# Can feel young elderly adults maintain cognitive and physical function nine years later?

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**気持ちが若い高齢者は認知機能や運動機能を 9 年後も維持できる？**

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**要約**

本研究の目的は、自分の主観年齢を暦年齢より若く見積もった Feel Young 成人が、自分の主観年齢を暦年齢より上と見積もった Feel Old 成人よりも、9 年後でも認知能力と身体能力が優れているかどうかを調べることであった。神経心理学チームと整形外科チームの両方の検査に参加した 1,735 人の地域住民のうち、9 年の間隔を空けて 2 回検査を受け、自分の主観年齢を回答した 82 人が分析の最終的な対象参加者であった。認知項目は、数字のキャンセル、論理的記憶、言語流暢性、ストループテストで構成され、身体機能項目は、10 m 歩行テスト、背筋力、バランス能力で構成されていた。結果は、第 1 に、Feel Young が Feel Old よりもほとんどの測定で優れていたこと、第 2 に、すべての測定で 9 年間の機能低下が観察されたことを示した。性差については、Feel Young グループの女性は Feel Old グループの女性よりも優れた成績を収めたが、男性ではグループ間差は観察されなかった。9 年間のパフォーマンスの低下は、女性よりも男性の方が顕著であった。こうした主観年齢の認識に関する男女差は、女性は慎ましく謙虚であるべきとする戦前の儒教の影響が強く、70 代、80 代の女性の主観年齢の推定に作用したためと考えられる。高齢期における主観年齢の維持は、認知機能と身体機能の両面で健康な老後生活と密接に関係していることが確認された。

Key words
subjective age, older adults, cognitive function, physical function, positive psychology

## 1. Introduction

Subjective Age Study has been increasing in the field of health psychology in recent years, especially based on longitudinal studies of middle-aged and older adults. These studies have showed that subjective age reflects the age norms of the society to which one belongs, that social status, income, physical health, and cognitive ability. Further, Subjective Age Study have suggested that Feel Young have better physical fitness and cognitive function, and slower functional decline (Debreczeni & Bailey, 2021; Hatta et al., 2023; Heimrich et al., 2022; Ihara et al., 2015; Sabatini et al., 2022; Stephan et al., 2013; Westerhof & Wurm, 2015; Xie & Lu, 2022).

However, most of Subjective Age Study involves limitation. Most of Subjective Age Studies based on the longitudinal studies and used multivariate regression analysis method to identify variables that contribute to subjective youth, but even though the results of this statistical method are greatly affected by the number and nature of the independent variables introduced, the variables used in the population screening were input without considering the logical background. We might insist that these

multivariate regression analyses have conducted without considering the logical background but just employed all variables in the health examination items, and therefore, sufficient confidence cannot be placed in the findings obtained.

In order to strengthen the reliability of the findings concerning to subjective age effect on cognitive and physical functions in older adults, the findings need to be validated by different statistical methods from the multiple regression analysis, such as those based on experimental design. In this light, Hatta et al. (2023) examined whether Feel Young lead to better cognitive functioning with a two-factor experimental design (cognitive test items vs two groups: Feel Young and Feel Old). The results by the analysis of variance (ANOVA) showed that Feel Young performed better than Feel Old even 10 years later in the one-digit cancellation task, which are considered to reflect attention and information processing speed. However, the results of other cognitive test items such as three-digits cancellation task and the Stroop effect size were not significantly different in the decline level for 10 years.

If robustness of the findings can be confirmed that Feel Young will preserve better cognitive function and physical functions than Feel Old even some years later, then the “Feel Young! type campaign” will be easier to adopt for municipal health promotion officers. Negative expressions of aging, such as “don’t get old, don’t get dementia,” could be replaced with positive ones, which could be seen as desirable from the perspective of ageism, a new human rights movement trend (Farrell et al., 2023; Sao Jose et al., 2019).

As Hatta et al. (2023) exploratory examined the relationship between subjective age and two cognitive functions, we introduced more cognitive and physical motor tasks in this study as previous studies have suggested many variables contribute subjective age effect (Heimrich et al., 2022; Sabatini et al., 2022; Stephan et al., 2013). Further, a sex difference was not examined in Hatta et al. (2023) due to small number of participants.

Therefore, this study aimed to confirm the previous findings filling the issue left by Hatta et al. (2023). We increased the number of cognitive function tasks in addition to physical function tasks to examine whether Feel Young older adults are in better condition in later life, and aimed to examine sex difference. To increase the number of participants for the aim, the interval years were set from 10 years to 9 years, it was considered that there would be no significant difference in accordance with the purpose of the study.

## 2. Materials and methods

### 2.1 Participants

The participants were over 40 years old people who participated in the municipal resident health examination twice with 9-years interval and they took part all examination tasks in both the neuropsychological and orthopedic teams, and answered the subjective age item described below. The total number of participants in the 2008, 2009, and 2011 Yakumo Study were 1,735, but only 702 met the necessary above requirements. Because only the results of the first-year participation were used in the case of multi-year participation, a total of 551 individuals were included in the final analysis. As the flow diagram show in Figure 1, 82 participants were the target participants of this study. Since the purpose of the study included an examination of sex differences, the basic data results of the subjective age index Proportional Discrepancy Score (PDS), described later, were classified into three groups based on quarter deviation: those who rated their subjective age as young relative to their calendar age (Feel Young: 9 men and 9 women each), those who rated their age as old (Feel Old: 11 men and 11 women each), and other groups. Table 1 shows the demographic characteristics of Feel Young and Feel Old group participants.

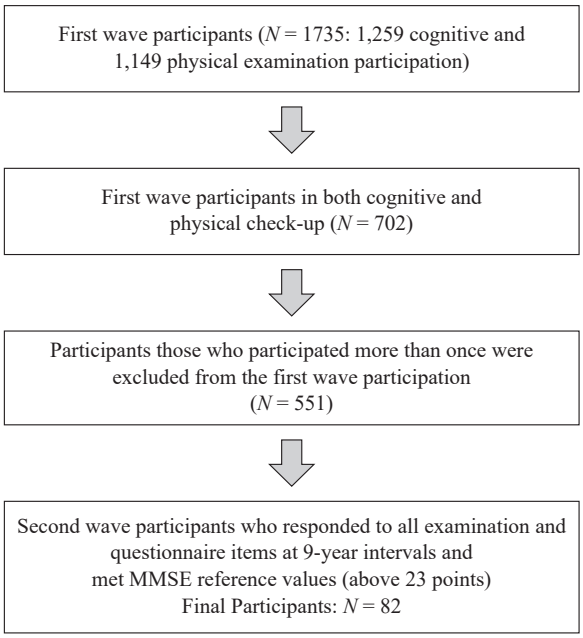


Figure 1: Selection process of the participants

Table 1: Demographic characteristics of the participants in feel young and feel old groups

| Group | Feel Young | | Feel Old | |
|---|---|---|---|---|
| Sex | Men | Women | Men | Women |
| Number of participants | 9 | 9 | 11 | 11 |
| PDS | –0.26 (0.07) | –0.25 (0.12) | –0.02 (0.02) | 0.00 (0.03) |
| Age (Years old) | 66.56 (9.04) | 61.82 (8.30) | 64.67 (6.10) | 65.18 (4.71) |
| Years of Education | 12.33 (2.30) | 11.55 (2.41) | 12.41 (2.22) | 11.65 (2.36) |
| MMSE | 28.56 (1.42) | 29.27 (1.01) | 28.33 (1.41) | 27.18 (2.09) |

### 2.2 Subjective age

Subjective age was obtained from the answers to the "About Your Health" items submitted at the on-site reception desk on the day of the municipal resident health examination. The health examination is basically voluntary participation by 40 years of age or older, and a questionnaire called "About Your Health" is distributed by the local government to those who wish to participate approximately three weeks prior to the health examination. Those who wished to receive the examination were asked to fill out this questionnaire. The "About Your Health" included questions on depression, cognitive and behavioral patterns and habits in daily life, forgetfulness, eating patterns, and other behavioral styles and dietary habits, as well as the question, "Aside from your actual age, how old do you think you are in terms of your feelings?" In this questionnaire item, participants were instructed to enter their age as a numerical value, and this response was used as their subjective age.

The PDS was used as the index for subjective age, following Stephan et al. (2013), which is calculated by subtracting calendar age from subjective age and dividing by calendar age, with negative values for responses that infer feelings of being younger than actual age, The larger the negative value, the greater the deviation. On the other hand, a positive value means that the respondent estimates that he/she is older than his/her actual age in terms of feelings.

### 2.3 Cognitive functions

Subjects were given the Nagoya University Cognitive Assessment Battery (NU-CAB) in the neuropsychology team. The NU-CAB included MMSE, D-CAT, logical memory test (LMT), Money Road Map Test (RMT), letter fluency test, (LFT), semantic fluency test (SFT), and Stroop test. Details of the NU-CAB are reported elsewhere (Hatta et al., 2012). In the D-CAT, number of targets correctly marked was used as an index. For the Stroop test, following Parris et al. (2022), the difference between the time required in the Stroop condition and the time required in the control condition divided by the time required in the control condition was used as the Stroop effect size (Str. T) as an index.

### 2.4 Physical functions

The Orthopedics team collected data on 10-meter walk test (10MWT), back muscle strength (BMS), and balance ability as physical functions, in addition to anatomical measurements of body parts based on X-ray images, bone densitometer measurements, and pain examination with palpation. For balance ability, the body's center of gravity sway was measured by the stabilometer (Anima GW5000, Anima Corporation, Tokyo, Japan) by one orthopedic surgeon and one assistant. Among measures, ENG (Close) and ENG (Open) were used as they are the most basic parameters of standing body balancing. The ENG is the length of the trajectory drawn by the center-of-gravity per unit time.

As described before, most of longitudinal studies using multiple regression analysis, the number and quality of variables incorporated are exclusively not considered background theory, even though they critically affect the results of the analysis. In this study, D-CAT, LMT, LFT, SFT, and Str. T, and 10MWT, ENG (Close), ENG (Open), and BMS were selected as variables based on the Late-in First-out proposal (Colhelo et al., 2021; Raz & Daughery, 2018) that proposed the age-related cognitive decline reflects biological evolution, and the acquired later functions are assumed to deteriorate faster than those acquired earlier in life. Based on this proposal, higher-order, complex cognitive and physical tasks can be viewed as more susceptible to the effects of aging than simple tasks.

## 3. Results

Table 2 shows the results of PDS and cognitive and physical variables by sex. Based upon these results, first hypothesis that whether "Feel Young" has better cognitive and physical function 9 years later than the "Feel Old," and second hypothesis that whether sex differences are observed between both groups were examined with a mixed three-factor ANOVA (PDS and sex as between factors and change (time) after 9 years as within factor).

From the results of ANOVA for the time factor, all variables showed a significant or a significant trend, except SFT (D-CAT1 ($F_{1, 36}$ = 3.11, $p < 0.08$), D-CAT3 ($F_{1, 36}$ = 9.30, $p < 0.01$), LMT ($F_{1, 36}$ = 7.64, $p < 0.\ 01$), LFT ($F_{1, 36}$ = 13.97, $p < 0.01$), and Str. T ($F_{1, 36}$ =2.61, $p < 0.10$). This is the same for physical function variables (BMS ($F_{1, 36}$ =7.18, $p < 0.01$, 10MWT ($F_{1, 36}$ =10.05, $p < 0.01$), ENG (Open) ($F_{1, 36}$ =21.40, $p < 0.01$), ENG (Close) ($F_{1, 36}$ =7.18, $p < 0.05$)). These means that an age-related functional decline for 9 years is robust both in cognitive and physical functions.

The PDS factor was significant for D-CAT1, D-CAT3, SFT, Str. T, and ENG (Close), suggesting that the "Feel Young" performed better than the "Feel Old" in both cognitive and physical functions. These support the previous studies (Ihara et al., 2015; Sabatini et al., 2022; Stephan et al., 2013; Xie & Lu, 2022).

First working hypothesis can be tested by whether the interaction between PDS and time factors is significant or not, however, no variable was found to be significant. This means that neither "Feel Young" nor "Feel Old" showed significant differences in the magnitude of change over the 9-year period, suggesting that the first hypothesis was not supported.

The second working hypothesis can be tested by examining the interaction between PDS and sex factors, and the interaction between sex and time factors are significant. First, there were significant differences in all physical variables (BMS, 10MWT, ENG (Open), and ENG (Close)), with men outperforming women, and women outperforming men in SFT. There was a significant interaction between sex and time factors for LMT, SFT, and ENG (Close) ( $F_{1, 36}$ = 8.33, $p < 0.05$), $F_{1, 36}$ = 3.74, $p < 0.05$), and ($F_{1, 36}$ = 5.09, $p < 0.05$), respectively, indicating that

Table 2: PDS and mean scores in cognitive and physical measures of feel young and feel old groups expressed by sex

| | PDS | First wave (2008, 2009, 2011) | | Second wave: 9 years later | |
|---|---|---|---|---|---|
| | | Men | Women | Men | Women |
| D-CAT1 | Feel Young | 31.33 (3.23) | 34.36 (5.86) | 34.56 (9.03) | 34.54 (13.68) |
| | Feel Old | 26.11 (4.25) | 27.82 (6.72) | 27.11 (5.60) | 25.00 (9.31) |
| D-CAT3 | Feel Young | 55.56 (3.09) | 58.91 (7.40) | 48.00 (18.26) | 50.55 (12.47) |
| | Feel Old | 46.00 (7.25) | 45.45 (12.84) | 44.78 (10.31) | 36.27 (16.64) |
| LMT | Feel Young | 18.11 (3.54) | 19.09 (3.02) | 13.67 (5.72) | 18.45 (4.99) |
| | Feel Old | 18.89 (2.13) | 15.09 (4.39) | 15.00 (4.94) | 15.91 (4.14) |
| LFT | Feel Young | 8.33 (3.77) | 11.18 (3.03) | 12.88 (5.13) | 13.36 (5.36) |
| | Feel Old | 8.67 (2.78) | 9.28 (3.38) | 12.11 (3.31) | 10.09 (5.36) |
| SFT | Feel Young | 18.33 (6.14) | 11.18 (3.03) | 15.56 (4.05) | 13.36 (5.36) |
| | Feel Old | 13.33 (3.65) | 9.27 (3.38) | 13.33 (2.78) | 10.09 (5.36) |
| Str. T | Feel Young | 1.17 (0.19) | 1.37 (0.22) | 1.08 (0.27) | 1.22 (0.36) |
| | Feel Old | 1.55 (0.16) | 1.19 (0.40) | 1.53 (0.18) | 1.41 (0.54) |
| 10MWT | Feel Young | 4.58 (0.56) | 5.07 (0.96) | 4.78 (0.66) | 5.43 (1.45) |
| | Feel Old | 4.53 (0.69) | 5.4580.60) | 4.86 (0.51) | 6.10 (0.73) |
| BMS | Feel Young | 118.33 (25.70) | 69.77 (14.09) | 111.22 (20.71) | 57.59 (16.41) |
| | Feel Old | 118.44 (16.36) | 56.73 (15.91) | 100.94 (28.53) | 57.09 (29.72) |
| ENG (Open) | Feel Young | 1.81 (0.58) | 1.32 (0.46) | 2.08 (0.87) | 1.54 (0.56) |
| | Feel Old | 1.3780.29) | 1.27 (0.29) | 1.68 (0.40) | 1.72 (0.42) |
| ENG (Close) | Feel Young | 2.31 (0.72) | 1.97 (0.71) | 3.09 (1.10) | 1.78 (0.77) |
| | Feel Old | 1.83 (0.56) | 1.75 (0.55) | 2.00 (0.28) | 1.87 (0.57) |

Note: Numbers in parentheses are standard deviation values.

for LMT, men declined for 9 years ($F_{1, 36} = 15.96$, $p < 0.01$) but not for women ($F_{1, 36} = 0.08$, *ns*), and in SFT, men declined for 9 years ($F_{1, 36} = 16.28$, $p < 0.01$) but not for women ($F_{1, 36} = 3.09$, *ns*). In ENG (Close), performance declined for 9 years for men ($F_{1, 36} = 25.81$, $p < 0.01$) but not for women ($F_{1, 36} = 0.43$, *ns*). There was an interaction between PDS and sex factors for LMT and ENG (Close) ($F_{1, 36} = 3.1$, $p < 0.05$) and ($F_{1, 36} = 3.16$, $p < 0.05$) meaning that for LMT, "Feel Young" has a large change over 9 years for men ($F_{1, 36} = 7.65$, $p < 0.01$) but for women ($F_{1, 36} = 1.92$, *ns*); for ENG (Close) the interaction suggests that men showed a significant functional decline for 9 years ($F_{1, 36} = 23.40$, $p < 0.01$) but not in women ($F_{1, 36} = 10.43$, *ns*).

## 4. Discussion

One of the purposes of this study was to confirm the finding of preliminary previous study (Hatta et al., 2023), where Feel Young showed better attention function even in 10 years later than Feel Old older adults. If this finding is reliable, Feel Young in older adults is a predictor of a healthier 10 years later, and would provide a scientific support for local government health promotion officials encouraging residents to "be young." Until recently, health guidance has been based on catchphrases such as "don't get blurry" and "don't get dementia"-type phrases, which include the negative element of "getting old relates to dementia." From the perspective of positive psychology, the "keep feeling young" type campaign is considered more desirable. This is because subjective estimation of one's age as young (i.e., positive perception) has beneficial effects on health, not only in terms of psychological well-being (Weiss et al., 2013), but also in terms of cognitive function and physical functions (Czekierda et al., 2017; Heimrich et al., 2022; Winger et al., 2016), and are noted to be superior in cardiovascular disease (Stephan et al., 2021, less frailty (Li et al., 2021). Thus, the focus on "keep feeling young" implies the new action strategies for local government health promotion officials.

In order to prove "keeps individual feeling young" are more likely to have a good sense of health and stay alive in the future, studies based on longitudinal research methods are the most reliable. Therefore, as a preliminary study, Hatta et al. (2023) analyzed the data of the Yakumo study and showed that Feel Young performed better at 10 years later than the Feel Old in the D-CAT1 but this was not the case in the Stroop test, and it is difficult to say that robust evidence was obtained. Therefore, to pursue robustness, this study examined by increasing the number of cognitive variables and adding physical function variables.

To address this objective, an ANOVA was performed in each variable rather than multivariate analysis, and the results did not reach a statistical significance for all variables. Although the time factor was significant for most of the variables, meaning that although a gradient of functional decline is observed for

both Feel Young and Feel Old, there was no difference in the gradient between both groups. Thus, the previous finding that cognitive function of Feel Young maintain superior performance 10 years later was not scientifically well-founded, and the first working hypothesis was not supported.

The second purpose was to examine sex differences. Hatta et al. (2023) did not examine the sex difference due to the small number of participants. By changing time interval from 10 to 9 years, a sex difference was examined in this study. The reason why sex difference was made an issue for examination due to the findings of a sex difference in Hatta et al. (2010) where they found a sex difference in subjective age perception though studies in Europe and the U.S. have reported a tendency to estimate subjective age as younger than actual age irrespectively of sex (Barak, 2009; Utoinen, 1998; Westerhof & Barrette, 2005).

The results on sex difference showed a significant interaction between PDS and group suggesting Feel Young women performed better on LMT and ENG (Close) than Feel Old, but there was no difference in men. This means that in memory and balance skills, Feel Young women were reasonably consistent with superior performance, while for men there was a discrepancy between the age estimation and their actual performances. Younger subjective age estimation for men may be interpreted as wishful thinking with little substantive support. The results showed a significant interaction between sex and time for the LMT, SFT, and ENG (Close) variables. These mean that the 9-year decline in performance was more pronounced for men, but the difference was small or not observed for women.

These results regarding sex difference might be interpreted as reflecting the characteristics of "modest and steady" self-reflection of Japanese women and self-reflection relying on "wishful thinking and thoughtless" of Japanese men. Since we do not readily agree with the sex-stereotypical interpretation of "modest women," we examined the specific evidence for the sex differences noted in Hatta et al. (2023), and found that a significant sex difference between subjective age and calendar age were only in the 70s and 80s with no sex difference in ages younger than 60s. In other words, only participants in the generation affected by pre-war education produced a sex difference, while those in the generation with post-war education did not. In Japan's prewar society, Confucian-influenced ideas about sex difference dominated society and school education. Although the purpose of this study is not to verify the utility of postwar education, we can confirm the influence of education on human thinking characteristics, or personality development.

The above considerations based on the two working hypotheses were partially unsupported and partially supported. A limitation of this result is that the accuracy of the judgment could be improved by further shortening the time interval, increasing the number of participants. Another limitation is that the majority of participants belonged to forestry, agriculture, and fishing villages, and this study has not been conducted with urban residents.

While not a guarantee of healthy cognitive and physical function nine years later for "Feel Young" older adults, the fact that Feel Young performed better on many cognitive and physical measures than Feel Old is consistent with suggestions that Feel Young is beneficial to the health status of older residents, and again supports the point that positive resident health guidance is preferable to negative type guidance.

## 5. Conclusions

To confirm that Feel Young older adults have superior cognitive function several years later was examined by increasing the number of cognitive tasks and adding physical function tasks so that sex difference can be examined with a larger number of participants.

The results showed that Feel Young showed better cognitive and physical function tasks performances than Feel Old group, but there was no group difference in the 9-years functional change gradient.

Women in their 70s and 80s tended to estimate their subjective age more conservatively than men, suggesting the influence of pre-war Japanese Confucian sexual attitudes.

The findings provided scientific evidences to municipal health promotion officials that to maintain subjective youthfulness is important for older adults in both cognitive and physical functions, and the activities based on this knowledge may contribute to a reduction in financial expenditures related to the welfare of the elderly. Further, not only Feel Young may contribute to a reduction in health care related expenditure but also Feel Young may contribute to increase revenue as suggested by the finding that employees in companies who perceive themselves to be younger than they actually have a higher average individual goal accomplishment and experience higher company performance (Kunze et al., 2015).

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## References

Barak, B. (2009) Age identity: A cross-cultural global approach. *International Journal of Behavioral Development*, 33, 2-11.

Colhelo, A., Fernandes, H., Magalhaes, R., Moreira, P., Marques, P., Soares, J., Amorim, L., Portugal-Nunes, C., Castenho, T., Santos, N. C., & Sousa, N. (2021). Reorganization of brain structural networks in aging: A longitudinal study. *Journal of Neuroscience Research*, 99, 1354-1376.

Czekierda, K., Banik, A., Park, C. L., & Luszczynska, A. (2017). Meaning in life and physical health: Systematic review and meta-analysis. *Health Psychology Review*, 11, 387-418.

Debreczeni, F. A. & Bailey, P. (2021). A systematic review and meta-analysis of subjective age and the association with cognition, subjective well-being, and depression. *Journal of Gerontology: Psychological Sciences*, 76, 471-482.

Farrell, T. W., Hung, W. W., Unroe, K. T., Brown, T. R., Furman, C. D., Jih, J., Karani, R., Mulhausen, P., Nápoles, A. M., Nnodim, J. O., Upchurch, G., Whittaker, C. F., Kim, A., Lundebjerg, N. E., & Rhodes, R. L. (2023). Exploring the interaction of structural racism and ageism healthcare. *Journal of American Geriatric Society*, 70, 3366-3377.

Hatta, T., Hatta, T., Kato, K., Kimura, T., Fujiwara, K., Hatta, J., & Iwahara, A. (2023). Does subjective feeling young in 60's remain attention function good ten years after?: Evidence from the Yakumo Study. *Journal of Human Environmental Studies*, 21, 133-138.

Hatta, T., Higashikawa, M., & Hatta, T. (2010). Subjective age in modern Japanese young, middle-age, and upper-middle age sample. *Perceptual and Motor Skills*, 111, 1-6.

Hatta, T., Yoshizaki, K., Ito, Y., Mase, M., & Kabasawa, H. (2012). Reliability and validity of the screening test for attention, Digit Cancellation Test (D-CAT). *Psychologia*, 55, 246-256.

Heimrich, K. G., Prell, T., & Schonenberg, A. (2022). What determines that old adults feel young than they are? Results from national representative study in Germany. *Frontiers in Medicine*, 9:901420.

Ihara, H., Furuna, T., Mizumoto, A., Makino, K., Saitoh, S., Phnishi, H., Shimada, H., & Makizako, H. (2015). Subjective physical and cognitive age among community-dwelling old people aged 75 years and old: Differences with chronological age and its associated factors. *Aging & Mental Health*, 19, 756-776.

Kunze, F., Raes, A. L. M., & Bruch, H. (2015) It matters how old you feel: Antecedents and performance consequences of average relative subjective age in organizations. *Journal of Applied Psychology*, 100, 151-1526.

Li, Y., Liu, M., Miyawaki, C. E., Sun, X., Hou, T., Tang, S., & Szanton, S. L. (2021). Bidirectional relationship between subjective age and frailty: A prospective cohort study. *BMC Geriatrics*, 21, 395.

Parris, B. A., Hsshim, N., Wadsley, M., Augsytinova, M., & Ferrand, L. (2022). The loci of Stroop effects: A critical review of methods and evidence for levels of processing contributing to color-word Stroop effects and the implications for the loci of attentional selection. *Psychological Research*, 86, 1029-1053.

Raz, N. & Daughery, A. M. (2018). Pathways to brain aging and their modifiers: Free-radical-induced energetic and neural decline in senescence (FRIENDS) model–A mini-review. *Gerontology*, 64, 49-57.

Sabatini, S., Siebert, J. S., Diehl, M., Brothers, A., & Wahl, H-W. (2022). Identifying predictors of self-perceptions of aging based on a range of cognitive, physical, and mental health indicators: Twenty-year longitudinal findings from the ILSE Study. *Psychology and Aging*, 37, 486-502.

Sao Jose, J., Amando, C. A., F., Ilinca, S., Buttingieg, S. C., & Larsson, A. T. (2019). Ageism I health care: A systematic review of operational definitions and inductive conceptualizations. *The Gerontologist*, 59, e98-e108.

Stephan, Y., Chalabaev, A., Kotter-Gruhn, D., & Jaconelli, A. (2013). 'Feeling younger, being stronger' an experimental study of subjective age and physical functioning among old adults. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 68, 1-7.

Stephan, Y., Sutin, A. R., Wurm, S., & Terracciano, A. (2021). Subjective aging and incident cardiovascular disease. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 76, 910-919.

Uotinen, V. (1998) Age identification: A comparison between finish and North-American cultures. *International Journal of Aging and Human Development*, 46, 109-124.

Weiss, D., Sassenberg, K., & Freund, A. M. (2013). When feeling different pays off: how old adults can counteract negative age-related information. *Psychology and Aging*, 28, 1140-1146.

Westerhof, G. & Barrette, A. E. (2005) Age identity and subjective well-being: A comparison of the United State and Germany. *Journal of Gerontology: Series B: Psychological Sciences and Social Sciences*, 60B, 129-136.

Westerhof, G. & Wurm, S. (2015). Longitudinal research on subjective aging, health, and longevity: current evidence and new directions for research. *Annual Review of Gerontology & Geriatrics*, 35, 145-165.

Winger, J. G., Adams, R. N., & Mosher, C. E. (2016). Relations of meaning in life and sense of coherence to distress in cancer patients: A meta-analysis. *Psychooncology*, 25, 2-10.

Xie, H. & Lu, S. (2022). The association between physical performance and subjective well-being in Chinese Old adults: A cross-sectional study. *Frontiers in Public Health*, 10, 965460.

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