = -0.01$, $p = .032$) and a quadratic effect for age ($\gamma = -0.00$, $p = .002$). There were no gender differences ($\gamma = 0.14$, $p = .057$). Generativity levels related positively to being a parent ($\gamma = 0.52$, $p < .001$) as well as better self-rated health ($\gamma = 0.08$, $p = .033$) and higher social satisfaction ($\gamma = 0.21$, $p < .001$). ΔR^2 increased by 15.6% compared to the null model.

Interindividual Predictors

After adding interindividual predictors to the model, the linear age effect was no longer significant, neither was subjective health. The quadratic age effect remained significant,

Table 4 Regression coefficients (γ), significance levels, and standard errors for all variables in different models predicting perceived generativity

Level and variable	Model with residualized age	
Level 2		
Intercept	5.13***	(0.07)
Age	0.01	(0.00)
Age ²	- 0.00**	(0.00)
SRLE	0.01**	(0.00)
Gender (Female)	0.10	(0.07)
Parenthood	0.46***	(0.09)
Subjective Health	0.00	(0.04)
Social Satisfaction	0.14***	(0.03)
Obsolescence	- 0.31***	(0.05)
Level 1		
Time	0.02	(0.02)
SRLE	0.01**	(0.00)
Obsolescence	- 0.14***	(0.04)

SRLE subjective remaining life expectation. Individual average scores were used as predictors on level 2, intraindividual deviations from these average scores were used as predictors on level 1

Table 5 Means, standard deviations, and correlations of generativity across all four measurement waves

Variable	M	SD	t1	t2	t3
t1	5.24	1.05			
t2	4.96	0.94	.69**		
t3	4.92	0.91	.67**	.66**	
t4	5.12	1.00	.70**	.61**	.64**

M and SD are used to represent mean and standard deviation, respectively. t1=2012, t2=2014, t3=2016, t4=2018. *Indicates $p < .05$. **Indicates $p < .01$

though, indicating generativity to be highest in middle adulthood ($\gamma = - 0.00, p = .003$). Being a parent remained associated with higher average generativity ($\gamma = 0.47, p < .001$). Among the interindividual predictors, a higher average social satisfaction ($\gamma = 0.14, p < .001$) was related to higher generativity, meaning that individuals with higher generativity were likely to be more satisfied with their social environment. Generativity was associated with higher SRLE ($\gamma = 0.01, p = .002$) and lower average perceived obsolescence ($\gamma = - 0.30, p < .001$) over the measurement points. ΔR^2 increased by 5.6% compared to the previous model, and this increase was fully due to the addition of SRLE and obsolescence.

Intraindividual Predictors

In the next step, we included fluctuations in the aforementioned constructs as intraindividual predictors. The effects

mirrored those of the interindividual predictors reported above. When SRLE increased between two time points, so did generativity ($\gamma = 0.01, p = .003$); when participants experienced lower feelings of obsolescence, generativity was higher as well ($\gamma = - 0.14, p < .001$). ΔR^2 increased by 0.5% compared to the previous model. However, 2.4% of the intraindividual variance were explained by the intraindividual predictors.² To address the possible intercorrelation of SRLE and age, we calculated this final model four further times: (1) including age, age², expected lifetime, and SRLE as predictors, (2) only age and age², (3) only SRLE, (4) only expected lifetime, and (5) age² and expected lifetime together as predictors (all other model components remaining unchanged, Table 6). SRLE partly accounts for the age effect on generativity. When including age in the model, both components of age (linear and squared) had a significant effect. Only the linear but not the quadratic component of this effect disappeared when we included SRLE as well.³ Expected Lifetime had a stand-alone effect that appeared significant both on its own and in combination with age. The disappearance of the linear age effect in combination with SRLE but not with expected lifetime indicates that SRLE combines the variance explanation of age and expected lifetime in a meaningful construct of subjective remaining lifetime. We conclude that while there remains a correlation after building one variable from the other, this does not seem to have a strong effect in the final model.

Discussion

Average perceived generativity was continuously and positively related to perceiving more time left in life and to feeling less obsolete in everyday life. Over the 6 years of the study, there was no evidence for linear increase or decrease in generativity, but individual levels of perceived generativity still varied non-linearly across waves. Intraindividual predictors indicated that these fluctuations in generativity related to fluctuations among the hypothesized concomitants. Generativity increased when SRLE increased and when psychological obsolescence decreased.

² Final model:
 Outcome = $\gamma_{00} + \gamma_{10}SRLE_{it} + \gamma_{20}OBSCOLESCENCE_{it} + \gamma_{30}TIME_{it} + \gamma_{01}SRLE_i + \gamma_{02}OBSCOLESCENCE_i + \gamma_{03}AGE_i + \gamma_{04}AGE^2_i + \gamma_{05}GENDER_i + \gamma_{06}PARENTHOOD_i + \gamma_{07}HEALTH_i + \gamma_{08}SOCIAL_SATISFACTION_i + u_{0i} + r_{it}$

γ_{10} up to γ_{30} refer to Level 1 variables, γ_{01} up to γ_{08} refer to Level 2 variables.

Neither a random slope for time, nor interactions between time and the predicting variables improved the model fit.

³ Aside from AGExAGE (the described age² effect), no other interaction effects were significant.

Table 6 Regression coefficients (γ), significance levels, and standard errors for all variables in different models predicting perceived generativity

Level and variable	Original model		Model including age, expected lifetime and SRLE		Model including age only		Model including expected lifetime only		Model including SRLE only		Model including age and expected lifetime	
Level 2												
Intercept	5.15***	(0.06)	5.18***	(0.06)	5.17***	(0.06)	5.06***	(0.04)	5.06***	(0.04)	5.18***	(0.06)
Age	0.01	(0.00)	- 0.01*	(0.00)	- 0.01*	(0.00)					- 0.01**	(0.00)
Age ²	- 0.00**	(0.00)	- 0.00**	(0.00)	- 0.00**	(0.00)					- 0.00**	(0.00)
Expected Lifetime			- 0.00	(0.00)			0.01*	(0.04)			0.01**	(0.00)
SRLE	0.01**	(0.00)	0.01	(0.00)					0.01***	(0.00)		
Gender (Female)	0.09	(0.07)	0.09	(0.07)	0.10	(0.07)	0.11	(0.07)	0.11	(0.07)	0.09	(0.07)
Parenthood	0.47***	(0.09)	0.47***	(0.09)	0.47***	(0.09)	0.35***	(0.07)	0.54***	(0.08)	0.47***	(0.09)
Subjective Health	0.00	(0.04)	0.03	(0.04)	0.04	(0.04)	0.04	(0.04)	0.01	(0.04)	0.01	(0.04)
Social Satisfaction	0.14***	(0.03)	0.14***	(0.03)	0.15***	(0.03)	0.13***	(0.03)	0.14***	(0.02)	0.14***	(0.03)
Obsolescence	- 0.30***	(0.05)	- 0.31***	(0.05)	- 0.32***	(0.05)	- 0.32***	(0.05)	- 0.32***	(0.05)	- 0.31***	(0.05)
Level 1												
Time	0.02	(0.02)	- 0.00	(0.02)	- 0.00	(0.02)	- 0.00	(0.02)	- 0.00	(0.02)	- 0.00	(0.02)
SRLE	0.01**	(0.00)										
Obsolescence	- 0.14***	(0.04)	- 0.15***	(0.04)	- 0.15***	(0.04)	- 0.15***	(0.04)	- 0.15***	(0.04)	- 0.15***	(0.04)

SRLE subjective remaining life expectation. Individual average scores were used as predictors on level 2, intraindividual deviations from these average scores were used as predictors on level 1

There was no mean-level rise or decline in generativity over the course of the 6 year study. However, we found evidence for meaningful fluctuations and heterogeneous patterns of change over the six measurement points (e.g., some individuals' generativity went up and down, while others' increased or decreased). Our models showed that these fluctuations can partially be explained by effects in SRLE and psychological obsolescence.

Both SRLE and psychological obsolescence were significant predictors of perceived generativity on an inter- as well as on an intraindividual level. Our sample showed a positive correlation between higher SRLE (equaling a wider time horizon) and higher generativity. While a shorter SRLE may raise the desire to be generative, this can also coincide with some obstacles in acting out such desire. Especially no longer being in good health may make it more difficult to engage in some forms of generative behavior and was thus found to be related with a shorter SRLE in previous studies (Deeg et al., 2021; Griffin et al., 2013). Severe health conditions might also influence the relationship between SRLE and age. The relationship between SRLE and chronological age seems to be mostly consistent. There are a few outliers, mostly younger people with lower than average SRLE. Many of those individuals reported their health to be either "poor" or "bad."

Taking a closer look at the items chosen from the LGS, the short 6-item measure may reflect concerns for others in a wider time horizon, including symbolic immortality, rather than emotion-regulative aspects of generativity that

were hypothesized in the introduction to this paper. This suggests that on top of the emotion-related aspect of generativity, there are other facets to this construct such as future-oriented and productive goals. Our short scale may weigh heavier on those dimensions than on the emotion-related aspect. Future research needs to better differentiate possible subdimensions of generativity such as symbolic immortality, caring for others, or passing on one's knowledge. There have been numerous approaches to measure specific aspects of generativity, from generative behavior (McAdams & de St. Aubin, 1992) to the three dimensions of *generativity in life retrospect*, *parental generativity*, and *current generativity* (Schoklitsch & Baumann, 2011). A more recent one considers prosocial attitudes and social responsibility (Morselli & Passini, 2015).

Furthermore, our observation of the association between SRLE, psychological obsolescence and perceived generativity may offer a possible pathway to develop an intervention strategy that aims to promote generative concerns and goals. A renown existing generativity intervention is the *Baltimore Experience Corps Trial* (Gruenewald et al., 2016) which demonstrated that intergenerational civic engagement influences generativity. With their volunteer program, Gruenewald et al. (2016) addressed a social component as well as obsolescence. Our multilevel model including intraindividual predictors supports this theory; when obsolescence decreased, generativity tended to increase. As generativity correlates with well-being (Grossbaum & Bates, 2002; Huta & Zuroff, 2007; Newton et al., 2020), an increase in generativity might have a positive influence on other parts of

one's life as well. Based on such findings, we suggest that the predictors in our model may play a role as antecedents of generativity, but no causal relationship can be assumed based on such data. Although being generative can lead to increased social satisfaction or less feelings of obsolescence as previously discussed, we expect the reverse relation to be somewhat more plausible. There are many influential aspects that can support or inhibit generativity on their own as well as interactions with others. As there is no conclusive framework of generativity, uncovering these relations offers many possibilities for future research.

Psychological obsolescence is a phenomenon which seems to occur when physical abilities and social embeddedness decrease, as is often the case at the end of life. Our sample showed a negative quadratic relation between age and obsolescence, indicating highest obsolescence for midlife adults. As previously described by phenomena like the *empty nest*, midlife can be a time of many changes. When accommodating such changes, the individual might undergo phases of obsolescence. As there are many other times in life where one can feel left behind, this is a mere speculation and requires further research.

Our findings do not allow to conclude any causal relationships between the variables. Therefore, we can only make assumptions about what is antecedent and what is consequent. In order to address some of the suggestions for future research, a causal approach could be a good fit for further studies on this topic.

Chronological age showed a smaller association with perceived generativity than many of the other concomitants. Above and beyond parenthood, social satisfaction, SRLE, and psychological obsolescence were associated with perceived generativity in our participants. As there was no significant linear age trend and only a weak quadratic age effect in our study—and the somewhat ambiguous results in previous work (McAdams et al., 1993)—stronger generativity might be less depending on one's chronological age, but more on other demands associated with the previously mentioned SRLE and psychological obsolescence. Future research should take a closer look on physical health, cultural aspects, and the individual's social environment or living situations.

Limitations

There are a few caveats that should be considered when interpreting the findings of this study. While the course of 6 years of this study provides some opportunities for change in one's life circumstances, a longer follow-up period may offer more insights regarding possible long-term change or stability of generativity. This may also vary depending on one's position in life: For instance, a young adult in their early 20s will probably finish their education,

move from place to place, start working, and meet their partner. A parent in their 40s with a permanent position in their line of work might experience fewer opportunities for change in a 6-year frame. Erikson's definition of generativity (Erikson, 1950) included major life events as a trigger to changes in generative behavior. Getting married, having children or losing a loved one can change one's outlook on life and hence influence the desire to leave something behind or to give back to society. Such changes in life may contribute to intraindividual fluctuations in generativity. Unfortunately, our study does not provide data on such events, yet future research might provide insights on this possible relation. Furthermore, the state of one's health varies over time, just like social embeddedness does. For example, a major health threat could increase generativity, losing a friend group might decrease opportunities to show generative behavior. Future research should therefore incorporate a closer look at fluctuating impact factors like health, social satisfaction, or major life events. Psychological obsolescence might even have a mediating effect in this context as it may change the perceived gravity of change in those factors.

The LGS used to assess generativity only includes self-report. Therefore, it is not possible to reflect about how these results could transfer to generative behavior. However, we submit that our measure of LGS reflects some of the central facets of generative concern which has been shown to contribute to positive aging outcomes such as life satisfaction (Adams-Price et al., 2018) and health (Gruenewald et al., 2012).

Furthermore, we assessed parenthood with the question "How many (biological) children do you have?" For the purpose of our study, the wording may have been unfortunate as it excludes fostered or adopted children.

It still is controversial whether there exists a strong link between generativity and educational level. While some studies reported a positive correlation (McAdams, 2001), others found no such indications (Hart et al., 2001). In the present study, only school education (up to a high school diploma) was used which showed no significant effects. Based on this result and the inconsistency of previous studies, we suggest that these effects may develop later in life, depending on vocational training or university degrees as well as the kind of employment. Future studies may want to investigate the relations between higher education, certain professions, and generativity.

As argued above, generativity may also depend on culture. Future research may put our findings to the test in different cultures. Last but not least, there could be a possible sample bias. Taking part in research questionnaires and studies could be viewed as a generative act per se; hence, mean levels of generativity in the sample could be higher than mean levels in the general population. This opens the

question whether the reported effects only occur in individuals with higher baseline generativity.

Conclusion

Perceived generativity showed much stability over the course of a 6-year study in an age-heterogeneous sample of adults from 18 to 88 years. Parenthood and social satisfaction were associated with higher mean levels of perceived generativity. However, there was also fluctuation in perceived generativity on the intraindividual level that occurred together with concomitant changes in SRLE and psychological obsolescence. Considering the relatively small age effects and the fact that chronological age cannot be experimentally manipulated, we suggest that both cultural resources and personal outlook on life are also relevant for perceived generativity, which points to opportunities for developing generativity interventions.

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Declarations

Conflict of interest The authors have no competing interests to declare that are relevant to the content of this article.

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References

- Adams-Price, C. E., Nadorff, D. K., Morse, L. W., Davis, K. T., & Stearns, M. A. (2018). The creative benefits scale: Connecting generativity to life satisfaction. *International Journal of Aging and Human Development*, 86(3), 242–265. <https://doi.org/10.1177/0091415017699939>
- Allen, J., & de Grip, A. (2012). Does skill obsolescence increase the risk of employment loss? *Applied Economics*, 44(25), 3237–3245. <https://doi.org/10.1080/00036846.2011.570727>
- Bates, D., Mächler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*. <https://doi.org/10.18637/jss.v067.i01>
- Beyer, A., Rupperecht, R., & Lang, F. R. (2017). Subjektive restlebenszeit und vorsorgende Umzugsplanung in der zweiten Lebenshälfte. *Zeitschrift Für Gerontologie Und Geriatrie*, 50, 194–199. <https://doi.org/10.1007/s00391-016-1025-1>
- Borland, D. C. (1982). A cohort analysis approach to the empty-nest syndrome among three ethnic groups of women: A theoretical position. *Journal of Marriage and the Family*, 44(1), 117. <https://doi.org/10.2307/351267>
- Brandtstädter, J. (2009). Entwicklungspsychologie der Lebensspanne: Entwicklungslinien und Perspektiven. In G. Krampen (Ed.), *Hogrefe eLibrary. Psychologie—Experten als Zeitzeugen* (pp. 110–122). Hogrefe.
- Brandtstädter, J., & Wentura, D. (1994). Veränderungen der Zeit- und Zukunftsperspektive im Übergang zum höheren Erwachsenenalter: Entwicklungspsychologische und differentielle Aspekte. *Zeitschrift Für Entwicklungspsychologie Und Pädagogische Psychologie*, 26(1), 2–21.
- Burke, R. J. (1969). Effects of aging on engineer's satisfactions and mental health: Skill obsolescence. *Academy of Management Journal*, 12(4), 479–486. <https://doi.org/10.5465/254736>
- Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist*, 54(3), 165–181. <https://doi.org/10.1037/0003-066X.54.3.165>
- Chu, Q., Grünh, D., & Holland, A. M. (2018). Before I die: The impact of time horizon and age on bucket-list goals. *GeroPsych*, 31(3), 151–162. <https://doi.org/10.1024/1662-9647/a000190>
- Deeg, D. J. H., Timmermans, E. J., & Kok, A. A. L. (2021). Capturing subjective age, subjective life expectancy, and their links with older adults' health: The Dutch longitudinal aging study Amsterdam. *Journal of Aging and Health*, 33(7–8), 633–644. <https://doi.org/10.1177/08982643211004001>
- Einolf, C. J. (2014). Stability and change in generative concern: Evidence from a longitudinal survey. *Journal of Research in Personality*, 51, 54–61. <https://doi.org/10.1016/j.jrp.2014.04.003>
- Erikson, E. H. (1950). *Childhood and society*. Norton.
- Ferdinand, T. N. (1966). On the obsolescence of scientists and engineers. *American Scientist*, 54(1), 46–56.
- Griffin, B., Loh, V., & Hesketh, B. (2013). A mental model of factors associated with subjective life expectancy. *Social Science and Medicine*, 1982(82), 79–86. <https://doi.org/10.1016/j.socscimed.2013.01.026>
- Grossbaum, M. F., & Bates, G. W. (2002). Correlates of psychological well-being at midlife: The role of generativity, agency and communion, and narrative themes. *International Journal of Behavioral Development*, 26(2), 120–127. <https://doi.org/10.1080/01650250042000654>
- Gruenewald, T. L., Liao, D. H., & Seeman, T. E. (2012). Contributing to others, contributing to oneself: Perceptions of generativity and health in later life. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 67(6), 660–665. <https://doi.org/10.1093/geronb/gbs034>
- Gruenewald, T. L., Tanner, E. K., Fried, L. P., Carlson, M. C., Xue, Q.-L., Parisi, J. M., Rebok, G. W., Yarnell, L. M., & Seeman, T. E. (2016). The Baltimore experience corps trial: Enhancing generativity via intergenerational activity engagement in later life. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 71(4), 661–670. <https://doi.org/10.1093/geronb/gbv005>
- Hair, J. F., Jr., & Fávero, L. P. (2019). Multilevel modeling for longitudinal data: Concepts and applications. *RAUSP Management Journal*, 54(4), 459–489. <https://doi.org/10.1108/RAUSP-04-2019-0059>
- Hart, H. M., McAdams, D. P., Hirsch, B. J., & Bauer, J. J. (2001). Generativity and social involvement among African Americans

- and White Adults. *Journal of Research in Personality*, 35(2), 208–230. <https://doi.org/10.1006/jrpe.2001.2318>
- Heisig, J. P., & Schaeffer, M. (2019). Why you should always include a random slope for the lower-level variable involved in a cross-level interaction. *European Sociological Review*, 35(2), 258–279. <https://doi.org/10.1093/esr/jcy053>
- Huta, V., & Zuroff, D. C. (2007). Examining mediators of the link between generativity and well-being. *Journal of Adult Development*, 14(1–2), 47–52. <https://doi.org/10.1007/s10804-007-9030-7>
- John, D., & Lang, F. R. (2015). Subjective acceleration of time experience in everyday life across adulthood. *Developmental Psychology*, 51(12), 1824–1839. <https://doi.org/10.1037/dev0000059>
- Kim, S., Chee, K. H., & Gerhart, O. (2017). Redefining generativity: Through life course and pragmatist lenses. *Sociology Compass*, 11(11), e12533. <https://doi.org/10.1111/soc4.12533>
- Kim-Knauss, Y., & Lang, F. R. (2021). Late-life preparedness and its correlates: A behavioral perspective on preparation. *The Journals of Gerontology Series B, Psychological Sciences and Social Sciences*, 76(8), 1555–1564. <https://doi.org/10.1093/geronb/gbaa088>
- Kornadt, A. E., Voss, P., & Rothermund, K. (2018). Subjective remaining lifetime and concreteness of the future as differential predictors of preparation for age-related changes. *European Journal of Ageing*, 15(1), 67–76. <https://doi.org/10.1007/s10433-017-0426-3>
- Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2017). lmerTest package: Tests in linear mixed effects models. *Journal of Statistical Software*. <https://doi.org/10.18637/jss.v082.i13>
- Lachman, M. E., & Agrigoroaei, S. (2010). Promoting functional health in midlife and old age: Long-term protective effects of control beliefs, social support, and physical exercise. *PLoS One*, 5(10), e13297. <https://doi.org/10.1371/journal.pone.0013297>
- Lang, F. R., & Carstensen, L. L. (2002). Time counts: Future time perspective, goals, and social relationships. *Psychology and Aging*, 17(1), 125–139. <https://doi.org/10.1037/0882-7974.17.1.125>
- Lenz, B. (2001). The transition from adolescence to young adulthood: A theoretical perspective. *The Journal of School Nursing : The Official Publication of the National Association of School Nurses*, 17(6), 300–306. <https://doi.org/10.1177/10598405010170060401>
- Line, M. B., & Sandison, A. (1974). Progress in documentation. *Journal of Documentation*, 30(3), 283–350. <https://doi.org/10.1108/eb026583>
- McAdams, D. P. (2001). Generativity in midlife. In M. E. Lachman (Ed.), *Handbook of midlife development* (pp. 395–443). John Wiley.
- McAdams, D. P., & de St. Aubin, E. (1992). A theory of generativity and its assessment through self-report, behavioral acts, and narrative themes in autobiography. *Journal of Personality and Social Psychology*, 62(6), 1003–1015. <https://doi.org/10.1037/0022-3514.62.6.1003>
- McAdams, D. P., de St. Aubin, E., & Logan, R. L. (1993). Generativity among young, midlife, and older adults. *Psychology and Aging*, 8(2), 221–230. <https://doi.org/10.1037/0882-7974.8.2.221>
- Mitchell, B. A., & Lovegreen, L. D. (2009). The empty nest syndrome in midlife families. *Journal of Family Issues*, 30(12), 1651–1670. <https://doi.org/10.1177/0192513X09339020>
- Morselli, D., & Passini, S. (2015). Measuring prosocial attitudes for future generations: The social generativity scale. *Journal of Adult Development*, 22(3), 173–182. <https://doi.org/10.1007/s10804-015-9210-9>
- Nelson, N. A., & Bergeman, C. (2020). Generativity development across adulthood: A longitudinal investigation. *Innovation in Aging*. <https://doi.org/10.1093/geroni/igaa057.1496>
- Nelson, N. A., & Bergeman, C. S. (2021). Development of generative concern across mid- to later life. *The Gerontologist*, 61(3), 430–438. <https://doi.org/10.1093/geront/gnaa115>
- Newton, N. J., Chauhan, P. K., & Pates, J. L. (2020). Facing the future: Generativity, stagnation, intended legacies, and well-being in later life. *Journal of Adult Development*, 27(1), 70–80. <https://doi.org/10.1007/s10804-019-09330-3>
- Peetsma, T. T. D. (2000). Future time perspective as a predictor of school investment. *Scandinavian Journal of Educational Research*, 44(2), 177–192. <https://doi.org/10.1080/713696667>
- R Core Team. (2021). *R [Computer software]*. R Foundation for Statistical Computing.
- Rothermund, K., & Brandtstädter, J. (2003). Depression in later life: Cross-sequential patterns and possible determinants. *Psychology and Aging*, 18(1), 80–90. <https://doi.org/10.1037/0882-7974.18.1.80>
- Rothrauff, T., & Cooney, T. M. (2008). The role of generativity in psychological well-being: Does it differ for childless adults and parents? *Journal of Adult Development*, 15(3–4), 148–159. <https://doi.org/10.1007/s10804-008-9046-7>
- Rupprecht, F. S., & Lang, F. R. (2020). Personal ideals of aging and longevity: The role of subjective discordances. *Psychology and Aging*, 35(3), 385–396. <https://doi.org/10.1037/pag0000455>
- Schoklitsch, A., & Baumann, U. (2011). FraGen—Fragebogen zur Generativität. <https://doi.org/10.23668/PSYCHARCHIVES.413>
- Shearer, R. L., & Steger, J. A. (1975). Manpower obsolescence: A new definition and empirical investigation of personal variables. *Academy of Management Journal*, 18(2), 263–275.
- Wittmann, M., & Lehnhoff, S. (2005). Age effects in perception of time. *Psychological Reports*, 97(3), 921–935. <https://doi.org/10.2466/pr0.97.3.921-935>
- Zacher, H., & Frese, M. (2009). Remaining time and opportunities at work: Relationships between age, work characteristics, and occupational future time perspective. *Psychology and Aging*, 24(2), 487–493. <https://doi.org/10.1037/a0015425>

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