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On the edge: The association between extreme values of proportional felt-age and functioning

Yuval Palgi^{a,*}, Liat Ayalon^b, Sharon Avidor^c, Dikla Segel-Karpas^a, Ehud Bodner^{d,e}

^a Department of Gerontology and the Center for Research and Study of Aging, University of Haifa, Mount Carmel, Israel

^b Louis and Gabi Weisfeld, School of Social Work, Bar Ilan University, Ramat-Gan 5290002, Israel

^c School of Social and Community Sciences, Ruppin Academic Center, Emek Hefer 4025000, Israel

^d The Interdisciplinary Department of Social Sciences, Bar-Ilan University, Ramat-Gan 5290002, Israel

^e The Department of Music, Bar-Ilan University, Ramat-Gan 5290002, Israel

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ABSTRACT

The present study examined whether endorsing a felt-age that is extremely divergent from one's actual age (whether older or younger) is related to worse functioning four years later.

Data were drawn from 4938 participants, who completed the 2008 and 2012 questionnaires of the Health-and-Retirement-Study (HRS). Participants were divided into four groups according to their reported proportional-felt-age: the normative-young ($N = 2229$), reported a normative felt-age at the median or younger; normative-old ($N = 2226$), reported normative felt-age at the median and older; and the extremely young and extremely old proportional-felt-age (upper and lower 5% of felt-age; N 's = 242 and 241, respectively). These groups were compared on chronic medical conditions, depressive symptoms, activities of daily living (ADL), instrumental activities of daily living (IADL), functional limitations, and loneliness.

While extremely younger proportional-felt-age participants did not reveal worse (or better) outcomes compared with the normative-young group, extremely old proportional-felt-age participants reported worse physical health, mental health, and functioning in cross-sectional, as well as longitudinal comparisons. Extreme values of older proportional-felt-age are usually not reported randomly and reflect less adaptive adjustment. The findings underscore the importance of studying participants at the extreme values of felt-age, especially extreme old proportional-felt-age, and the need for further inspection of the mechanisms underlying these evaluations.

1. Introduction

While it may be reasonable to think that a realistic sense of one's age, e.g., a perceived felt-age that is consistent with chronological age, is adaptive, the gerontological literature suggests otherwise. After the age of 25, most individuals report a younger felt-age than their chronological age (Rubin and Berntsen, 2006), suggesting that this commonly found disparity between the two measures of age might be adaptive during the adult life-span (for an exception, see Segel-Karpas and Palgi, 2018). Indeed, a younger felt-age is related to better adaptation and functioning (Kornadt et al., 2018) and even to lower rates of mortality (Kotter-Grühn et al., 2009). At the other end of this continuum, older felt-age may represent a psychological sign of adverse, or accelerated aging processes (Avidor et al., 2014). Felt-age therefore typifies a self-perception that is associated with a more general system related to adjustment to the aging process (Diehl et al., 2014). In the literature, the notion of felt age is sometimes referred to as

subjective age, or age identity. While these terms may be used interchangeably, in the present study we use the term proportional felt-age, due to the operational measurement of this variable as the difference between one's felt age and one's chronological age.

The ability to maintain a younger age identity may be conceptualized as a way to create a positive psychological environment that protects one's identity from age-related threats like the stigma attached to older age (Avidor et al., 2017; Shmotkin, 2005), and to maintain a sense of control across the lifespan, particularly when growing older (Keyes and Westerhof, 2012). In the same vein, younger felt-age is related to better functioning whereas older felt-age is related to deteriorations in functioning in the second half of life (Shrira et al., 2014). Despite these endeavors, it is still unclear whether this pattern is indeed ubiquitous. Particularly, the question still remains whether this pattern also applies to those whose felt-age scores consist of extreme values, that is, those who evaluate themselves as extremely younger or extremely older than their chronological age.

* Corresponding author.

E-mail address: ypalgi@research.haifa.ac.il (Y. Palgi).

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The main aim of this study, then, is to explore whether extreme old or young felt-age values represent authentic, deliberately exaggerated values that researchers should refer and inquire into.

1.1. Extreme values of felt-age

From a statistical viewpoint, outliers are traditionally considered as erroneous, anomalous observations, that one should consider removing from the data (Hodge and Austin, 2004). To the best of our knowledge, the outliers of felt-age were always treated as extraneous data and in most studies these participants were excluded from analyses (e.g., Stephan et al., 2015). Contrary to outliers, extreme values are considered as valid evaluations that are either very high or low. In line with the literature (Field, 2017; Hodge and Austin, 2004; Stephan et al., 2015) we decided to differentiate outliers from extreme values by referring to outliers as an anomalous observation which signifies an error, and to extreme values as a legitimate part of the distribution which may be explained by other mechanisms. In other words, we wanted to examine if participants with extreme values of felt-age differ from participants with normal values of felt-age in terms of the study's dependent variables. Thus, in the present study we have chosen to examine extreme values of felt-age, and not to take them for arbitrary or mistaken outlying data, but rather as an authentic evaluation that is within the distribution of the data. Furthermore, it is assumed that individuals who report these values do so intentionally, and not due to other causes, such as cognitive deterioration (Field, 2017). Therefore, we explore the extreme evaluations of felt-age, and attempt to consider the consequences of the seemingly inflated or exaggerated evaluations of those who, in their seventies report feeling as if they are in their twenties or, conversely, as if they are centenarians.

While the motivations behind these extreme evaluations are unknown, one cannot assume that they are inherently similar to the more normative, often-found reports of felt-age that deviate from one's chronological age by smaller increments. Thus, we suggest the possibility that these phenomena of extreme values in felt-age scores may consist of two different mechanisms. An extreme younger felt-age may result from the denial of one's aging, due to internalized stereotypes related to older adults. While participants with an extremely younger felt-age may base their evaluations on good physical health, their drastically young subjective evaluation of their age may reflect poorer mental health and/or worse social functioning (e.g., more loneliness) as compared to those with a normal-young felt-age. An extreme older felt-age, on the other hand, may be an indication of physical or psychological accelerated aging processes and therefore is expected to be related to worse physical and mental health, physical functioning limitations and disabilities, and worse social functioning.

1.2. Physical health, mental health, physical functioning and social functioning

Older adults have to cope with changing and often deteriorating physical health, which might also have mental and social implications (Alpass and Neville, 2003). Indeed, it has been found that when older adults cannot avoid a negative change in their experienced physical health or in their emotions they tend to report an older felt-age (Kotter-Grühn et al., 2015; Palgi et al., 2017). It has also been found that physical limitations and disabilities were associated with feeling relatively older (Infurna et al., 2010; Shrira et al., 2014). Additionally, feeling older might be related to experiencing a greater risk for social isolation and loneliness (Ayalon et al., 2016), and to suffering from the negative psychological aspects of feeling alone, which are associated with a sustained decrease in well-being (Shankar et al., 2015). However, older adults can cope effectively with these risks if they accept to a considerable degree the deterioration in their physical and mental health and in their physical functioning (i.e., feel only slightly younger than their actual age – about a decade younger, which is within normal

range; Rubin and Berntsen, 2006). In this way they may prepare themselves to spend more time by themselves, or by adjusting to changes in their social network. Thus, coming to terms with one's older age may lead to better preparedness and adjustment in the face of age-related losses (Segel-Karpas and Palgi, 2018). A felt age that is considerably younger or older, on the other hand, might hinder one's ability to adjust to age-related changes.

The present study examines those who deviate by extreme scores in their self-perceptions of felt-age, perhaps due to difficulties in adaptively accepting the changes that occur throughout their aging process. We specifically refer to individuals who report feeling extremely younger or older in proportion to their chronological age. Drawing on the literature on the psychological notions of denial, self-deception, or positive illusions, we see the variations in felt-age as resulting from a favorable mechanism that helps the individual to better adapt to the environment, unless it is used in an extreme manner (Kortte and Wegener, 2004). Therefore, our first hypothesis is that individuals who evaluate their proportional felt-age as extremely younger or older, will report poorer outcomes relating to physical and mental health, physical limitations and disabilities, as well as greater loneliness. Our second hypothesis is that these effects of extreme felt-age will predict lower functioning over a period of four years.

2. Methods

2.1. Participants and procedure

We used data from the 2008 and 2012 Leave-behind Questionnaire (LB) of the Health and Retirement Study (HRS). The HRS is a biannual survey of health, assets, employment, and retirement administered to a representative sample of US citizens over the age of 50. The LB Questionnaire addresses psychosocial aspects including attitudes and beliefs. It is administered as a self-completion measure to half the sample every other wave, so that every four years, the same half-sample completes the LB questionnaire.

A total of 8269 respondents were eligible to complete the LB in 2008. Of these, 6857 completed and returned the questionnaire by mail and 100 returned it by phone. Using χ^2 analyses, those who completed the LB were more likely to be men (40.3% vs. 32.1%, $\chi^2(8267, 1) = 33.27, p < 0.01$) and married (65.2% vs. 54.0%, $\chi^2(8267, 1) = 61.23, p < 0.001$) compared with those who did not complete the LB. The present study concerns those individuals who responded to the question about their felt-age ($N = 5454$). As cognitive disorders may impair one's evaluation of felt-age, we first compared those who reported on cognitive decline or problems (reported memory loss or memory-loss related prescriptions in 2008, and dementia or Alzheimer's disease in 2012; $N = 355$) to the rest of our sample. These comparisons showed that they did not differ in their gender (60.6%_{women} vs. 57.5%_{women}, $\chi^2(5454, 1) = 1.36, p = 0.133$), but were significantly older ($M[SD] = 73.74 [10.66]$ vs. $M[SD] = 67.52[9.52]$, $t[5452] = 11.80, p < 0.001$), fewer of them were married (64.6% vs. 50.7%, $\chi^2[5454, 1] = 27.55, p < 0.001$), had a lower education level ($M[SD] = 1.77 [1.50]$ vs. $M[SD] = 2.24[1.52]$, $t[5437] = 5.97, p < 0.001$) and had a lower proportional felt-age ($M[SD] = 0.10[0.21]$ vs. $M[SD] = 0.16[0.18]$, $t[5452] = 5.97, p < 0.001$) compared with those without reported cognitive disease or problems. Therefore, we decided to omit participants who reported on cognitive disease or problems from our sample. After omitting those who reported having cognitive disease or problems, as well as those who were under the age of 50 ($N = 105$), we were left with 4994 participants. In the next step we omitted those who were statistically considered outliers (Hoaglin and Iglewicz, 1987). In our data we located 56 outlier observations in total, as will be further elaborated in the description of data analyses. After omitting these data, we were left with 4,938 participants. In order to have enough participants with extreme values we used the broad definition for the upper and lower 5% as extreme values

(see, Field, 2017). Following these steps, we created four research groups:

- 1) Those classified as having an extremely younger proportional felt-age (upper 5% proportional felt-age; $n = 242$), with an average proportional felt-age of 0.50, meaning they perceived themselves as 50% younger than their age and their average felt-age was $M = 32.79$, $SD = 6.37$.
- 2) Those classified as normative-young subjective age group, between the median and the upper 5% ($n = 2229$), with an average proportional felt-age of 0.26, meaning they perceived themselves as 26% younger than their age, and their average felt-age was $M = 50.07$, $SD = 7.94$ in the first wave.
- 3) Those classified as normative-old subjective age group, between lower 5% and the median, with an average proportional felt-age of 0.07 ($n = 2226$), meaning they perceived themselves as 7% younger than their age, and their average felt-age was $M = 64.79$, $SD = 6.20$ in the first wave.
- 4) The remaining respondents were classified as having an extremely older proportional felt-age (lower 5% proportional felt-age; $n = 241$) with an average proportional felt-age of -0.16 , meaning they perceived themselves as 16% older than their age, and their average felt-age was $M = 73.58$, $SD = 11.09$ in the first wave.
- 5 Detailed information regarding the distribution of covariates and demographic variables is presented in Table 1.

2.2. Measures

2.2.1. Felt-age

Respondents were asked 'what age do you feel? Participants' replies were within the range of 0 and up to 165 with an average felt-age of $M = 56.97$, $SD = 13.72$. After omitting outliers and those with self-reported cognitive disease or problems, participants' felt-age ranged between 16 and 100 with an average felt-age of $M = 57.01$, $SD = 12.93$.

2.2.2. Proportional felt-age

Felt-age was subtracted from respondents' chronological age and divided by their chronological age to generate an overall estimate of proportional felt-age (see Jaconelli et al., 2017). Using this procedure, we could control for chronological age variance. A higher score indicates a younger felt-age and vice versa.

2.2.3. Reported chronic physical conditions

Respondents were asked whether or not a physician had told them that they suffered from one or more of eight chronic conditions (e.g.,

arthritis, diabetes, heart condition, cancer, lung disease). The sum of all possible physical conditions was calculated to indicate the number of chronic medical conditions, with a higher score indicating more physical health problems (Bodner et al., 2017).

2.2.4. Mental health functioning

Mental health was measured by a nine-item version of depressive symptoms from the Center for Epidemiologic Studies Depression (CES-D; Geisser et al., 1997). The CES-D was administered as part of the core interview to assess depressive symptoms over the past week, (1 = yes/0 = no for the experience of a depressive symptom). We calculated a total score after reverse-coding appropriate items. The score ranged between 0 and 9, such that higher scores indicated greater depressive symptoms. Kuder–Richardson's ρ was 0.80 and 0.79 in 2008 and 2012 respectively.

2.2.5. Loneliness

Eleven items were used to assess loneliness (Hughes et al., 2004). Respondents were asked about the portion of the time they felt a lack of companionship, left out, isolated from others etc., using a three-point response scale. Responses were averaged so that a higher score represents greater loneliness. Cronbach's alpha was 0.88 and 0.87 in 2008 and 2012 respectively.

Difficulties in activities of daily living (ADL), were measured by counting the sum of difficulties (dichotomized into 1 = not having difficulties, vs. 2 = having difficulties) in basic activities of daily living (ADL; adapted from Katz et al., 1970). Participants reported on difficulties in six activities: dressing, crossing a small room, bathing, getting in or out of bed, eating, and toileting. Higher scores represented more difficulties in ADL. Internal reliability for ADL measured by Kuder–Richardson's ρ was 0.63 and 0.70 in 2008 and 2012 respectively.

Difficulties in instrumental activities (IADL), were measured by counting the sum of difficulties (dichotomized into 1 = not having difficulties vs. 2 = having difficulties) in instrumental activities of daily living (IADL; Lawton and Brody, 1969). Participants reported on difficulties in seven instrumental activities which included difficulties in using a map, preparing meals, daily shopping, using the telephone, taking medications, doing housework, and handling personal finances. Internal reliability for IADL according to Kuder–Richardson's ρ was 0.58. and 0.65 in 2008 and 2012 respectively.

Functional limitations were assessed by an adaptation of Nagi's (1976) instrument. This measure consists of twelve items (dichotomized into 1 = not having difficulties vs. 2 = having difficulties) describing physical activity. The participants reported if they are able to perform tasks such as walking 1 mile, pulling or pushing heavy objects,

Table 1
Demographic and covariate characteristic of the study groups in 2008.

	1. Extremely young PFA (N=242)	2. Normative young PFA (N=2229)	3. Normative old PFA (N=2226)	4. Extremely old PFA (N=241)	χ^2 test, F test, & Scheffe test.
Age, M (SD)	66.60 (8.45)	67.40 (8.65)	69.33 (9.13)	63.51 (8.81)	$F(4934, 3) = 42.70$ $1 \neq 3^{***}, 4^{**}; 2 \neq 3, 4^{***};$ $3 \neq 4^{***}$
Gender (women, N,%)	135 (55.8)	1377 (61.8)	1307 (58.7)	150 (62.2)	$\chi^2(N=4938, 3) = 6.77,$ $p = .081$ $\chi^2(N=4938, 3) = 8.16^*$
Marital status (married, N, %)	138 (57.0)	1453 (65.2)	1452 (65.2)	147 (61.0)	
Education M (SD)	2.12 (1.53)	2.38 (1.51)	2.17 (1.53)	1.85 (1.44)	$F(4921, 3) = 13.31$ $2 \neq 3, 4^{***}; 3 \neq 4^*$
Immediate recall	5.44 (1.84)	5.69 (1.65)	5.33 (1.73)	5.17 (2.04)	$F(4934, 3) = 19.94$ $2 \neq 3, 4^{***}$
Serial 7	3.55 (1.53)	3.93 (1.33)	3.93 (1.31)	3.68 (1.44)	$F(4488, 3) = 7.09$ $1 = 2, 3^{**}$

Note: $N = 4938$. PFA = proportional felt age.

* $p < 0.05$,
** $p < 0.01$,
*** $p < 0.001$.

and climbing stairs. The sum score ranged from 0 to 12, with a higher score indicating better functioning. Kuder–Richardson’s ρ was 0.67 and 0.67 in 2008 and 2012 respectively.

2.2.6. Demographic data

Age, gender, marital status (married/partnered vs. not) and education (classified to seven categories: 0 = preprimary education, 1 = primary education, 2 = lower secondary education, 3 = upper secondary education, 4 = post-secondary education, 5 = first tertiary education, and 6 = second stage tertiary education; ISCED-97, United Nations Educational, Scientific and Cultural Organization, 1997), were gathered based on self-report.

2.2.7. Covariates

In addition, we controlled for memory and executive cognitive functioning measures, immediate recall and serial 7. The immediate recall test examines a recall of 10 words. The serial 7s test requires participants to subtract 7 from 100, 93, 86 and so on, testing their working memory. Every subtraction adds one point up to 5. Higher scores on these measures were associated with a lower likelihood of cognitive impairment (Crimmins et al., 2011). For further information see Table 1.

2.3. Data analysis

In order to calculate the statistical outliers we used Tukey’s (1977) formula for outlier observations: $FL - k(Fu - FL)$ and $Fu + k(Fu - FL)$. Fu and FL represent the upper and lower quartiles of the sample, respectively. In the present study we used the suggested parameter $k = 2.2$ (Hoaglin and Iglewicz, 1987). This calculation leads to the omission of 56 participants, about 0.05–0.06% of the present samples. We assessed differences between the outliers and the samples of extreme values in their respective correlations of subjective age with the study variables. Whereas the correlations in the extremely older group were consistent and positive, those in the older subjective age outlier group were negative and less consistent in their pattern. Fischer’s z tests for the significance of the differences between the correlations revealed that the correlations significantly differed (except for physical health and IADL). When examining differences in the correlations among young outliers and extreme young values, no systematic direction was found. In some cases the correlations of the outliers were higher, and in others those of extreme values, and the differences between correlations were not significant (except for loneliness). These findings may indicate that old subjective age outliers reveal different patterns of mental and physical

health outcomes from those who reported extreme values. This difference may not necessarily exist, however, between extreme young subjective age values and young outliers. Following these findings we decided to omit these outlier values, for theoretical and practical purposes. Although the participants omitted in this process do not necessarily represent random or arbitrary values, we nonetheless used this method out of caution, similar to our decision to omit participants with cognitive problems from our analyses. Theoretically, this may serve to differentiate between potential outliers and extreme values.

For the purpose of testing the first hypothesis, a Multivariate Analysis of Covariance (MANCOVA) was performed to assess differences in functioning between the four categories of proportional felt-age. For the purpose of testing the second hypothesis, six separate Univariate ANCOVAs were conducted, examining differences between the proportional felt-age categories in 2008 in physical health, depressive symptoms, loneliness, ADL, IADL and functional limitations in 2012. Control variables were age, gender, education, marital status, and memory and executive cognitive functioning. In addition, for the purpose of testing the second hypothesis, we controlled for each dependent variable in 2008. All independent variables and covariates were standardized.

3. Results

3.1. Preliminary results

There was a strong correlation between one’s proportional felt-age in 2008 and 2012, $r = 0.53$, $p < 0.001$. Moreover, comparing the proportional felt-age groups measured in 2008 shows significant differences between all groups and their continuous level of proportional felt-age in 2012. Those who reported a normative-old proportional felt-age in 2008 ($M = -0.18$, $SD = 0.43$), reported significantly older proportional felt-age in 2012, than the normative-young and the extreme-young proportional felt-age ($M = 0.22$, $SD = 0.46$; $M = 0.61$, $SD = 0.66$, respectively) and younger than the extreme older proportional felt-age group ($M = -0.54$, $SD = 0.54$; $F(3, 3946) = 392.54$, $p < 0.001$).

Participants from the extreme-older proportional felt-age group in 2008, were younger than the normative-old, normative-young and the extreme-younger proportional felt-age group. For further information see Table 1.

Table 2
Functioning differences in 2008 according to division to proportional felt-age groups.

	Total	1.Extremely young PFA	2.Normative young PFA	3.Normative old PFA	4.Extremely old PFA	F test, Partial η^2 & Bonferroni test.
Chronic physical health	2.42(1.22)	2.27(1.18)	2.31(1.21)	2.47(1.22)	2.95(1.36)	$F = 16.96$, $\eta^2 = 0.02$ 1 \neq 4***; 2 \neq 4***; 3 \neq 4***
Depressive symptoms	1.94(2.14)	1.56(1.82)	1.63(1.97)	2.010(2.11)	3.78(2.65)	$F = 151.31$, $\eta^2 = 0.05$ 1 \neq 3**, 4***; 2 \neq 3,4***; 3 \neq 1***, 2, 4***
Loneliness	1.51(0.42)	1.50(0.41)	1.46(0.41)	1.52(0.42)	1.82(0.48)	$F = 31.90$, $\eta^2 = 0.03$ 1 \neq 4***; 2 \neq 3,4***; 3 \neq 4***
ADL	0.25(0.69)	0.21(0.63)	.17(0.56)	0.29(0.73)	0.59(1.02)	$F = 19.73$, $\eta^2 = 0.02$ 1 \neq 4***; 2 \neq 3**,4***; 3 \neq 4***
IADL	0.12(0.45)	0.07(0.25)	0.07(0.34)	0.13(0.49)	0.40(0.74)	$F = 27.28$, $\eta^2 = 0.03$ 1 \neq 4***; 2 \neq 3*,4***; 3 \neq 4***
NAGI	3.78(2.35)	3.43(2.35)	3.37(2.17)	3.93(2.36)	5.653(2.43)	$F = 52.77$, $\eta^2 = 0.05$ 1 \neq 4***; 2 \neq 3,4***; 3 \neq 4***

Note: $N = 2891$. PFA = proportional felt age. Multivariate analysis of covariance (MANCOVA) was calculated to assess differences across the four categories of felt-age. The results are controlled by age, gender, marital status, education, immediate recall and serial 7 covariates. The multivariate statistic of Wilks Lambda for proportional felt age groups was $\Lambda = 0.90$, $F = 16.80$ ***

* $p < 0.05$,
** $p < 0.01$,
*** $p < 0.001$.

Table 3
Functioning differences in 2012 according to division to proportional felt-age at 2008.

	Total	1.Extremely young PFA	2.Normative young PFA	3.Normative old PFA	4.Extremely old PFA (4)	Difference test
Chronic physical health	2.39(1.41)	2.11(1.34)	2.24(1.39)	2.51(1.39)	3.11(1.50)	$F(3, 4468) = 6.84, \eta^2_{\text{partial}} = 0.01, 1 \neq 4^{***}; 2 \neq 4^{***}; 3 \neq 4^{***}$
Depressive symptoms	1.68(2.04)	1.32(1.77)	1.40(1.87)	1.81(2.06)	3.67(2.53)	$F(3, 4407) = 22.91, \eta^2_{\text{partial}} = 0.02, 1 \neq 4^{***}; 2 \neq 3^*; 4^{***}; 3 \neq 4^{***}$
Loneliness	1.48(0.41)	1.50(0.42)	1.42(0.40)	1.51(0.40)	1.75(0.49)	$F(3, 3864) = 4.73, \eta^2_{\text{partial}} = 0.004, 2 \neq 3, 4^*$
ADL	0.46(0.95)	0.52(1.05)	0.32(0.80)	0.50(0.99)	0.86(1.22)	$F(3, 2485) = 7.72, \eta^2_{\text{partial}} = 0.01, 2 \neq 4^{***}; 3 \neq 4^{**}$
IADL	0.17(0.57)	0.16(0.52)	0.12(0.48)	0.20(0.60)	0.47(0.86)	$F(3, 4465) = 8.90, \eta^2_{\text{partial}} = 0.01, 1 \neq 4^*; 2 \neq 4^{***}; 3 \neq 4^{***}$
NAGI	3.11(2.77)	2.49(2.79)	2.69(2.59)	3.38(2.80)	5.31(2.88)	$F(3, 4466) = 5.96, \eta^2_{\text{partial}} = 0.004, 1 \neq 4^{**}; 2 \neq 4^{***}; 3 \neq 4^{**}$

Note: Six separate Univariate Analysis of Variance was calculated to assess differences across the four categories of proportional felt-age. The result presented are after controlling for age, gender, marital status, education, memory and executive cognitive functioning (immediate memory, and serial 7). In addition, we controlled for the dependent variable as measured in 2008.

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$.

3.2. Main results

In order to examine the first hypothesis, we conducted a cross-sectional analysis regarding the characteristics of the sample in 2008. Table 2 shows that, supporting the hypothesis, compared to the three other groups, the extreme-older proportional felt-age group had more chronic physical health problems, more depressive symptoms, felt lonelier, had higher levels of ADL, IADL and more physical limitations.

The extreme-young group did not differ in any of the variables from the normal-young group. The normal-young group functioned better than the normal-old groups in all variables except for chronic physical health problems, where no differences were found between the groups.

Regarding the second hypothesis, similar results were found when predicting the same functional variables four years later in 2012. Table 3 presents the results of six separate univariate ANCOVAs, controlling for demographics, and memory and executive cognitive functioning, as well as for each dependent variable as measured in 2008.

Participants from the extreme-older proportional felt-age group had lower levels of functioning in all variables compared to the normal proportional felt-age groups and compared to the extreme-young proportional felt-age group in chronic physical health problems, depressive symptoms, IADL and physical limitations. The extreme-young proportional felt-age group did not differ in any of the variables from the normal-young proportional felt-age group. Compared with those who were classified as reporting normal-young proportional felt-age, those who had a normal-old proportional felt-age had higher levels of depressive symptoms and loneliness.

To sum, the results show that even four years later, those who report extremely old proportional felt-age functioned worse than those who reported normal proportional felt-age. In addition, those who reported normal-old proportional felt-age, functioned worse in most variables compared to those who reported normal-young proportional felt-age. No significant differences in functioning were found between the normal-young proportional felt-age group and the extreme-young proportional felt-age group.

4. Discussion

This study examined the phenomenon of extreme evaluations that individuals give regarding their felt-age. The main aim of our investigation was to explore whether these extreme old or young proportional felt-age values that are not statistical outliers, reflect authentic, deliberately exaggerated values that researchers should inquire into. The fact that the proportional felt-age groups in 2008 predicted

significant differences in the level of proportional felt age in 2012, suggests that an extreme evaluation of felt-age is conceptually reliable, and represents a coping mechanism the individual holds across time when coping with one's aging process. Although future studies are needed to better understand this mechanism, the present results offer a first glimpse to the fascinating ways that the entire continuum of age perceptions interrelates with adjustment throughout the second half of life.

Feeling extremely older than one's chronological age was related to worse chronic physical conditions, worse mental health, more physical limitations and disabilities and less social functioning. This was found in a cross-sectional analysis, and also in a longitudinal analysis, carried out four years later. Additionally, those who reported extremely older proportional felt-age, were on average chronologically younger than the other felt-age groups. A possible explanation for this finding is that individuals who suffer health-related losses or deteriorations in their social conditions relatively early in life (referred to as "off time" experiences in gerontological research; Neugarten, 1976), perceive their aging process as precipitated. Since these processes are reciprocal in nature, they may in turn enhance the perception of extreme-older proportional felt-age. This effect may represent the accelerated psychological and physical aging process that is a concomitant of an older felt-age (Avidor et al., 2014). Moreover, it might imply that those reporting extreme and relatively unrealistic proportional older felt-age are perhaps aware that they are experiencing the first signs of physical age-related deterioration. Such an awareness of one's physical deterioration may lead to a pessimistic representation of oneself in the future, as reflected in an extremely older proportional felt-age. This, in turn, drives toward lowered activity levels and resignation, and might even become recursively the reason for negative late-life health behaviors and for health deterioration (Frazier and Hooker, 2006). It is of note that almost all participants in this group had worse functioning than the normal-old proportional felt-age group, suggesting that this group is at higher risk for functional deterioration.

As for extremely young proportional felt-age, our findings show no significant differences between this group and the other normative groups (except for lower depressive symptoms than the normative-old group in the cross-sectional examination). It seems that reporting on extreme-young felt-age, is not related directly to worsened functioning as hypothesized. With that, these participants did not demonstrate any functioning or health advantages as compared to those reporting normal-young proportional felt-age. This may suggest that feeling younger is not invariably a predictor of more favorable outcomes, such as in the present case of extreme values. Taking the present results

together, there is likely no place for making the distinction between extremely younger proportional felt-age and normative-young felt-age, as it seems that both groups rely on adaptive psychological mechanisms related to younger felt-age (Shrira et al., 2014). These mechanisms may differ between the two groups, however, and it is possible that the extreme-young proportional felt-age group relies more heavily on psychological denial, but their adaptability is generally similar to the normal-young proportional felt-age group. Finally, and in line with previous studies, those in the normal-young group reported better functioning than those in the normal-old proportional felt-age group. This result is in accordance with similar, often-found patterns reported in the literature (Kornadt et al., 2018).

While the present findings are based on a study with several merits, including the fact that it was longitudinal in nature, and drew on a representative sample of the older population in the US, several caveats should be noted. First, as this is the first time, to the best of our knowledge, that the relationship between extreme values of proportional felt-age and future physical health, mental health, physical limitations, disabilities and social functioning measures were examined, future replications are needed in order to generalize from these results. Furthermore, the study relied on self-report measures, which may have been subject to some response bias. Lastly, while the present study concerned observations of extreme values of felt-age, and omitted other extreme values that were statistical outliers, it is difficult to assess with certitude that some statistical outliers were not also valid, extreme reports of felt-age and vice versa. The deletion of statistical outliers was done as a way of cautious, in order to prevent arbitrary evaluations. Thus, relevant data may have been omitted from the present study while answers that represent measurement errors were included in it. Future studies are needed in order to shed light on the different motivations involved in self-reports of extreme felt-age as opposed to self-reported values that are outliers. A qualitative follow-up study, for example, that is based on interviews could better investigate the motives that underlie people's reports of extremely older and younger felt-age estimations.

Nonetheless, the findings of the present study contribute to the current literature on felt-age. Our findings suggest that a distinction should be made regarding the direction of extreme values of proportional felt-age. Only an extreme older proportional felt-age is associated with more impairment to one's adjustment, whereas extreme younger proportional felt-age is as adaptive as normal-young felt-age. More specifically, these findings suggest that the adaptive psychological concomitants of a younger felt-age are not restricted to those who reported normal-younger felt-age and appear also among those with extreme values of younger felt-age, even if they did not reveal any additional positive associations with physical and mental health but rather similar ones. Our findings also suggest the need for a closer inspection of the psychological characteristics and mechanisms of extremely older proportional felt-age, as these can serve as important psychological markers for predicting early signs of accelerated aging.

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References

Alpass, F.M., Neville, S., 2003. Loneliness, health and depression in older males. *Aging Ment. Health* 7, 212–216. doi.org/10.1080/1360786031000101193.

Avidor, S., Ayalon, L., Palgi, Y., Bodner, E., 2017. Longitudinal associations between perceived age discrimination and subjective well-being: variations by age and subjective life expectancy. *Aging Ment. Health* 21, 761–765. https://doi.org/10.1080/13607863.2016.1156050.

Avidor, S., Benyamini, Y., Solomon, Z., 2014. Subjective age and health in later life: the role of posttraumatic symptoms. *J. Gerontol. B: Psychol. Sci. Soc. Sci.* 71, 415–424. https://doi.org/10.1093/geronb/gbu150.

Ayalon, L., Palgi, Y., Avidor, S., Bodner, E., 2016. Accelerated increase and decrease in subjective age as a function of changes in loneliness and objective social indicators over a four-year period: results from the Health and Retirement Study. *Aging Ment. Health* 20, 743–751. https://doi.org/10.1080/13607863.2015.1035696.

Bodner, E., Ayalon, L., Avidor, S., Palgi, Y., 2017. Accelerated increase and relative decrease in subjective age and changes in attitudes toward own aging over a 4-year period: results from the Health and Retirement Study. *Eur. J. Ageing* 14, 17–27. https://doi.org/10.1007/s10433-016-0383-2.

Crimmins, E.M., Kim, J.K., Langa, K.M., Weir, D.R., 2011. Assessment of cognition using surveys and neuropsychological assessment: the Health and Retirement Study and the Aging, Demographics, and Memory Study. *J. Gerontol. B: Psychol. Sci. Soc. Sci.* 66 (suppl 1), i162–i171. doi.org/10.1093/geronb/gbr048.

Diehl, M., Wahl, H.W., Barrett, A.E., Brothers, A.F., Mische, M., Montepare, J.M., et al., 2014. Awareness of aging: theoretical considerations on an emerging concept. *Dev. Rev.* 34, 93–113. https://doi.org/10.1016/j.dr.2014.01.001.

Field, A. (2017). *Discovering Statistics Using IBM SPSS Statistics: North American Edition*. SAGE.

Frazier, L.D., Hooker, K., 2006. Possible selves in adult development: linking theory and research. In: Dunkel, C., Kerpleman, J. (Eds.), *Possible Selves: Research and Applications*. Nova Science, Hauppauge, NY, pp. 41–59.

Geisser, M.E., Roth, R.S., Robinson, M.E., 1997. Assessing depression among persons with chronic pain using the Center for Epidemiological Studies-Depression Scale and the Beck Depression Inventory: a comparative analysis. *Clin. J. Pain* 13, 163–170. https://doi.org/10.1097/00002508-199706000-00011.

Hoaglin, D.C., Iglewicz, B., 1987. Fine-tuning some resistant rules for outlier labeling. *J. Am. Stat. Assoc.* 82, 1147–1149.

Hodge, V., Austin, J., 2004. A survey of outlier detection methodologies. *Artif. Intell. Rev.* 22, 85–126. https://doi.org/10.1023/B:AIRE.0000045502.10941.a9.

Hughes, M.E., Waite, L.J., Hawkey, L.C., Cacioppo, J.T., 2004. A short scale for measuring loneliness in large surveys results from two population-based studies. *Res. Aging* 26, 655–672. https://doi.org/10.1177/0164027504268574.

Infurna, F.J., Gerstorf, D., Robertson, S., Berg, S., Zarit, S.H., 2010. The nature and cross-domain correlates of subjective age in the oldest old: evidence from the OCTO Study. *Psychol. Aging* 25, 470–476. https://doi.org/10.1037/a0017979.

Jaconelli, A., Terracciano, A., Sutin, A.R., Sarrazin, P., Raffard, S., Stephan, Y., 2017. Subjective age and dementia. *Clin. Gerontol.* 40, 106–113. https://doi.org/10.1080/07317115.2016.1187695.

Katz, S.C., Downs, T.D., Cash, H.R., Grotz, R.C., 1970. Progress in development of the index of ADL. *Gerontologist* 10, 20–30. https://doi.org/10.1093/geront/10.1_Part_1.20.

Keyes, C.L.M., Westerhof, G.J., 2012. Chronological and subjective age differences in flourishing mental health and major depressive episode. *Aging Ment. Health* 16, 67–74. https://doi.org/10.1080/13607863.2011.596811.

Kornadt, A.E., Hess, T.M., Voss, P., Rothermund, K., 2018. Subjective age across the life span: a differentiated, longitudinal approach. *J. Gerontol. B: Psychol. Sci. Soc. Sci.* 73, 767–777. https://doi.org/10.1093/geronb/gbw072.

Kortte, K.B., Wegener, S.T., 2004. Denial of illness in medical rehabilitation populations: theory, research, and definition. *Rehabil. Psychol.* 49, 187–199. https://doi.org/10.1037/0090-5550.49.3.187.

Kotter-Grühn, D., Kleinspehn-Ammerlahn, A., Gerstorf, D., Smith, J., 2009. Self-perceptions of aging predict mortality and change with approaching death: 16-year longitudinal results from the Berlin Aging Study. *Psychol. Aging* 24, 654–667. https://doi.org/10.1037/a0016510.

Kotter-Grühn, D., Neupert, S.D., Stephan, Y., 2015. Feeling old today? Daily health, stressors, and affect explain day-to-day variability in subjective age. *Psychol. Health* 30, 1470–1485. doi.org/10.1080/08870446.2015.1061130.

Lawton, M.P., Brody, E.M., 1969. Assessment of older people: self-maintaining and instrumental activities of daily living. *Gerontologist* 9, 179–186. doi.org/10.1097/00006199-197005000-00029.

Nagi, S.Z., 1976. An epidemiology of disability among adults in the United States. *Milbank Mem. Fund. Q.* 54, 439–467.

Neugarten, B.L., 1976. Adaptation and the life cycle. *Couns. Psychol.* 6, 16–20.

Palgi, Y., Ayalon, L., Avidor, S., Bodner, E., 2017. Changes in positive and negative affect as predictors of change in felt age: results from the Health and Retirement Study. *J. Posit. Psychol.* 12, 605–612. https://doi.org/10.1080/17439760.2016.1221121.

Rubin, D.C., Berntsen, D., 2006. People over forty feel 20% younger than their age: subjective age across the lifespan. *Psycho. Bull.* 132, 776–780. https://doi.org/10.1037/0096-3445.132.4.776.

Segel-Karpas, D., Palgi, Y., 2018. 'It is nothing more than a senior moment': the moderating role of subjective age in the effect of change in memory on self-rated memory. *Aging Ment. Health* 1–5. https://doi.org/10.1080/13607863.2017.1399350.

Shankar, A., Rafnsson, S.B., Steptoe, A., 2015. Longitudinal associations between social connections and subjective wellbeing in the English Longitudinal Study of Ageing. *Psychol. Health* 30, 686–698. https://doi.org/10.1080/08870446.2014.979823.

Shmotkin, D., 2005. Happiness in the face of adversity: reformulating the dynamic and modular bases of subjective well-being. *Rev. Gen. Psychol.* 9, 291–325. https://doi.org/10.1037/1089-2680.9.4.291.

Shrira, A., Bodner, E., Palgi, Y., 2014. The interactive effect of subjective age and subjective distance-to-death on psychological distress of older adults. *Aging Ment. Health* 18, 1066–1070. https://doi.org/10.1080/13607863.2014.915925.

Stephan, Y., Sutin, A.R., Terracciano, A., 2015. How old do you feel? The role of age discrimination and biological aging in subjective age. *PLoS One* 10, e0119293. doi.org/10.1371/journal.pone.0119293.

Tukey, J.W., 1977. *Exploratory Data Analysis*. Addison-Wesley, Reading, MA.

United Nations Educational, Scientific and Cultural Organisation (UNESCO), 1997. *International Standard Classification of Education 1997*. UNESCO, Geneva.