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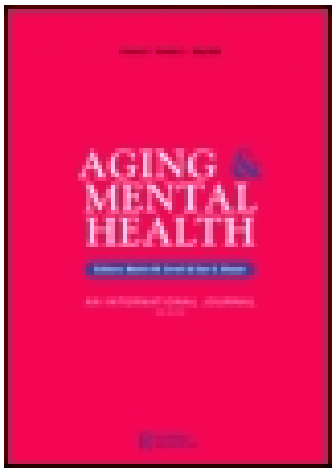

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Accelerated increase and decrease in subjective age as a function of changes in loneliness and objective social indicators over a four-year period: results from the health and retirement study

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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

Liat Ayalon[a]*, Yuval Palgi[b], Sharon Avidor[c] and Ehud Bodner[d]

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Objectives: The study examined the role of changes in loneliness and objective social indicators in the formation of changes in subjective age over a four-year period.
Methods: The Health and Retirement Study is a US nationally representative study of older adults over 50 and their spouse of any age. We restricted the sample to individuals, 65 years of age and older ($n = 2591$). An accelerated increase in subjective age was defined as an increase in subjective age over the two waves greater than five years. An accelerated decrease in subjective age was defined as a difference that was lower than three years. These were examined against a change in subjective age in the range of three to five years (i.e., change consistent with the passage of time).
Results: For 23.4% of the sample, changes in subjective age were consistent with the passage of time. A total of 38.3% had an accelerated decrease in subjective age, whereas 38.3% had an accelerated increase. A decrease in loneliness over the two waves resulted in an accelerated decrease in subjective age, whereas an increase in depressive symptoms resulted in an accelerated increase in subjective age. Changes in objective social indicators, physical difficulties or medical comorbidity did not predict changes in subjective age.
Conclusions: This is one of very few studies that examined changes in subjective age over time. Changes in subjective age represent an important construct that corresponding to other changes in subjective experiences.

Keywords: age; subjective; epidemiology; loneliness; aloneness; social relations

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Introduction

Subjective age is defined as one's perceived or felt age (Barak & Stern, 1986; Montepare, 2009). Younger individuals usually perceive themselves as older than they actually are (Galambos, Albrecht, & Jansson, 2009; Galambos, Turner, & Tilton-Weaver, 2005), whereas older individuals perceive themselves as younger than their chronological age (Choi, DiNitto, & Kim, 2014; Kaufman & Elder, 2002). Some have argued for an adaptive gap of about 13 years between chronological and subjective age. This gap is thought to have protective purposes for older adults (Kleinspehn-Ammerlahn, Kotter-Grühn, & Smith, 2008).

Interest in the concept of subjective age stems from the growing body of literature, which has identified subjective age as a risk for increased morbidity and mortality (Choi et al., 2014; Kotter-Grühn, Kleinspehn-Ammerlahn, Gerstorf, & Smith, 2009; Spuling, Miche, Wurm, & Wahl, 2013). Research has shown that older adults who hold an older subjective age are more likely to die at an earlier age compared with their peers (Kotter-Grühn et al., 2009). They also are more likely to suffer a variety of illnesses and to present with more impaired functioning, are less likely to be physically active (Caudroit, Stephan, Chalabaev, & Le Scanff, 2012) or to report emotional well-being (Mock & Eibach, 2011). Subjective age has even shown to outperform chronological age as a predictor of psychological and health-related functioning (Kotter-Grühn et al., 2009). In fact, a recent meta-analysis suggested that subjective age poses an effect on health and mortality of comparable magnitude to the effect of well-being (Westerhof et al., 2014).

Given the important role of subjective age, researchers have attempted to identify potential predictors of subjective age. A useful conceptualization of potential predictors of subjective age can be derived from Nydegger's (1986) description of general, specialized, personal, and interdependent timetables. General timetables are widely shared in society, whereas specialized timetables represent social contexts of potential effect on one's timetables, such as chronological age, socioeconomic status, or gender. Personal timetables emphasize the individual's unique experiences. For instance, subjective and objective health and well-being represent unique experiences potentially associated with one's personal timetables. Finally, interdependent timetables refer to the mutual influences between individuals' life course trajectories (Nydegger, 1986). Living with a spouse or a partner, for instance, could be one example in which individuals' lives and perceptions are interrelated.

Research on the topic of subjective age has developed extensively in the past decade. However, with a few exceptions, most studies on subjective age have relied on

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cross-sectional designs (Barak & Stern, 1986; Barrett, 2003; Choi et al., 2014; Ihira et al., 2014). Consistent with the timetable perspective (Nydegger, 1986), research has shown that lower socioeconomic status, more impaired physical difficulties, higher medical morbidity, and lower well-being are all predictors of older subjective age (Barrett, 2003; Choi et al., 2014; Ihira et al., 2014).

The importance of studying changes in subjective age

To date, we know very little about changes in subjective age over time. A Finish study of 451 individuals, conducted over an eight-year period, found that overall changes in subjective age were quite consistent with the passage of time. Nonetheless, about half of the participants showed stability in the gap between chronological and subjective age over time, whereas the remaining participants showed a decline or an increase in this gap (Uotinen, Rantanen, Suutama, & Ruoppila, 2006). A different study has also shown that on average, participants reported feeling two-thirds of a year older for every additional year lived or four-fifth of a year older, when the time metric used was time to death (Kotter-Grühn et al., 2009). Whereas reduced health, lower levels of education, and older age predicted an increase in subjective age over a four-year period, the authors found no predictors for stability in subjective age or for a reduction in subjective age over time (Markides & Boldt, 1983). Relying on a six-year longitudinal study of changes in subjective age, researchers found that a higher number of medical conditions at baseline attenuated changes in felt age discrepancy (Kleinspehn-Ammerlahn et al., 2008). A recent study has shown that changes in the discrepancy between chronological age and subjective age were associated with changes in personality (Stephan, Sutin, & Terracciano, 2014) and another longitudinal study has shown that both initial level and changes in subjective age serve as risk factors for all-cause mortality (Kotter-Grühn et al., 2009).

Subjective age is highly susceptible to changes (Stephan, Chalabaev, Kotter-Gruhn, & Jaconelli, 2013). The evaluation of changes in subjective age can tell whether one is subjectively aging faster or slower than the passage of time. It can also differentiate between a person who feels younger than his or her chronological age, but ages quickly, and another person who feels older than his or her chronological age, but ages much more slowly. Another shortcoming of past research that is addressed by the present study is the limited attention to the role of loneliness and objective social relations as potential determinants of one's perceived subjective age.

The potential role of loneliness and objective social indicators

Loneliness is defined as the perceived gap between actual social relations and desired ones (Andersson, 1998; Gierveld, 1998). Similar to subjective age, loneliness is a subjective construct, rather than an objective social phenomenon (Andersson, 1998). Although loneliness can be related to objective indicators of the social network, such as the number and frequency of actual social contacts, it is not synonymous with these indicators, but rather represents qualitative aspects of the relations (Hawkley & Cacioppo, 2010). Aloneness, in contrast, represents an objective absence of social relations (Peplau & Perlman, 1989).

With a few exceptions, the majority of past research has stressed the role of loneliness as a strong predictor of both morbidity and mortality (Fees, Martin, & Poon, 1999; Shiovitz-Ezra & Ayalon, 2010). There is a substantial body of research that has shown that high levels of loneliness serve as a major risk for cardiovascular disease (Hawkley, Masi, Berry, & Cacioppo, 2006), disability (Perissinotto, Cenzer, & Covinsky, 2012), poor sleep hygiene (Cacioppo et al., 2002), impaired cognition (Wilson et al., 2007), and impaired physical functioning (Hawkley & Cacioppo, 2010). These negative effects of loneliness are maintained even when objective social indicators are controlled for. A recent study has even suggested a plausible causal model from loneliness to morbidity and mortality, documenting the mediating role of subjective health, depressive symptoms, and functional limitations (Luo, Hawkley, Waite, & Cacioppo, 2012). Although objective indicators of social relations also play a role in determining one's health and well-being (Golden et al., 2009; Seeman, 1996), these are generally thought to exert a somewhat smaller effect compared with loneliness.

Loneliness is thought to have a U-shaped association with age. It is high in early adolescence and young adulthood, decreases in middle age and subsequently increases in old age (Pinquart & Sorensen, 2001). In contrast, a cross-sectional, cross-national study based on the European social survey found a linear association between age and loneliness, with the levels of loneliness increasing as age increases (Yang & Victor, 2011). No matter what the nature of the relationship is, there is a general agreement that among older adults, loneliness increases with age (Dykstra, van Tilburg, & Gierveld, 2005).

The increase in loneliness that occurs in old age is not surprising, given the many objective losses that take place in old age (Dykstra et al., 2005). The transition to retirement is often associated with the narrowing down of one's social network. The death of one's spouse, siblings, and close friends further result in reduced social contacts. In addition, increased disability and morbidity impair the ability of older adults to engage socially (Korporaal, Broese van Groenou, & van Tilburg, 2008; Wrzus, Hänel, Wagner, & Neyer, 2013).

The present study

An innovative aspect of the present study lies in the fact that instead of asking individuals for their subjective age once, we examine changes in subjective age over two time periods. Hence, we evaluate not only subjective age in relation to one's chronological age, but changes in subjective age in relation to the passage of time. The present study examines the potential role of changes in loneliness and objective social indicators (i.e., interdependent timetables) in determining changes in one's subjective age over time and the potential contribution of these changes to an accelerated increase vs. an accelerated decrease in subjective age. An accelerated increase in subjective age over the four-year period of the study was defined as an

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increase in subjective age that was greater than five years. An accelerated decrease in subjective age was defined as a difference in subjective age between 2012 and 2008 that was lower than three years. In contrast, a change in subjective age in the range of three to five years, over the four-year period of the study represented a balanced subjective age that was consistent with the passage of time.

It was expected that maintaining one's age (i.e., a balanced subjective age consistent with the chronological passage of time) would be more likely in the absence of changes in one's loneliness level or objective social indicators. We expected both changes in the levels of loneliness and changes in objective social indicators to be associated with changes in subjective age, with an increase in loneliness and a worsening in objective social indicators to be associated with an accelerated increase in subjective age. A decrease in loneliness and an improvement in objective social indicators, on the other hand, were expected to result in an accelerated decrease in subjective age. We controlled for specialized (e.g., age, gender, education, and employment status) and personal timetables (e.g., morbidity, physical difficulties, and depression) given their known associations with loneliness, objective social indicators, and subjective age (Dykstra et al., 2005; Golden et al., 2009; Kotter-Grühn et al., 2009; Luo et al., 2012). We also controlled for the difference between one's chronological and subjective age in 2008, because this difference has been associated a variety of health and mental health indicators (Kleinspehn-Ammerlahn et al., 2008; Westerhof & Barrett, 2005).

Methods

The Health and Retirement Study (HRS) is a biannual longitudinal US nationally representative panel survey of older adults over the age of 50 and their spouses of any age. The HRS is supported by the National Institute on Aging (NIA U01AG009740) and the Social Security Administration. The core questionnaire collects information about income, work, assets, health, and disability over a face-to-face or a phone administration. As of 2006, the HRS has added a self-administered psychosocial questionnaire to a rotating 50% of the core panel participants. The psychosocial questionnaire evaluates life satisfaction, subjective well-being, and life circumstances. This study is based on the 2008 and 2012 data, which represent a longitudinal panel of individuals who completed two waves of the psychosocial questionnaire.

In 2008, 7500 individuals were eligible to complete the psychosocial questionnaire. Of these, 6479 (86%) completed and returned the questionnaire and 97 (1.2%) completed by phone with an interviewer, 78 (1.0%) individuals were not assigned to the psychosocial questionnaire and completed it, and 846 (11.3%) individuals did not return the questionnaire. In 2012, 10,079 individuals were eligible to complete the questionnaire. Of these, 7306 (72.4%) individuals completed the questionnaire by mail, 24 (.2%) by phone with an interviewer, 82 (.8%) had the questionnaire completed by another person, and 2668 (26.5%) did not return the questionnaire.

The present study concerns those individuals, 65 years and older in 2008, who were eligible to complete both waves of the psychosocial questionnaire and provided a response to the question concerning one's subjective age perception in 2008 and 2012 ($n = 2591$). Those who responded to the subjective age question on both waves were significantly younger (mean (SD) = 73.2 (6.7)) and more educated (mean (SD) = 12.7 (2.9)) than those who did not respond to the subjective age item or responded to it only once (mean (SD) = 75.0 (7.1), $p < .001$; mean (SD) = 11.6 (3.7), $p < .001$, respectively). They also had fewer physical difficulties (mean (SD) = 2.4 (2.5)), fewer medical conditions (mean (SD) = 2.2 (1.2)), fewer depressive symptoms (mean (SD) = 1.1 (1.7)), and lower levels of loneliness (mean (SD) = 1.5 (.4)) compared with those who did not respond to the subjective age item or responded to it only once (mean (SD) = 2.9 (2.8), $p < .001$; mean (SD) = 2.3 (1.3), $p = .03$; mean (SD) = 1.6 (1.9), $p < .001$; mean (SD) = 1.6 (.4), $p < .001$, respectively).

Measures

Subjective age

Respondents indicated at what age they felt (Kastenbaum, Derbin, Sabatini, & Artt, 1972; Rubin & Berntsen, 2006). In the present study, we excluded respondents who provided extreme responses (age < 15 years or age > 120 years). A difference score was calculated between the subjective age provided in 2012 and 2008. A difference score that was between three and five years was coded as 0 = changes in subjective age are consistent with changes in the passage of time. A score difference lower than three years was coded as 1 = an accelerated decrease in subjective age, whereas a score difference greater than five years was coded as 2 = an accelerated increase in subjective age. A difference between one's chronological and subjective age, as reported in 2008, was also calculated.

Demographic information

Age, gender, and years of education were gathered based on self-report as part of the core interview.

Number of medical conditions

As part of the core interview, respondents indicated whether or not a physician had told them that they suffered from one to seven possible conditions: high blood pressure, diabetes, cancer, lung disease, heart condition, stroke, and arthritis. Range was between 0 and 7, with a higher score indicating more medical conditions. A difference score of overall number of medical conditions reported in 2012 vs. 2008 was calculated.

Physical difficulties

As part of the core interview, respondents were asked about difficulties to perform everyday activities, such as walking several blocks, running or jogging about a mile,

walking one block, sitting for about two hours, getting up from a chair after sitting for a long period, climbing several flights of stairs without resting, stooping, kneeling or crouching, reaching or extending one's arm about shoulder level, pulling or pushing large objects like a living room chair, lifting or carrying weights over 10 pounds, like a heavy bag of groceries, and picking up a dime from the table. Range was between 0 and 10, with a higher score representing greater difficulties. The measurement has been used extensively in the past and has shown adequate psychometric properties (Wallace et al., 2004). In the present study, Cronbach alpha was .67 in 2008 and .69 in 2012. A difference score of physical difficulties in 2012 vs. 2008 was calculated.

Depressive symptoms

The Center for Epidemiological Studies of Depression (CES-D; Geisser, Roth, & Robinson, 1997) was used as part of the core interview to assess depressive symptoms, on an eight-item, yes−no response format. The item that explicitly assessed loneliness was excluded from the total score due to its potential overlap with the loneliness scale. After reverse-coding appropriate items, a total score was calculated. Range was between 0 and 7, with a higher score indicating greater depressive symptoms. Cronbach alpha was .79 in 2008 and .77 in 2012. A difference score of depressive symptoms in 2012 vs. 2008 was calculated.

Number of social relationship

As part of the psychosocial questionnaire, respondents were asked to indicate whether they had close relationships with a spouse or partner, children, family members, or friends. Range was between 0 and 4, with a higher score indicating more social relationship sources. A difference score of number of close social relations in 2012 vs. 2008 was calculated.

Frequency of social contact

As part of the psychosocial questionnaire, respondents were asked to indicate the frequency with which they met up, spoke on the phone, and wrote or emailed children, family, or friends. An average score was calculated, with a range between 1 and 6. Cronbach alpha was .68 in 2008 and .69 in 2012. A difference score of frequency of social contact in 2012 vs. 2008 was calculated.

Loneliness

As part of the psychosocial questionnaire, respondents were asked to indicate on a three-point scale their responses to 11 questions taken from the R-UCLA (e.g., lack companionship, left out, isolated from others, in tune with others, part of the group, etc.; Hughes, Waite, Hawkley, & Cacioppo, 2004). After reverse-coding appropriate items, a total mean score was calculated to indicate overall level of loneliness, with a higher score indicating greater loneliness. Range was between 1 and 3. Cronbach alpha was .88 in both waves. A difference score of loneliness in 2012 vs. 2008 was calculated.

Analysis

To examine differences across the three groups (changes in subjective age are consistent with changes in the passage of time, accelerated subjective age increase, and accelerated subjective age decrease), we first ran descriptive statistics using chi-square analysis to examine differences on categorical variables and MANOVAs to examine differences on continuous variables. Next, we conducted a multinomial logistic regression analysis, with group membership (the three subjective age groups) as the outcome variable. In the first model, interdependent timetables (e.g., changes in number of relationships, social contact, and loneliness between 2012 and 2008) were entered as predictors. In the second model, specialized (e.g., age, gender, education, and employment status) and personal timetables (e.g., changes in medical conditions, physical functioning, and depressive symptoms between 2012 and 2008) were entered as control variables. The difference score between one's chronological age and subjective age in 2008 was also entered into the model as a control variable.

Results

Table 1 presents the characteristics of the sample. The average chronological age of the sample in 2008 was 73.8 (SD = 6.4) and the average subjective age was 61.9 (SD = 12.7). In 2012, the average subjective age was 66.0 (SD = 12.7). Both chronological age and subjective age increased by approximately the same amount, with the average difference between chronological age and subjective age being 11.8 (SD = 11.1) in 2008 and 11.3 (SD = 11.6) in 2012.

For 23.4% of the sample, changes in subjective age were consistent with changes in the passage of time over the four-year period of this study. A total of 38.3% had an accelerated decrease in subjective age, whereas 38.3% had an accelerated increase. There were significant differences between the three groups with regard to age, the difference between one's chronological and subjective age, and level of education. In addition, the degree of change between the two waves in physical difficulties, depressive symptoms, and loneliness also differed across the three groups.

Table 2 presents the results of the multinomial logistic analysis. In the unadjusted multinomial logistic regression (Model 1), a decrease in loneliness over the two waves resulted in an accelerated decrease in subjective age. An increase in loneliness over the two waves resulted in an accelerated increase in subjective age. After controlling for specialized and personal timetables (Model 2), it was found that older individuals, women and individuals of lower levels of education, were more likely to experience an accelerated decrease in subjective age. Lower levels of loneliness in 2012 compared with 2008 were also associated with an accelerated decrease in subjective age. As for

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Table 1. Sample characteristics as a function of changes in subjective age[1]

	Overall sample (2591)	Changes in subjective age are consistent with passage of time (606; 23.4%)	Accelerated decrease of subjective age (993; 38.3%)	Accelerated increase of subjective age (992, 38.3%)	F(df)/χ^2 (df)	P
Age (65−96)	73.8 (6.4)	72.7 (5.9)	73.1 (5.9)	73.5 (6.1)	3.3 (2588, 2)	.04
Difference between chronological age and subjective age (−36 to 60)	11.8 (11.1)	8.3 (8.6)	8.8 (10.6)	17.5 (10.2)	240.9 (2588, 2)	<.001
Women	1508 (58.2%)	432 (59.3%)	285 (59.6%)	791 (57.1%)	1.46 (2)	.48
Education (0−17)	12.3 (3.2)	12.9 (2.7)	12.5 (3.0)	12.7 (2.8)	6.5 (2588, 2)	<.01
Δ[2] medical conditions (−5 to 4)	.28 (.8)	.30 (.8)	.24 (.7)	.30 (.8)	2.20 (2587, 2)	.11
Δ physical difficulties (−8 to 10)	.70 (2.2)	.53 (1.9)	.40 (1.9)	.71 (2.0)	6.15 (2588, 2)	<.01
Δ depressive symptoms (−7 to 7)	.11 (1.6)	.10 (1.5)	−.08 (1.6)	.32 (1.5)	16.6 (2539, 2)	<.001
Δ number of relationships (−4 to 3)	−.22 (.8)	−.20 (.7)	−.15 (.8)	−.22 (.7)	2.47 (2574, 2)	.09
Δ contact frequency (−3.67 to 3.0)	−.08 (.8)	−.04 (.8)	−.06 (.8)	−.09 (.7)	1.05 (2553, 2)	.35
Δ loneliness (−1.73 to 1.45)	.02 (.4)	.04 (.3)	−.02 (.4)	.05 (.4)	8.7 (2544, 2)	<.001

[1]Changes in subjective age are consistent with the passage of time = subjective age increased by 3−5 years over the four-year period; accelerated decrease = subjective age decreased over the four-year period; accelerated increase = subjective age increased by more than five years over the four-year period.
[2]Δ represents the difference score between 2012 and 2008.

Table 2. Multinomial logistic regression analyses, predicting accelerated decrease and increase in subjective age relative to subjective age being consistent with the passage of time (reference category)[1]

	Accelerated decrease OR (95% CI)		Accelerated increase OR (95% CI)	
	Model 1	Model 2	Model 1	Model 2
Age (65−96)		1.02* (1.00−1.04)		1.02 (.99−1.04)
Difference between chronological age and subjective age (−36 to 60)		1.01 (.99−1.02)		1.11**(1.09−1.129)
Ref. women		.81* (.65−.99)		1.06(.85−1.33)
Education (0−17)		.93** (.90−.97)		.94**(.90−.98)
Δ^2 medical conditions (−5 to 4)		.90 (.78−1.04)		1.02 (.88−.1.18)
Δ physical difficulties (−8 to 10)		.97 (.91−1.02)		1.03 (.98−1.10)
Δ depressive symptoms (−7 to 7)		.94 (.88−1.01)		1.12**(1.04−1.21)
Δ number of relationships (−4 to 3)	.85 (.72−1.01)	1.09 (.94−1.07)	.85*(.75−.97)	.92 (.78−1.07)
Δ contact frequency (−3.67 to 3.00)	1.02 (.87−1.20)	.97 (.84−1.12)	.97 (.86−1.09)	.92 (.79−1. 07)
Δ loneliness (−1.73 to 1.45)	.56** (.40−.78)	.66** (.49−.89)	1.18 (.91−1.52)	.97 (.71−1.34)

Note: Model 1: −2ll = 4161.5; Model 2: −2ll = 4767.5; OR = odds ratio; and CI = confidence interval.
[1] Changes in subjective age are consistent with the passage of time = subjective age increased by 3−5 years over the four-year period; accelerated decrease = subjective age decreased over the four-year period; and accelerated increase = subjective age increased by more than five years over the four-year period. Two multinomial logistic regression analyses were conducted: (a) Model 1: only difference in number of relationships, difference in contact frequency, and differences in loneliness were entered into the model and (b) Model 2: age, gender, education, difference in number of medical conditions, difference in number of physical difficulties, and difference in number of depressive symptoms were also entered into the model as control variables.
[2]Δ represents the difference score between 2012 and 2008.
*$p < .05$.
**$p < .01$.

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an accelerated increase in subjective age, a wider gap between one's chronological and subjective age (e.g., having a younger subjective age relative to chronological age in 2008), lower levels of education, and more depressive symptoms in 2012 compared with 2008 were associated with an accelerated increase in subjective age. Changes in loneliness level and objective indicators of social relations were not associated with an accelerated increase in subjective age.

Discussion

The present study evaluated the role of changes in loneliness and objective social indicators as potential predictors of changes in subjective age over a four-year period. Interestingly, consistent with past research (Uotinen et al., 2006), as a group, changes in subjective age over the four-year period of this study balanced out, so that on average, both chronological age and subjective age changed by a similar amount and the overall differences between chronological age and subjective age remained consistent over time. Nonetheless, a more detailed examination revealed that the majority of the sample had gone through either an accelerated decrease or as accelerated increase in their subjective age, with the smallest group demonstrating a change in subjective age which is consistent with the passage of time. Even though only four years had passed between the two measurements, on the second measurement, the majority of the sample reported a subjective age that did not fully take into consideration the passage of chronological time. In fact, the smallest group in this study was the group that experienced a balanced change in subjective age, in which changes in subjective age between 2012 and 2008 reflected the chronological passage of time. Given the important role that subjective age plays in both morbidity and mortality (Westerhof et al., 2014), evaluating potential predictors of change in subjective age over time is crucial. Partially consistent with Nydegger's perspective, our findings demonstrate that the subjective age perception of the years going by varies as a function of personal, specialized, and interdependent timetables. The study adds by showing that mainly subjective changes, rather than objective changes, are associated with changes in subjective age over time.

Only little attention has been given to the role of interdependent timetables in determining changes in subjective age. Loneliness is a common experience in old age (Dykstra et al., 2005). Past research has shown that loneliness is often perceived as an 'on-time' event in the lives of older adults (Ayalon & Shiovitz-Ezra, 2011; Prince, Harwood, Blizard, Thomas, & Mann, 1997). The present study adds by demonstrating that when a decrease in loneliness takes place (i.e., an unexpected off-time event), this is associated with an accelerated decrease in subjective age. The on-time event which is reflected by an increase in loneliness across the two waves was not a significant predictor of accelerated increase in subjective age, potentially because of its on-time and expected nature. Interestingly, objective indicators of social relations were not related to accelerated decrease or accelerated increase in subjective age. This is consistent with past research which has shown that the subjective sense of inadequate social relations is of more substantial consequences than objective indicators of social support (Berkman, Glass, Brissette, & Seeman, 2000; Fiori, Smith, & Antonucci, 2007). These findings provide partial support to Nydegger's (1986) perspective on interdependent timetables.

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An increase in depressive symptoms predicted an accelerated increase in subjective age. The association between increased depressive symptoms and an accelerated increase in subjective age is in accordance with previous investigations. For example, past research has found that higher levels of well-being were associated with a younger subjective age (Infurna, Gerstorf, Robertson, Berg, & Zarit, 2010; Uotinen, Suutama, & Ruoppila, 2003). A different study has argued that depression serves as a precipitator of accelerated aging in older adults, due to its negative effects on the development of serious medical comorbidities (Wolkowitz, Reus, & Mellon, 2011).

Others studied the association of major depressive episode and flourishing mental health with subjective (felt and ideal) age, by analyzing data of 3032 participants from the Midlife in the United States. They found that participants who felt younger had lower adjusted odds for having a major depressive episode and higher adjusted odds for having flourishing mental health (Keyes & Westerhof, 2012). In that study, younger felt age predicted the mental condition of the individual, whereas in our study it was the negative mental condition of the person (e.g., increased depressive symptoms) which predicted an accelerated increase in subjective age. Given the cross-sectional design used by Keyes & Westerhof (2012) and the fact that the present study relied on only two waves of date, we cannot speculate about causality between one's negative mental condition and his or her subjective age. It is highly possible that a bidirectional relationship between subjective age and a variety of subjective and objective experiences exists. However, theoretically, we argue for the importance of first identifying potential predictors of subjective age and changes in subjective age over time, prior to evaluating their role as mediators or predictors.

It is important to note that physical difficulties and medical comorbidity did not predict an accelerated increase or decrease in subjective age. This finding is inconsistent with Nydegger's (1986) perspective of personal timetables. This is also inconsistent with past research which has shown that worse physical functioning was associated with higher subjective age (Infurna et al., 2010). The present study was restricted to older adults, for whom a decline in physical functioning and increase in medical comorbidity are expected occurrences (Hairi et al., 2010; Spalter, Brodsky, & Shnoor, 2014). It is possible that these 'on-time,' highly expected personal timetables are less likely to have impact older adults' changes in subjective age.

Several specialized timetables were associated with accelerated changes in subjective age. Specifically, older age was a predictor of accelerated decrease in subjective age. This is consistent with past research that has shown that older adults are more likely to report a younger subjective age compared with younger adults (Choi et al., 2014; Kaufman & Elder, 2002; Markides & Boldt, 1983) and potentially supports the claim that younger subjective age is particularly adaptive for older adults (Kleinspehn-Ammerlahn et al., 2008). In contrast, a younger subjective age in comparison to one's chronological age (e.g., a larger gap between one's chronological and subjective age) was associated with an accelerated increase in subjective age. This potentially reflects a 'regression to the mean' or implicit attempts to more adequately match one's subjective age to the passage of time.

Lower levels of education were associated with both an accelerated increase and an accelerated decrease in subjective age. Past research has resulted in inconsistent findings regarding the role of education as a predictor of subjective age (Barak & Stern, 1986; Rubin & Dorthe Berntsen, 2006). Consistently, our findings demonstrate that education cannot adequately differentiate between an accelerated increase vs. an accelerated decrease in subjective age. Being a woman was associated with an accelerated decrease in subjective age. This could potentially serve as a protective mechanism and explain the gender paradox (Singh-Manoux et al., 2008) in which men are more likely to die younger even though women present with higher morbidity.

The present study has several limitations. Although the study is based on two waves of data collection, we are unable to differentiate between cause and effect. Additional waves of data collection will allow for a longitudinal analysis of changes in subjective age. It is also important to evaluate additional predictors of changes in subjective age, such as activity level, volunteering or employment status. Nonetheless, the present study demonstrates the important role of personal, specialized, and interdependent timetables, with a particular emphasis subjective changes, in determining accelerated increase and accelerated decrease in subjective age.

To date, the majority of research has focused on subjective age or the difference between chronological age and subjective age. This study provides a somewhat different perspective on the construct of subjective age by examining changes in this construct relative to the passage of time. Innovative aspects of this study concern its focus on two waves of data collection, which allow for the construction of a construct that represents accelerated increase and decrease in subjective age vs. a more balanced subjective age consistent with the passage of time. We specifically decided to use a theoretical definition of accelerated increase vs. decrease in subjective age, rather than a statistical definition defined by the characteristics of the sample in order to improve the interpretability of the findings in line with real-life changes, such as the passage of time. This unique examination allows us to evaluate not only how one perceives his or her age, but also trends in this perception over time.

Our findings show that even though on average, changes in subjective age are quite consistent with variations in chronological age, a more detailed examination reveals specific groups that demonstrate accelerated decrease or increase in their subjective age. The focus on potential predictors of subjective age, rather than the examination of subjective age, as a predictor of positive aging experiences and the emphasis on personal, specialized, and interdependent timetables are additional innovative aspects of this study. Our findings emphasize the important role that loneliness and depression play in determining one's subjective age experiences and call for

further longitudinal research on the topic of subjective age. Our findings show that subjective perceptions and experiences, rather than merely objective indicator, are highly related to changes in subjective age perceptions. This could potentially allow for greater opportunities to intervene by changing one's perceptions of loneliness or depression, for instance, in order to change one's subjective age and subsequently impact the health and mental health consequences associated with it.

Disclosure statement

No potential conflict of interest was reported by the authors.

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