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What does feeling younger or older than one's chronological age mean to men and women? Qualitative and quantitative findings from the PROTECT study

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ABSTRACT

Objective: We explored which factors are associated with subjective age (SA), i.e. feeling younger, the same as, or older than one's chronological age, and whether these factors differ between men and women and between two age sub-groups.

Design: Cross-sectional study using qualitative and quantitative data for 1457 individuals (mean age= 67.2 years).

Main outcome measures: Participants reported how old they feel they are and provided comments in relation to their SA judgments.

Results: By using content analysis participants' comments were assigned to 13 categories, grouped into three higher-order categories (*antecedents of age-related thoughts, mental processes,* and *issues when measuring subjective age*). SA may result from the interaction between factors that increase or decrease age-related thoughts and mental processes that individuals use to interpret age-related changes. Chi-squared tests show that individuals reporting an older SA are more likely to experience significant negative changes and to engage in negative age-related thoughts than individuals reporting an age-congruent SA or a younger SA. Women experience a more negative SA and more age-salient events than men.

Conclusion: Individuals reporting an older SA may benefit from interventions promoting adaptation to negative age-related changes. There is the need to eradicate negative societal views of older women.

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Background

The terms 'subjective age' (SA) and 'felt age' interchangeably refer to the age people feel they are, which may differ from their chronological age (Barrett, 2003). Some people feel as if they are younger or older than their chronological age, whereas for others SA is congruent with chronological age. Generally, a minority of individuals report an age-congruent or older SA (Kotter-Grühn et al., 2015), whereas the majority of individuals report a younger SA and, with increasing age, the discrepancy between how old individuals feel and their chronological age increases (Bordone et al., 2020). There is, however, some variability in the extent to which individuals feel younger than their chronological age (Rubin & Berntsen, 2006).

Younger SA is associated with healthier lifestyle and better mental, physical, and cognitive health (Kwak et al., 2018; Schönstein et al., 2021; Stephan et al., 2014; Westerhof et al., 2014). Younger SA is also related to many psychosocial factors including more openness, conscientiousness, agreeableness, optimism, time spent with younger people, and positive attitudes towards ageing (Bordone & Arpino, 2016; Hess et al., 2017; Kornadt et al., 2020; Kornadt & Rothermund, 2012; Kotter-Grühn & Hess, 2012; Levy, 2009; Spuling et al., 2020).

Although numerous studies have identified factors linked to a younger SA, less is known about what makes individuals report an older SA or an age-congruent SA. Qualitative evidence suggests that specific age-related changes, for instance due to illnesses or retirement, can increase awareness of ageing (Furstenberg, 2002; Nilsson et al., 2000; Steverink et al., 2001). However, to the best of our knowledge, only the study by Giles et al. (2010) linked participants' descriptions of age-salient events to their evaluations of SA. This study found that those individuals reporting an older SA or an age-congruent SA are more likely to experience poor mental and physical health than those reporting a younger SA.

Interpretation of Giles et al. (2010) results is, however, limited as the study assumed that the same age identity trigger events have the same effect for everyone, without considering sex differences. Although current evidence on sex differences in SA is inconclusive (Kornadt et al., 2013; Levy et al., 2002; Sabatini, Ukoumunne, Ballard, Brothers, et al., 2020; Schafer & Shippee, 2010), the distinct attributional processes, social roles, and age-related expectations that characterise men and women may impact on their evaluations of age-related changes and consequently on SA (Barrett, 2005; Hvas, 2006; Settersten, 2017). Those studies reporting a younger SA among women hypothesised that this is due to women having some characteristics associated with a younger SA including optimism, adaptation, resilience, strong family identity, and elongated view of the life course (Hvas, 2006; Lytle et al., 2018; Montepare, 2020; Sontag, 1997). Those studies reporting more negative SA among women instead suggested that their results are due to women being more likely than men to experience poor physical health and ageing anxiety, and to internalise negative age-related stereotypes (Barrett, 2005). A possible explanation for the inconsistent evidence on sex differences is that men are more positive in some aspects of ageing (e.g. physical health) and women in others (e.g. social relationships) (Miche et al., 2014; Settersten, 2017). Moreover, sex differences in SA may be more salient in certain phases of life compared to others. For instance, the experience of menopause may make age-related thoughts more salient among women compared to

men in midlife whereas sex differences in SA may be more attenuated in advanced old age.

In sum, poor health may be one of the factors contributing to an older SA (Westerhof et al., 2014). However, life events (e.g. retirement) and psychosocial variables (e.g. mental processes) may also shape SA judgments (Ferring & Hoffmann, 2007; Montepare, 2009). Individuals' sex may also influence SA judgments; however, so far evidence on sex differences in SA has led to inconsistent results and has not identified factors underlying sex differences in SA. Qualitative studies capturing individuals' perspective of what they consider when reporting their SA may help to understand what characterises the minority of people who report an older SA or an age-congruent SA and why sex differences in SA may occur. The current study, therefore, examines and categorises the written comments made by 1457 older individuals while evaluating their SA. We hypothesise that participants consider several life events and psychosocial factors when evaluating their SA (hypothesis 1). This study also tests whether the comments made by participants while reporting their SA differ among those who report a younger SA, older SA, or age-congruent SA (hypothesis 2); between two age sub-groups (chronological age younger than 68 vs chronological age of 68 years or over) (hypothesis 3); and between men and women in the overall study sample and in the two age sub-groups (hypothesis 4). It may be that individuals with limited functional ability report an older SA whereas individuals actively engaged in several activities may report a younger SA (Miche et al., 2014; Montepare, 2020). Moreover, as the life events and experiences that characterise individuals in middle, young-old, and old-old age differ, it may be that when reporting their SA participants in the older sub-group consider certain factors (e.g. life events such as retirement and/or death of a spouse) with a higher frequency compared to participants in the younger sub-group. It may also be that men and women comment more frequently on factors that are respectively more valued by men (e.g. physical strength) and women (e.g. social roles) (Barrett, 2005; Calasanti, 2010; Calasanti & King, 2018) and that gender differences vary between age sub-groups. Study results will provide information about the factors that influence SA judgments and whether these factors are different for men and women. As individuals feeling older than their age constitute a group at high risk of experiencing poor cognitive, physical, and mental health and wellbeing (Levy et al., 2018; Sabatini, Ukoumunne, Martyr, et al., 2021; Stephan et al., 2016; 2016, 2018; Westerhof et al., 2014), more positive experiences of ageing among these individuals may be promoted through individualised interventions that help them to adapt to those factors that make them feel older than their age.

Method

Design and participants

This study uses data from the UK version of the PROTECT study (https://www.protectstudy.org.uk), which is a 25-year longitudinal cohort study that started in November 2015. The PROTECT study aims to explore the role of genetic, lifestyle, and medical factors on cognition in individuals aged 50 years or over and living in the UK. PROTECT participants are UK residents, English speakers, and aged ≥ 50 years, with access to the internet, and did not have a clinical diagnosis of dementia at baseline (2015).

PROTECT participants were recruited through national publicity and existing cohorts of older adults (https://exetercrfnihr.org/about/exeter-10000/; https://www.joindementiaresearch.nihr.ac.uk/; https://bdr.alzheimersresearchuk.org). Participants provided electronic informed consent online. Ethical approval for the PROTECT study and for the secondary data analyses were respectively given by London Bridge NHS Research Ethics Committee and Health Research Authority (Ref: 13/LO/1578) and by the Ethics Committee of the School of Psychology, University of Exeter (Ref: eCLESPsy000603 v2.1)

PROTECT participants are assessed every year regarding physical, mental, and cognitive health. As part of the PROTECT annual assessment in January 2019 participants were asked to fill in additional questionnaires specific to this study including a single-item question assessing SA and an open-ended question in which participants had the opportunity to write any additional information they wished to add in relation to their SA judgements. Asking participants to write any additional information they wished to report in relation to their SA is an appropriate approach to explore participants' thoughts as they arise while evaluating their SA (Teal et al., 2015). We therefore deemed these additional textual data suitable for content analysis. Among the 14757 participants that were part of the PROTECT study in 2019, 9410 individuals answered the SA measure (response rate of 63.8%) and 1457 individuals (response rate of 9.9%) answered both the SA measure and the open-ended question (Mean (SD) age= 67.2 (7.5); Women= 73.3%). Compared to the sub-sample of PROTECT participants that did not answer the SA open-ended question (N = 13300), the sub-sample that answered the SA open-ended question included fewer participants that were married, working, completed post-graduate education, and in good or excellent health (See Table 1).

Measures

Demographic variables

Demographic variables were age, sex, marital status, education level, and employment status. Marital status (*married, in a civil partnership, or co-habiting* versus *unmarried, divorced, separated, or widowed*) and employment (*employed* versus *not employed*) were operationalised as dichotomous variables. Education level included the categories *secondary education; post-secondary education; vocational qualifications; undergraduate degrees; post-graduate degree; and doctorates*.

Subjective age (SA)

We assessed SA with the single-item question: *Many people feel older or younger than they actually are. Fill in the age (in years) that you feel most of the time:___* (Barrett, 2003). Participants feeling at least one year younger than their chronological age were considered as having a younger SA; participants feeling less than one year younger than their chronological age and less than one year older than their chronological age were considered as having an age-congruent SA; and participants reporting feeling at least one year older than their chronological age were considered as having an older SA. Based on SA answers, the study sample was divided into three sub-samples: those with a younger SA, those with an age-congruent SA, and those with an older SA.

Table 1. Demographic characteristics of participants who did and did not answer the subjective age open-ended question.

Characteristics		PROTECT Participants who did not answer the subjective age open-ended question	Total current study sample	Younger subjective age group from current study	Age-congruent subjective age group from current study	Older subjective age group from current study
		N = 13300	N = 1457	N = 1129	N = 180	N = 148
Age	Mean (SD; range)	65.6 (7.1; 50 – 103)	67. 2 (7.5; 51 – 95)	67.6 (7.4; 51 to 92)	68.2 (8.2; 52 – 95)	63.4 (6.6; 51 – 81)
Sex	Females (%)	75.3	77.3	75.55	80	87.2
Marital status	Married (Yes %)	79.1	75.5	76.5	71.6	72.6
Highest level of education	Secondary (%)	15.4	10.3	10.1	10	12.2
	Post-secondary (%)	11.7	11.7	10.9	11.7	18.3
	Vocational qualification (%)	20.1	19.3	19.8	16.1	19.6
	Undergraduate degree (%)	32.7	33.5	34.0	33.3	29.7
	Post-graduate degree (%)	16.8	19.7	20.0	19.4	17.6
	Doctorate (%)	3.1	5.5	5.2	9.4	2.7
Employment	Employed (%)	48.1	36.6	36.5	29.3	46.0
SRH	Poor (%)	1.56	5.9	2.3	4.5	34.5
	Fair (%)	11.8	19.6	14.2	33.9	43.2
	Good (%)	55.5	46.2	50.9	40.1	17.6
	Excellent (%)	31.2	28.4	32.6	21.5	4.7

PROTECT Participants who did not answer the subjective age open-ended question includes those participants that were part of the PROTECT study between 1st of January 2019 and 31st of March 2019, but did not answer the subjective age open-ended question. Total current study sample comprises participants that in 2019 answered the subjective age open-ended question. SRH = Self-rated health assessed with a single-item question asking participants to rate their health from poor to excellent.

We used the following open-ended question to invite participants to add comments regarding the SA question: *If you wish, please add any additional information or comments for this section in the box below.*

Self-rated health

Participants were asked to rate their health on a four-point scale ranging from poor to excellent (Ware & Sherbourne, 1992).

Data analysis

We applied content analysis to participants' answers to the SA open-ended question (Grbich, 2012; Pope et al., 2000) as it made it possible to group responses taken directly from the text into categories (Hsieh, 2005). Moreover, content analysis is a flexible approach that can be used with several types of data (Neuman, 2011) including short written texts like those in the present study. As we were interested to identify any factors that individuals report in relation to their SA, the analysis was exploratory. Data were analyzed by the first author.

After familiarization with the data through reading and re-reading participants' responses (Polit & Beck, 2004), 13 categories were defined and then participants' comments were assigned to these categories. When appropriate, participants' statements were assigned to more than one category (Richards, 2015). Categories were then presented visually in a diagram. To maximise the reliability of our account (Elliott et al., 1999), an independent researcher not otherwise involved in the study analyzed 10% of the data; differences were discussed until consensus was reached on the categories the comments were allocated to. The percent agreement was calculated as a measure of inter-rater reliability and was 93.1%. In the results section we have illustrated the categories with relevant extracts to demonstrate that the categories are grounded in the data (Whittemore et al., 2001).

As reporting quantitative data can make an important contribution to the interpretation of meaning in content analysis (Sandelowski & Barroso, 2003), frequencies of the total sample and each SA group that mentioned a specific category were reported. To do this we dichotomised the categories as being reported or not reported. We then conducted Chi-squared tests to analyze differences in the generated categories among those reporting a younger SA, an age-congruent SA, or an older SA; between the two age sub-groups; between men and women in the overall study sample and in each age sub-group. Participants were allocated into two age sub-groups (younger sub-group; older sub-group) based on the median (67 years) for Age. Analysis were performed using STATA version 16 (StataCorp, 2017).

Results

Descriptive analysis

Among study participants (N = 1457), 77.5% reported a younger SA, 12.4% reported an age-congruent SA, and 10.2% reported an older SA. Individuals with an older SA

tended to be female, younger, less well-educated, evaluated their health as being poorer, and were more likely to be employed and not married than those who reported an age-congruent SA or a younger SA. On average (based on the mean) the overall study sample felt 15% younger than their age. The sub-group of participants who reported a younger SA felt on average 21% younger than their chronological age whereas the sub-group of participants who reported an older SA felt on average 11% older than their chronological age. The younger sub-group (chronological age between 50 and 67 years) on average felt 15% younger than their chronological age whereas the older sub-group (chronological of 68 years and over) felt on average 16% younger than their chronological age. In the study sample, men and women felt 17% and 15% younger than their age, respectively. Among participants excluded from the current study sample, as they only completed the SA measure but not the SA open-ended question, men and women felt on average 18% and 17% younger than their chronological age, respectively. In younger sub-group, men and women felt on average 18% and 14% younger than their chronological age, respectively. In the older sub-group, men and women felt on average 17% and 16% younger than their age, respectively.

Demographic details are reported in Table 1 for the study sample and the three sub-samples of participants reporting a younger SA, an age-congruent SA, or an older SA.

Participants' thoughts regarding their SA

Thirteen categories, grouped into three higher-order categories, captured participants' thoughts about their SA. The first higher-order category is *antecedents of age-related thoughts* and includes six sub-categories: 'not paying attention', 'hard to believe my age', 'age-symbolic and life events', 'awareness of changes', 'activities and lifestyle', and 'multidimensionality'. The second higher-order category is *mental processes* and includes five sub-categories: 'acceptance', 'social comparison', 'stereotypes and expectations', 'social influence', and 'temporal comparison'. The third higher-order category is *issues when measuring subjective age* and includes two sub-categories: 'variability' and 'difficulty answering'. Examples of participants' comments for each category are in Table 2.

Antecedents of age-related thoughts. The higher-order category 'antecedents of age-related thoughts' describes factors that decrease or increase occurrence of age-related thoughts. For instance, some people pay little attention to their age and seldom think about it; instead, they focus on how they feel. For people who rarely reflect on their age, making SA judgements can be difficult. Other individuals perceive a contrast between the age they feel and the age they are. Despite being aware of their chronological age some people find it hard to believe their age as they continue to feel mentally young, fit, active, or generally unchanged. Similarly, individuals may feel younger but be aware that in doing so they are 'kidding themselves'. Some people may frequently forget about their age and be horrified at those moments when they realise their age. Developmental markers such as retirement, menopause, an upcoming birthday, or becoming a grandparent can also impact on SA. Retirement and becoming a grandparent have a positive impact on judgments about SA for some individuals but are seen as negative experiences by others. Menopause or an upcoming birthday

Table 2. Examples of participants' comments for each of the identified categories.

Higher-order categories	Categories	Examples of participants' comments per each of the identified categories
Antecedents of age-related thoughts	Not paying attention	*"I actually never think about my age unless someone asks me" (Female, 72 years).*
		"Have no ideas about this question as never think about it. In fact, hardly ever remember how old I am. Never have done. Age means nothing to me" (Female, 73 years).
		"I don't particularly contemplate my age" (Male, 63 years).
	Hard to believe my age	*I'm probably kidding myself, but I can't believe I'm 64!" (Female, 64 years).*
		"I certainly do not feel my age apart from stiff joints, particularly in the morning, and I am slightly horrified when I realise I have just turned 63" (Female, 63 years).
		"I sometimes forget I am over 40 and it comes as a shock to remember I am over 50" (Female, 54 years).
	Age-symbolic and life events	*"I have had some symptoms with the menopause which definitely make me feel my age" (Female, 57 years).*
		"I am going to be 70 in a couple of months and this is really changing my attitude. I think last year I felt about 60 but now I am struggling to reconcile myself with the idea of the reality of dying and getting old" (Female, 69).
	Awareness of changes	*"Have been going through some difficult years in caring for my parents which makes me feel old" (Female, 62 years).*
		"At present we have suffered a major bereavement in the family and until sufficient time has passed, I really feel my age" (Male, 68 years).
		"I do not know how old I feel, I am very involved in looking after my grandchildren so that brings joy and a certain degree of feeling on their level. On the downside, you are aware of being old as you are a grandmother" (Female, 68 years).
		"I feel content most of the time" (Female, 70 years).
		"Fortunately I enjoy good health" (Male, 81 years).
		"I had pneumonia in January 2018 which left me with Bronchiectasis. I now feel my age more than I did in 2017" (Female, 78 years).
		"I have chronic back pain, and on a bad day it makes me feel very old!" (Female, 76 years).
		"My memory is not as good as it used to be" (Female, 70 years).
		"Loss of memory is my biggest concern" (Male, 85 years).
	Activities and lifestyle	*"I am extremely lucky to be healthy and my hips and knees still work well - so I am able to continue my love of long-distance walking" (Female, 73 years).*
		"I am 58 and play netball and do step aerobics classes without any problem" (Female, 58 years).
		"I am fit & healthy and able to do all I want / need to" (Male, 71 years).
		"Bi-lateral trapped nerves in my spine mean I am on medication for pain and cannot walk as far as I would like and have had to give up playing tennis some years ago and now given up golf. I now play bowls!" (Female, 70 years).
		"I try to eat healthily, stay fit and keep my brain engaged" (Female, 69 years).
		"I run between 35 and 45 miles per week, and therefore consider myself fitter than most people half my age" (Male, 63 years).
	Multidimensionality	*"Brain health = 40, but physical health = 70" (Female, 73 years).*
		"Socially I feel pretty much my actual age. Physically I keep up with people just over 50" (Male, 72 years).
		"I have put my age because physically I feel old, but mentally I feel young, in spite of my memory" (Female, 73 years).

(*Continued*)

Mental processes	Acceptance	*"I know I am 76 this does not bother me at all I am fit and healthy" (Female, 76 years).*
		"Not sure how you can really feel anything other than your actual age" (Female, 67 years).
		"I like being my age I don't want to be younger. I am proud to be 82 and consider myself lucky to have lived so long" (Female, 82 years).
		"Any other than my actual age is a fantasy….!" (Male, 71 years).
	Social comparison	*"When I feel younger it is in comparison to my friends who are younger" (Female, 78 years).*
		"Certainly feel much younger than my father seemed at my current age" (Male, 69 years).
		"My eldest son is 64. I often feel younger than he seems" (Male, 87 years).
	Stereotypes and expectations	*"Certainly don't feel or look like what people seem to think an 89 year-old looks like" (Female, 89 years).*
		"I feel very blessed physically for someone of my age" (Male, 94 years).
	Social influence	*"I work with under 18 s- they keep me young" (Female, 57 years).*
		"Most of my friends are in the mid 30 s and 40 s" (Male, 54 years).
	Temporal comparison	*"Compared with 10 years ago I often walk more slowly, climb stairs holding on the handrail, take more time with housework" (Female, 77 years).*
		"The activities I do and enjoy doing are not really much different to what I have always done, except I now have more time to do them" (Female, 61 years).
		"Feel my present age. Feel "old" but did not feel so until around 18 months ago, partly because now walking less well and increasing deafness" (Male, 81 years).
Issues when measuring subjective age	Variability	*"These things change every day depending on aches and pains" (Female, 82 years).*
		"This fluctuates depending on how tired I am" (Female, 54 years).
		"I am 88 and feel 90 in the early morning- younger as the day progresses!" (Female, 88 years).
		"Felt age changes depending on such things as the weather, time of the year" (Female, 80 years).
		"My age perception changes" (Male, 59 years).
	Difficulty answering	*"It's hard to put a number on it, but I do not feel as old as 69" (Male, 69 years)*
		"How can I feel younger when I can't remember how that feels? I only know how I feel now" (Female, 58 years).
		"I find it difficult to answer that, I don't know what a person of my age 82 should be, I don't have any relatives older than I am and close family have all died, none lives as long as 82 years" (Female, 82 years).
		"How can I feel older when I don't know how older feels" (Female, 58 years).
		"I actually feel younger than fifty, but as I am 67 it seems a bit daft to say so!" (Female, 67 years).

are perceived as negative changes by those women who referred to these markers. For some people judgments about their SA are influenced by negative events or circumstances that mark their lives. Examples are assuming the role of caregiver or a recent bereavement.

Some people express their SA in relation to one domain of their life. Individuals can reflect on various life domains, including mental, physical, and cognitive health. To judge their mental health, some individuals refer to their psychological and emotional states such as feeling content or happy. Individuals can use several indicators to judge their physical health including having one or more chronic health conditions, energy levels, a health episode (e.g. an operation), the presence of visual impairments, the experience of physical pain, physical appearance, the quality of their sleep, the outcome of a health assessment conducted by a doctor or a specialist at the local gym, or using a phone app to rate their health. To evaluate their cognitive health some people refer to their cognitive abilities such as memory. For some individuals, their SA is influenced by their level of engagement in healthy behaviours, hobbies, social relations, or other activities. Individuals can be influenced by various activities they are still able to perform including those indispensable for an independent life such as driving and walking.

Whereas for some individuals all the activities they are still able to do justify why they feel younger, for others having to abandon those activities they loved make them feel older. Finally, for some individuals their SA is the result of how they feel in several domains of their lives. While some individuals feel either younger or older in relation to several domains, others experience contrasting subjective ages; for instance, they may feel younger in relation to cognitive abilities but older in relation to physical abilities. Feeling distinct ages in relation to different life domains is due to experiencing both positive and negative changes in relation to distinct sectors of their lives. For some people the age they feel reflects an 'average age' summarising how they feel in multiple domains.

Mental processes. The second higher-order category describes how several mental processes are used by older individuals to make sense of the age-related changes they experience and/or to decrease the value assigned to negative changes. People who enjoy their age, are not afraid of getting older, or believe that feeling a different age than their chronological age would be an illusion report a SA that is consistent with their chronological age. The age some people feel can result from comparing themselves, their health, and/or their abilities with a familiar person such as their spouse, parents, other relatives, or their peers. Hence sources of comparison could be either people close to the individual or a generalized other. Whereas some individuals compare themselves with more fortunate people, others compare themselves with less fortunate people. Those individuals who compare themselves with others who are ageing less healthily generally feel younger whereas those who compare themselves with more fortunate people generally feel older.

Some people compare themselves with a stereotyped negative image of an older individual, for instance one who has poor memory or poor health. People feel younger or older depending on whether in their opinion they meet the negative stereotype.

Some people look at themselves in relation to social expectations of how they think a person of their age or an old person in general should be. Finally, through their lives some individuals have developed expectations about themselves in old age and their SA results from comparison of their current self with such expectations. Moreover, for some individuals their SA is influenced by the age of other people that surround them in their daily lives, either in the workplace, at home, or in other social contexts. Finally, by comparing their actual self with their previous self, individuals can either reach the conclusion that something has changed (for better or worse), that nothing has changed, or that some aspects have changed whereas others have remained stable. Some of the people who conclude that they have not changed substantially or that things have improved with increasing age also believe that this justifies why they feel younger. People who feel their age or older than their chronological age think that their previous self was a better version of themselves (e.g. healthier and more capable).

Issues when measuring SA. The third higher-order category relates to some issues that, if not considered when assessing one's SA, may be sources of poor reliability. For some individuals their SA fluctuates depending on various circumstances including how well they sleep, their mood, levels of pain, tiredness, memory performance, time of the day, the season, and the weather. Some people find it hard to report their SA and this can also be a source of lack of reliability when reporting SA. Difficulties in answering the SA question can arise from having to choose a specific SA, forgetting how they felt when they were younger, not knowing how a person of a certain age is supposed to feel, feeling older but being unable to assign a number to their SA due to lack of experience of being older, struggling to come up with an age because of the contrast between knowing their chronological age and the age they feel, and being afraid of ridicule for saying that they feel younger.

Relations among categories

The categories described above are organised in a diagram showing how they are inter-related (Figure 1). The left side of the diagram illustrates categories that may enhance or decrease age-related thoughts. In our study we found that whereas 'age-symbolic and life events', 'awareness of changes', 'activities and lifestyle', and 'multidimensionality' are factors that may facilitate age-related thoughts; 'not paying attention' and 'hard to believe my age' are factors that may reduce age-related thoughts. The category 'multidimensionality' may indicate lack of validity when assessing SA with a single-item measure. The center of the diagram illustrates how individuals' age-related thoughts can be mentally processed in several ways (through 'acceptance', 'social comparison', 'stereotypes and expectations', 'social influence', and 'temporal comparison'). The right side of the diagram illustrates how the combination of factors that facilitate or hinder age-related thoughts and mental processes may result in reporting a younger SA, an age-congruent SA, or an older SA. The categories 'variability' and 'difficulty answering' describe possible sources of inadequate reliability when reporting SA.

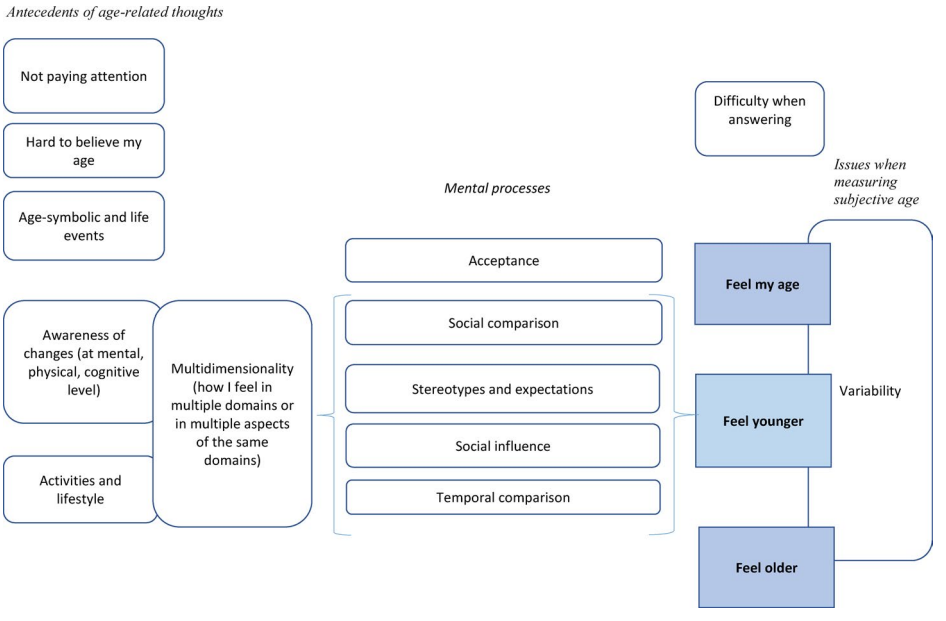

Figure 1. Diagram showing how the categories are inter-related.

Frequencies of individuals that mentioned a specific category in the total study sample and Sub-samples

Frequencies under each category for the total study sample, the three SA sub-samples, the two age sub-groups, and for men and women, as well as differences in frequencies among the three SA sub-samples, the two age sub-groups, between men and women in the overall study sample and in the two age sub-groups are presented in Tables 3–6. Participants in all sub-samples commented most frequently on their awareness of changes and on how changes characterize several domains of their lives. Frequencies for the categories 'awareness of changes', 'activities and lifestyle', 'variability', and 'difficulty in answering' were significantly different among the three SA sub-samples (*p-values* < .001). The sub-group reporting an older SA was the most likely to be aware of changes, and the less likely to engage in activities, to experience variability in SA, or to have difficulty in expressing SA judgments.

We found no statistically significant difference in the percentage of participants in the two age sub-groups commenting on the identified categories, suggesting that, when evaluating their SA, younger and older adults take into consideration the same factors.

When evaluating their SA both men and women commented most often on 'awareness of changes', 'multidimensionality', and 'activities and lifestyle', suggesting that both men and women experience age-related changes in several domains of their lives, including in their activities and lifestyle. However, percentages for the categories 'age-symbolic life events' (p= .03) and 'variability' (p= .03) were significantly different between men and women, with the percentage of women commenting on the experience of age-symbolic life events and variability in their SA being higher than the percentage of men commenting on the same categories. Even though in the remaining categories, differences in percentages between men and women were not statistically

Table 3. Number (%) of observations and frequencies for the total sample and each subjective age group that mentioned a specific category.

Categories	Total study sample (N = 1457)	Younger subjective age (N = 1129)	Age-congruent subjective age (N = 180)	Older subjective age (N = 149)	Chi2; *p*-value
Not paying attention	59 (4.1%)	47 (4.2%)	10 (5.6%)	2 (1.4%)	3.86; .15
Age-symbolic and life events	85 (5.8%)	59 (5.2%)	15 (8.3%)	11 (7.4%)	3.49; .17
Awareness of changes	712 (48.9%)	503 (44.6%)	89 (49.4%)	120 (81.1%)	69.90; < .001
Activities and lifestyle	287 (19.7%)	268 (23.7%)	15 (8.3%)	4 (2.7%)	53.37; < .001
Multidimensionality	309 (21.2%)	246 (21.8%)	35 (19.4%)	28 (18.9%)	1.03; .60
Acceptance	62 (4.3%)	12 (1.1%)	50 (27.8%)	0 (0%)	___
Social comparison	73 (5%)	59 (5.2%)	7 (3.9%)	7 (4.7%)	0.61; .74
Stereotypes and expectations	62 (4.3%)	50 (4.4%)	6 (3.3%)	6 (4.1%)	0.47; .79
Social influence	97 (6.6%)	1 (0.1%)	8 (4.4%)	6 (4.1%)	3.91; .14
Temporal comparison	89 (6.1%)	70 (6.2%)	12 (6.7%)	7 (4.7%)	0.60; .74
Variability	133 (9.1%)	105 (9.3%)	25(13.9%)	3 (2%)	13.96; < .001
Difficulty answering	201 (13.8%)	155 (13.7%)	40 (22.2%)	6 (4.1%)	22.56; < .001
Hard to believe my age	11 (0.8%)	11 (1%)	0 (0%)	0 (0%)	___

Total study sample comprises participants that in 2019 answered both the subjective age measure and the subjective age open-ended question. N = Number of people whose comments referred to the selected category. Differences across sub-samples in frequencies under the categories "hard to believe my age" and "acceptance" were not calculated as only participants feeling younger than their age wrote comments that were included in the category "hard to believe my age" and only participants feeling younger than their age and participants feeling their age commented on the category "acceptance".

Table 4. Number (%) of observations and frequencies of categories for men and women.

Categories (yes)	Men (N = 331)	Women (N = 1126)	
	n (%)	n (%)	Chi2; *p*
Not paying attention	10 (3.0)	49 (4.4)	1.66; .33
Age-symbolic and life events	11 (3.3)	74 (6.6)	4.91; .03
Awareness of changes	154 (46.5)	558 (49.6)	0.94; .33
Activities and lifestyle	69 (20.9)	218 (19.4)	0.36; .55
Multidimensionality	67 (20.2)	242 (21.5)	0.24; .63
Acceptance	11 (3.3)	51 (4.5)	0.91; .34
Social comparison	22 (6.7)	51 (4.5)	2.41; .12
Stereotypes and expectations	17 (5.1)	45 (4.0)	0.82; .37
Social influence	28 (8.5)	69 (6.1)	2.24; .14
Temporal comparison	14 (4.2)	75 (6.7)	2.64; .10
Variability	20 (6.0)	113 (10.0)	4.92; .03
Difficulty answering	49 (14.8)	152 (13.5)	0.37; .55
Hard to believe my age	0	11 (0.9)	3.26; .07

N = Number of people whose comments referred to the selected category.

significantly, a higher percentage of women commented on the categories 'not paying attention', 'awareness of changes', 'multidimensionality', 'acceptance', 'temporal comparison', and 'hard to believe my age'. Compared to women, a higher percentage of men commented on the categories 'activities and lifestyle', 'social comparison', 'stereotypes and expectations', 'social influence', and 'difficulty answering'.

Further exploration of sex differences in the percentage of categories reported in the two age sub-groups shows that in the younger sub-group the percentage of women commenting on the experience of age-symbolic life events in their SA is higher than the percentage of men commenting on the same categories; however, this sex difference disappears in the older age sub-group. In contrast, in the older age sub-group the percentage of women experiencing variability in their SA is higher than the percentage of men commenting on the same categories, but this sex difference is not present in younger age sub-group. Finally, even though in the overall

Table 5. Number (%) of observations and frequencies of categories for the younger and older sub-groups.

Categories (yes)	Younger sub-group (N = 721)	Older sub-group (N = 736)	
	n (%)	n (%)	Chi2; *p*
Not paying attention	30 (4.2)	29 (3.9)	0.05; .83
Age-symbolic and life events	50 (6.9)	35 (4.8)	3.15; .08
Awareness of changes	374 (51.9)	338 (45.9)	5.16; .02
Activities and lifestyle	144 (20.0)	143 (19.4)	0.07; .79
Multidimensionality	154 (21.4)	155 (21.1)	0.02; .89
Acceptance	29 (4.0)	33 (4.5)	0.19; .66
Social comparison	36 (5.0)	37 (5.0)	0.001; .97
Stereotypes and expectations	31 (4.3)	31 (4.2)	0.01; .93
Social influence	46 (6.4)	51 (6.9)	0.18; .67
Temporal comparison	42 (5.8)	47 (6.4)	0.20; .66
Variability	56 (7.8)	77 (10.5)	3.19; .07
Difficulty answering	93 (12.9)	108 (14.7)	0.97; .33
Hard to believe my age	6 (0.8)	5 (0.7)	0.11; .74

N = Number of people whose comments referred to the selected category.

Table 6. Number (%) of observations and frequencies of categories for men and women in the two age sub-groups.

Categories (yes)	Younger sub-group (N = 721)			Older sub-group (N = 736)		
	Men (N = 114)	Women (N = 607)		Men (N = 217)	Women (N = 519)	
	N (%)	N (%)	Chi2; *p*	N (%)	N (%)	Chi2; *p*
Not paying attention	5 (4.4)	25 (4.1)	0.02; .89	5 (2.3)	24 (4.6)	2.18; .14
Age-symbolic and life events	3 (2.6)	47 (7.7)	3.89; .049	8 (3.7)	27 (5.2)	0.78; .38
Awareness of changes	54 (47.4)	320 (52.7)	1.10; .29	100 (46.1)	238 (45.9)	0.003; .96
Activities and lifestyle	32 (28.1)	112 (18.5)	5.56; .02	37 (17.5)	106 (20.4)	1.11; .29
Multidimensionality	24 (21.1)	130 (21.4)	0.008; .93	43 (19.8)	112 (21.6)	0.29; .59
Acceptance	3 (2.6)	26 (4.3)	0.68; .41	8 (3.7)	25 (4.8)	0.46; .50
Social comparison	6 (5.3)	30 (4.9)	0.02; .89	16 (7.4)	21 (4.1)	3.55; .06
Stereotypes and expectations	5 (4.4)	26 (4.3)	0.003; .96	12 (5.5)	19 (3.7)	1.33; .25
Social influence	8 (7.0)	38 (6.3)	0.09; .76	20 (9.2)	31 (6.0)	2.50; .11
Temporal comparison	5 (4.4)	37 (6.1)	0.51; .48	9 (4.2)	38 (7.3)	2.58; .11
Variability	9 (7.9)	47 (7.7)	0.003; .96	11 (5.1)	66 (12.7)	9.55; .002
Difficulty answering	15 (13.2)	78 (12.9)	0.008; .93	34 (15.7)	74 (14.3)	0.24; .62
Hard to believe my age	0 (0)	6 (1.0)	1.14; .29	0 (0)	5 (1.0)	2.10; .15

N = Number of people whose comments referred to the selected category.

study sample the percentage of men and women commenting on their activities and lifestyle was not significantly different, examination of sex differences between the two age sub-groups shows that in the younger age sub-group the percentage of men commenting on their activities and lifestyle is higher than the percentage of women commenting on the same category whereas this gender difference is not preset in the older age sub-group.

Discussion

This study identified thirteen factors related to SA judgments and tested whether the frequency with which individuals comment on these factors differs among individuals reporting a younger SA, an age-congruent SA, or an older SA; between age sub-groups; and between men and women. In line with our first hypothesis, when evaluating their SA participants considered, not only their health status, but also a variety of

life events and psychosocial factors. Participants' comments suggest that SA judgments emerge from the interaction between factors that facilitate or decrease age-related thoughts and several mental processes that people use to make sense of age-related changes or to decrease the emotional impact of negative changes. Use of these mental processes frequently results in positive evaluations of SA. In line with our second and third hypotheses, the factors that participants considered when reporting their SA differed among sub-samples. Participants reporting an older SA were more likely to be aware of changes and less likely to engage in activities, compared to participants reporting a younger SA or an age-congruent SA. In line with existing literature on SA, participants in the older age sub-group reported a younger SA compared to those in the younger age sub-group (Bordone et al., 2020). Women experienced more age-symbolic events, especially in the younger age sub-group, and reported a more negative SA than men.

Among the categories that we identified, awareness of changes (Bowling et al., 2005; Sabatini, Silarova, et al., 2020), poor physical health (Desrosiers et al., 2006), the experience of age-symbolic events, and some life circumstances were associated with participants reporting an older SA (Bordone & Arpino, 2016). Events such as retirement, menopause, birthdays, and bereavement, and life circumstances such as being a caregiver may have reminded participants of their position in their lifespan (Barrett, 2003; Bordone & Arpino, 2016; Brothers et al., 2016; Bytheway, 2009; Montepare, 1996a, 2009). The combination of levels of gains and losses experienced by older individuals may play a role in whether these changes are attributed to age. Indeed a recent study showed that individuals are more likely to attribute negative changes to ageing compared to positive changes (Rothermund et al., 2021). The interpretation of negative changes as being a consequence of older age may in turn result in an older SA. Indeed, evidence shows that those individuals that report higher levels of awareness of age-related losses (AARC losses) tend to report an older SA compared to those who experience fewer AARC losses (Brothers et al., 2019; Kaspar et al., 2019; Sabatini, Ukoumunne, Ballard, Brothers, et al., 2020).

As participants reporting an older SA were more likely to be aware of age-related changes, less likely to engage in adaptive behaviours or activities, and rated their health as being poor, an older SA may represent a legitimate reaction to significant and permanent losses (e.g. decrease functional and cognitive ability) (Sabatini, Ukoumunne, Ballard, et al., 2021). As the experience of AARC losses and of an older SA are related to poorer emotional and physical well-being (Mock & Eibach, 2011; Sabatini, Silarova, et al., 2020; Westerhof et al., 2014) and lower engagement in health-related and adaptive behaviours (Brothers & Diehl, 2017; Dutt et al., 2018; Montepare, 2020; Wilton-Harding & Windsor, 2021), the emotional well-being of individuals reporting an older SA could be enhanced through disengagement from unachievable goals (Wrosch et al., 2003) and acceptance of negative changes (Collins & Kishita, 2019). However, when individuals with an older SA experience potentially modifiable changes, more active coping strategies should be promoted in order to enable these individuals to continue engaging in enjoyable activities (Brandtstädter & Rothermund, 2002).

Some participants reported an age-congruent SA or even a younger SA despite experiencing negative age-related changes and negative life circumstances. This finding

may be due to several reasons. First, these individuals may have experienced positive changes alongside negative ones (Sabatini, Ukoumunne, Ballard, Diehl, et al., 2020; Wilton-Harding & Windsor, 2021). Second, as those participants who reported a younger SA or an age-congruent SA perceived their health as good and were able to continue performing a variety of meaningful activities, the health changes they experienced may have been mild (Spuling et al., 2013) and not severe enough to prevent them from leading an active and independent life (Franke et al., 2017). Third, some participants may report a positive SA despite the experience of age-related losses due to the use of a variety of mental processes that enable them to perceive their situation in a more optimistic light (Heckhausen & Krueger, 1993). However, subjective evaluations of health can differ greatly from scores obtained with objective measures of health (Carstensen, 1992, 1993, 2006; Chan et al., 2007; Idler & Benyamini, 1997; Jylha et al., 2001). Due to the subjective nature of the concepts, SA may be more strongly associated with self-rated health compared to objective measures of health and future studies should test this. We were unable to test this in the current study as in 2019 the PROTECT study annual assessment did not include an objective measure of health. However, the assessment of comorbidity was included as part of the 2020 annual assessment of the PROTECT study; this will enable the authors to explore in future studies the associations of SA with self-rated health and comorbidity.

Among the mental processes identified in the current study, consistent with social comparison theory (Rickabaugh & Tomlinson-Keasey, 1997) and with temporal comparison theory (Ferring & Hoffmann, 2007), participants reported a younger SA when they compared themselves to people in worse health than themselves (Beaumont & Kenealy, 2004) or when they concluded that despite their increasing age they had not changed significantly. In line with resilience theory some participants reported a younger SA when they concluded that they did not match negative stereotypes of older individuals (Kotter-Grühn & Hess, 2012). Finally, some participants reported a younger SA when others attributed a younger age to them or when they spent time with younger people (Bordone & Arpino, 2016). In contrast, participants reported an older SA when they compared themselves with more healthy others, they felt they matched negative stereotypes of older individuals and/or they thought they had changed significantly compared to previous versions of themselves. This pattern of results emphasises the positive impact that eradicating negative age-related stereotypes at societal level and promoting more realistic age-related expectations and intergenerational contact, may have on individuals' experiences of ageing (Levy, 2017). Intervention programs promoting positive and realistic age-related beliefs, in addition to healthy behaviours, are effective in promoting more positive experiences of ageing, healthier lifestyle (e.g. more engagement in physical activity), and better mental (e.g. reduction in depressive symptoms) and physical (e.g. better physical performance in terms of balance, gait speed, and chair rise) health (Beyer et al., 2019; Brothers & Diehl, 2017; Menkin et al., 2020).

When estimating their SA, both men and women reflected most frequently on the changes they had experienced in multiple domains (e.g. physical, cognitive, social) of their lives and on how such changes led to modifications in their lifestyle. However, as expected, we found some differences in the way in which men and women evaluate their own ageing (Antonucci et al., 2010; Barrett, 2005).

Compared to men, women, especially in the older sub-group, were more likely to experience variability in their SA evaluations. As women also commented more frequently than men on the co-occurrence of positive and negative changes in multiple domains of their lives, the more frequent variability in SA reported by women may be due to them being more likely to experience a mix of positive (e.g. enjoyable social relationships) and negative (e.g. decreased health) age-related changes (Miche et al., 2014). Whereas women were more likely to reflect on age-symbolic events, men commented more frequently on whether their preserved strength enabled them to continue those activities they had initiated earlier in life. This pattern of results suggests that when evaluating their SA men are more likely to reflect on their daily performance whereas women are more influenced by age-salient events and social expectations rather than by their actual daily abilities.

Discrepancies in the way in which men and women experience ageing may be due to our society having different expectations for older men and women. In support of this Kornadt et al. (2013) showed that individuals aged 20 to 92 years attach different stereotypes to older men and women; older women are believed to be more religious, friendly, and engaged in leisure activities whereas men are believed to be more capable in financial and work-related tasks. The different expectations that our society has for older men and women may result in older men and women being treated differently, and this may explain why in our study women reported a more negative SA than men. Indeed, older women often become invisible in the public domain. For instance, among TV presenters, older men are distinguished whereas older women are frequently dismissed (Jermyn, 2013). In sum, our results highlight one more time how much our society -and men, in particular - need to learn to think differently about ageing women and how strategies aiming to eradicate negative age-related stereotypes (Levy, 2017) should give particular attention to negative stereotypes of older women.

Finally, although it was not a primary aim of the current study, participants' comments outlined several sources of lack of validity and reliability when measuring SA with an unidimensional measure asking participants to specify how old they feel in general (Barrett, 2003). First, as different participants interpreted the SA question in distinct ways, answers to unidimensional measure of SA may not be comparable. Indeed, for instance, some participants reported their SA after reflecting on physical changes, whereas others on their mental abilities.

Second, as some participants reported that their SA fluctuates, assessing SA at one time point may oversimplify individuals' experiences of ageing. Future studies could therefore adopt methodological designs that take into account the fluctuating nature of self-perceptions in older age (Armenta et al., 2018), for instance, by controlling for situational factors, such as levels of pain, that impact on SA (Sabatini, Ukoumunne, Ballard, Collins, et al., 2020), or by averaging individuals' SA across several time points (Neupert & Bellingtier, 2017). Third, some participants experienced difficulty in reporting SA which arose from not being able to assign a specific number to SA. Asking individuals to report their SA on a scale ranging from 'a lot younger than my age' to 'a lot older than my age' may reduce difficulty in answering (Montepare, 1996b). Moreover, difficulty in reporting SA may underlie the difficulty of capturing the

complexity of perceptions of ageing when using unidimensional measures. By collecting information about the coexistence of positive and negative experiences in individuals' lives, multidimensional measures of SA may facilitate SA judgments (Kastenbaum et al., 1972; Turner et al., 2021).

The nature of our dataset places some limitations on our findings. First, all data were collected through self-report measures and descriptive analysis have not been conducted on objective indicators of health. Second, the sample included a majority of women and was predominantly white, with above average education and self-rated health. Among the 14757 participants that took part in the PROTECT study in 2019, only a small sub-group of participants answered the open-ended item (N = 1457); hence the opinions of the remaining participants are unknown. Third, some of the characteristics of study participants are slightly different from the remaining PROTECT participants. For instance, compared to participants included in the current study sample, those excluded from the study sample reported on average a younger SA. Fourth, SA was assessed with a single-item question rather than in a domain-specific format (Kastenbaum et al., 1972; Turner et al., 2021). This is a limitation of the current study as individuals can experience ageing differently in relation to different domains of their lives (e.g. physical and cognitive) which may lead to individuals reporting different subjective ages in relation to different domains of one's life (Kaspar et al., 2019). Finally, views on ageing and age stereotypes were not taken into account when explaining SA and SA-related thoughts. However, views on ageing and age stereotypes may influence SA (Brothers et al., 2017; 2020; Mock & Eibach, 2011; Sabatini, Ukoumunne, Ballard, et al., 2021).

It should be noted that ours was a large sample for content analysis. The large sample also made it possible to include quantitative data for all the identified categories and to compare frequencies among individuals reporting a younger SA, an age-congruent SA, or older SA; between age sub-groups; and between men and women. The examination of sex difference in SA enriched the scarce literature on factors underpinning sex differences in SA. To analyze data, we generated categories directly from the data; this is a strength of our study as it made it possible to explore the additional role that mental processes play in shaping individuals' SA, going beyond what has been reported by previous studies (e.g. Giles et al., 2010) and providing targets for future health promoting interventions. For instance, as we found that individuals' mental processes impact on the age their feel, targeting negative mental processes such as self-attribution of negative age stereotypes may help to enhance mental health in older age. It also made it possible to identify limitations related to the SA questionnaire that had not been considered before and that may find application in the development of a multidomain tool assessing SA.

Conclusions

This study identified thirteen factors underlying SA judgments; these factors suggest that SA results from the interaction between factors that increase or decrease age-related thoughts and mental processes that individuals use to interpret age-related changes. Individuals reporting an older SA tend to experience significant negative changes and to engage in negative age-related thoughts; they are therefore good

candidates for interventions promoting adaptation to age-related changes. As, compared to men, women experience more age-salient events and report a less positive SA, future interventions facilitating adaptation to ageing should consider sex differences. This would be particularly important when targeting women in middle age and early old age as this gender difference was most salient in the younger sub-group. There is also the need to put in place societal strategies aiming to eradicate negative stereotypes commonly attached to older women. Participants' comments outlined several sources of lack of validity and reliability when measuring SA with an unidimensional measure which are due to different individuals interpreting the SA question in distinct ways, fluctuation in the age individuals feel, and difficulty in reporting a unique SA. Hence, it is important to use multidimensional measures of SA and to adopt methodological designs that take into account the fluctuating nature of SA.

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Availability of data and materials

This study was conducted using secondary data collected as part of the UK version of the PROTECT ongoing study. PROTECT data are available to investigators outside the PROTECT team after request and approval by the PROTECT Steering Committee. Data for the AARC questionnaires will be available from May 2022.

Disclosure statement

The authors declare that there is no conflict of interest.

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