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The Scales of Psychological Well-Being – a validation, usability and test-retest study among community-dwelling older people in Finland

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The Scales of Psychological Well-Being – a validation, usability and test-retest study among community-dwelling older people in Finland

Objectives: To validate the Finnish version of the 42-item Scales of Psychological Well-Being (Ryff, 1989) among community-dwelling older people. The study also examined the test-retest reliability and usability, i.e., user experience, of the scales in this age group.

Method: The 42-item version of the SPWB was administered as part of a face-to-face interview among 968 men and women aged 75, 80 or 85 years. The subsample for test-retest analyses comprised 42 participants, who in addition to 11 interviewers also answered questions concerning the usability of the scales. Exploratory and confirmatory factor analyses, Cronbach's alpha coefficients, Pearson and intra-class correlation coefficients, and Kendal's Tau B were used in the analyses.

Results: The factor analyses did not support the theory-based six-factor structure of the scales. The Cronbach's alphas showed high internal consistency reliability for the total scale, but modest for the subscales. The intercorrelations between the subscales were moderate. The total score and the subscale scores of the SPWB correlated positively with quality of life and life satisfaction, and negatively with depressive symptoms. The interviewers reported that while most of the participants responded to the scales without marked difficulties, others could only answer after clarifications of some statements.

Discussion: The reliability of the 42-item version of the SPWB was modest. The factor structure was inconsistent among the three age groups studied, but the scales were feasible to use. The current results call for further methodological consideration to optimize assessment of eudaimonic well-being in old age.

Keywords: eudaimonic well-being, psychometrics, aging

1 **Introduction**

2 There is mounting evidence on the importance of mental well-being in promoting health
3 throughout the life course (e.g. Howell, Kern, & Lyubomirsky, 2007; Ryff, Radler & Friedman,
4 2015). Positive mental well-being decreases the risk of diseases, potentially through
5 immunological pathways (e.g. Davidson, Mostofsky & Whang, 2010; Howell et al., 2007;
6 Morozink, Friedman, Coe & Ryff, 2010), and predicts greater survival in both healthy and
7 clinical samples (Chida & Steptoe, 2008). Thus, mental well-being may be a key factor making
8 for both healthier lives and greater longevity in older people. These notions point to the
9 relevance of examining positive psychological functioning in old age.

10 In line with Keyes' (2005) tripartite model of mental well-being, positive psychological
11 functioning can be empirically captured by such dimensions as emotional, psychological, and
12 social well-being, as well as the absence of depressive feelings (Kokko, Korkalainen, Lyyra &
13 Feldt, 2013). The emotional side refers to personal pleasure and happiness, capturing the core
14 ideas of hedonic well-being (Keyes, 2005). In turn, psychological well-being reflects the
15 eudaimonic view, emphasizing e.g. self-actualization and optimal development as the
16 foundations of well-being (Ryff, 2014). In the three-partite model, these personal sides of well-
17 being are complimented with social well-being, which takes into account the contribution of
18 social environment on positive psychological functioning. Maximizing well-being in these three
19 components is assumed to yield into human flourishing (Keyes, 2005).

20 The present study focused on the model of psychological well-being proposed by Carol
21 C. Ryff (1989) emphasizing the importance of meaning and self-realization in people's lives
22 (Ryff, 2018). The model is grounded on the idea of 'what constitutes the best of us'. This
23 viewpoint is highly relevant for gerontological research. Identifying 'what constitutes the best of

1 us in old age', instead of focusing solely on the negative consequences of aging, can offer a more
2 balanced view of aging (Ranzijn, 2002). To further such knowledge, we need to ascertain the
3 reliability and validity of assessing positive psychological functioning among older people.

4 To enable assessment of the eudaimonic side of well-being, Ryff (1989) developed the
5 Scales of Psychological Well-Being (SPWB). The SPWB are unique in that they are built on a
6 solid theoretical conceptualization of what constitutes the core elements of psychological well-
7 being. Based on the model, psychological well-being is optimized when one is self-determined
8 and independent (autonomy), feels competent in managing one's environment (environmental
9 mastery), has a sense of continuous growth and development in life (personal growth), has
10 satisfying relationships with other people (positive relations), feels that one's life has meaning
11 (purpose in life) and sees oneself and one's life in a positive light (self-acceptance) (Ryff, 1989,
12 2014). The SPWB are widely used and established measure referenced in over 750 scientific
13 publications with translations into over 30 languages (Ryff, 2018). Shortened scales developed
14 based on the original 120-item SPWB range from an 18-item version (Ryff & Keyes, 1995;
15 Clarke, Marshall, Ryff & Wheaton, 2001) to more lengthy 42-, (e.g., Davison et al. 2012;
16 Springer & Hauser, 2006), 54- (e.g. Triadó, Villar, Solé & Celdrán, 2007) and 84-item versions
17 (e.g., Meléndez, Tomás, Oliver & Navarro, 2009; Phelan, Love, Ryff, Brown & Heidrich, 2010).

18 Originally, Ryff (1989) validated the 120-item measure among young, middle-aged and
19 older adults. Her analyses supported the construct validity of the six-factor model, which
20 included the above mentioned dimensions of eudaimonic well-being, and test-retest
21 reproducibility of the scales, although some of the subscales were highly intercorrelated. Later,
22 several studies have also supported the six-factor multidimensionality of the SPWB (e.g. Chen &
23 Chan, 2005; Clarke, Marshall, Ryff & Rosenthal, 2000; Kállay & Rus, 2014; Ryff & Keyes,

1 1995). However, also inconsistent results have been reported questioning the six-factor model
2 (Springer et al., 2006; Springer & Houser, 2006), with overlap reported especially for the
3 subscales of purpose in life, self-acceptance, environmental mastery and personal growth (Clarke
4 et al., 2001; Springer & Hauser, 2006). Often, the results have been contradictory: for example
5 Springer and Houser (2006) did not find much support for the multidimensionality of the 42-item
6 version of the scales, but yet, the best model fit was found for the original six-factor model.
7 Among older populations, findings on the construct validity of the six-factor model of the scales
8 have been mixed: some studies have supported (Miguel et al., 2008; Tomas et al., 2010), while
9 others have not supported (Guindon et al., 2004; Triadó et al., 2007) the six-factor structure.
10 Therefore, one of the aims of the current study was to evaluate the validity of the factor structure
11 of the scales.

12 As well as construct validity, the internal consistency reliability of the SPWB has been
13 questioned. The 18-item version of the SPWB is a reliable measurement of overall psychological
14 well-being (Kokko et al., 2013) and comparable with the original 120-item version of the
15 instrument (Ryff & Keyes, 1995). However, the subscales of the 18-item version have rather
16 systematically shown poor reliability (e.g., Ryff & Keyes, 1995; Clarke et al., 2001), and hence
17 the more lengthy versions are recommended for assessing the separate dimensions of
18 psychological well-being (Ryff, 2014). A few studies have utilized the 42-item version of the
19 SPWB among older people, with relatively good results for internal consistency reliability of the
20 subscales. For example, Choi and Kim (2011) found Cronbach's alphas to range from 0.70
21 (autonomy) to 0.80 (self-acceptance) among a large probability sample of 55- to 84-year-old
22 participants. Similarly, Davison, McCabe, Knight and Mellor (2012) reported Cronbach's alphas
23 of the subscales ranging from 0.70 to 0.82 among a sample of 64- to 98-year-old people. With

1 longer versions of the scales, the internal consistency reliability has not been any higher (Chiang
2 et al., 2013; Triadó et al., 2007). However, a shorter 22-item version of the SPWB targeted for
3 older people yielded only modest results for internal consistency reliability and factorial validity
4 (Villar, Triadó, Celdrán, & Solé, 2010). We chose the 42-item version of the SPWS for our study
5 because its subscales have shown good internal consistency and the respondent burden is
6 reasonable (Morozink et al., 2010; Ryff, 2014).

7 The usability of the SPWB among older people has not been addressed, even though they
8 were developed for use among adults of all ages (Ryff, 1989) and have also been employed
9 among people aged 90 or older (Frazier, Mintz & Mobley, 2005; Meléndez et al., 2009; Oliver,
10 Navarro, Meléndez, Molina & Tomás, 2009; Phelan et al., 2010) and among persons living in
11 aged care facilities (Davison et al., 2012; Schanowitz & Nicassio, 2006). With usability we refer
12 to the experience of respondents and interviewers about how easy, difficult or burdensome it is to
13 understand and respond to the items. Age may affect how a person understands the questions or
14 response options, and therefore bias results (Knäuper et al., 2016). However, this notion has not
15 been translated into practice in developing measurement scales more suitable for use with older
16 people who may be frail or cognitively impaired. Earlier studies using SPWB have
17 systematically excluded people with cognitive decline (e.g., Davison et al., 2012; Guindon,
18 O'Rourke & Cappeliez, 2004; Schanowitz & Nicassio, 2006), which decreases the
19 representativeness of the findings. However, even for cognitively intact older people, the scales
20 may be difficult to answer, since they require rather complicated self-evaluation, half of the
21 items are reverse-coded, and some are negatively worded. Especially negatively worded items
22 can reduce the reliability of measurement scales among older people (Springer, Pudrovska &
23 Hauser, 2011; Tomas, Meléndez, Oliver, Navarro & Zaragoza, 2010). The SPWB was initially

1 designed to be a self-administered questionnaire and has most often been employed as such, also
2 among older people (e.g., Choi & Kim, 2011; Frazier et al., 2005, Meléndez et al., 2009, Phelan
3 et al., 2010). This mode of employing the scales may, however, be problematic for people who
4 fail to understand the meaning of some items, or who are frail or have poor vision. Therefore, we
5 decided to employ the SPWB in a face-to-face interview and explored how usable the scales are
6 among older people who may for example suffer from cognitive decline.

7 Since mental well-being plays an important role in health and longevity (e.g. Chida &
8 Steptoe, 2008; Howell et al., 2007; Ryff et al., 2015), it is important to assess it with a valid
9 method. While there is evidence to support the validity and reliability of the SPWB, some studies
10 have yielded mixed results and evidence on the test-retest reliability of the scales is largely
11 absent. Furthermore, the usability of the scales in this age group is uncertain. Therefore, the aim
12 of this study was to examine the validity and internal consistency reliability of the Finnish
13 version of the 42-item SPWB, administered in a face-to-face interview, among community-
14 dwelling 75-, 80- and 85-year-old people. In addition, the test-retest reliability of the SPWB and
15 their usability in these age groups were examined.

16 **Methods**

17 *Study design and participants*

18 The current data forms part of the AGNES cohort study (*Active Ageing – Resilience and external*
19 *support as modifiers of disablement outcome*), which is an observational study conducted among
20 three non-overlapping age cohorts (75, 80 and 85 years). These age groups were chosen for the
21 AGNES study due to harmonization with an older dataset collected nearly 30 years earlier with
22 the purpose of cohort comparisons on older people's health and functioning. After the age of 80
23 years, the burden on diseases and disability increases, making this age range interesting for

1 research on psychological well-being (Rantanen et al., 2018). Details of the AGNES recruitment
2 procedure are given elsewhere (Portegijs et al., 2019; Rantanen et al., 2018). A probability
3 sample of 2 791 community-dwelling people in these age groups, living in the city of Jyväskylä
4 in Central Finland, was derived from the Finnish Population Information System of the
5 Population Register Centre and informed about the study. A total of 2 348 persons were reached,
6 of whom 1 021 were willing and able to participate in the study. Finally, 1 018 persons
7 participated in a computer-assisted face-to-face interview in their homes. The interviews were
8 performed between October 2017 and December 2018 by 24 trained interviewers. The
9 participants also filled in a self-administered questionnaire. The present analyses were performed
10 for 968 individuals who had responded to the SPWB in the face-to-face interview. Altogether 50
11 people did not respond to the SPWB, because administration of the SPWB was not completed
12 due to difficulty understanding the first questions of the scales or preceding questions in the
13 interview. When compared to those who answered the scales (n=968), those who did not answer
14 (n=50) were more often 85-year-old (60% vs. 20 %, $p<.001$), more often rated their health as
15 average or poor (88% vs. 53 %, $p<.001$) and had a lower MMSE score (24.4 vs. 27.3, $p<.001$).
16 The groups did not differ in sex, years of education or perceived financial situation.

17 For the test-retest study, an additional home interview was organized for 42 consecutive
18 volunteer participants of the initial sample, on average 18 days (SD 5.7) after the first interview.
19 Of these, one was 75-, 16 were 80- and 25 were 85-year-old. The test-retest analyses were
20 conducted for those with full data at both measurement points for the subscales (range n=38-41)
21 and the total SPWB (n=34), respectively.

22 The study protocol was approved by the Central Finland Health Care District and the
23 participants signed a written informed consent.

1 *Scales of Psychological Well-Being*

2 The 42-item version of the SPWB was administered during the computer-assisted face-to-face
3 interview that took place in the participants' homes. The scales were adopted from the Midlife in
4 the United States study (MIDUS 2; ICPSR, 2010, 22-24) with 7 items in each of the six
5 subscales (i.e. autonomy, environmental mastery, personal growth, positive relations, purpose in
6 life and self-acceptance). Of the 42 items, 18 had been translated into Finnish earlier (Pulkkinen,
7 Nygren & Kokko, 2002). We translated the remaining items using a back and forward translation
8 procedure by native-speaking English and Finnish translators. The back and forward translation
9 procedure is commonly accepted as a valid method for translation of multidimensional
10 questionnaires. However, an expert committee to evaluate the results and finalize the procedure
11 is recommended (Epstein, Osborne, Elsworth, Beaton & Guillemin, 2015). Our Finnish
12 translators had received academic training in English, worked in Academia in English speaking
13 countries, and had academic degrees in psychology, behavioral sciences and gerontology, and
14 they ensured the correspondence between the English and Finnish versions of the scales.

15 On a six-point rating scale, participants rated to what extent they either agreed or
16 disagreed with each of the 42 statements (1 totally disagree – 6 totally agree). A response card
17 marked with the scale 1 to 6, with extreme options 1 and 6 worded, were shown to the
18 participants to facilitate answering. Half of the 42 items were formulated as reversed items and
19 thus the answers to these were reverse coded. The subscale scores range from 7 to 42 and the
20 total score from 42 to 252, with higher scores indicating higher psychological well-being. In the
21 test-retest study, the SPWB were administered similarly.

22

23

1 ***Other variables***

2 Age and sex of the participants were derived from the Finnish Population Information System of
3 the Population Register Centre as part of the initial sampling procedure. Years of education,
4 perceived financial situation (Likert scale from 1 = very good to 4 = poor), and self-reported
5 health (Likert scale from 1=very good to 5=very poor) were elicited during the home interview.
6 Cognitive ability was assessed with the Mini-Mental State Examination (MMSE; Folstein,
7 Folstein & McHugh, 1975), in which scores range from 0 to 30, with higher scores indicating
8 better cognitive ability. Depressive symptoms were assessed with the Center for Epidemiologic
9 Studies Depression Scale (CES-D; Radloff, 1977), in which scores range from 0 to 40, with
10 higher scores indicating more depressive symptoms. Participants' quality of life was assessed
11 with the 13-item version of the Older People's Quality of Life questionnaire (OPQOL-brief;
12 Bowling, Hankins, Windle, Bilotta & Grant, 2013), in which scores range from 13-65, with
13 higher scores indicating better quality of life. All the above assessments were administered in the
14 home interview. Emotional well-being was assessed with the Satisfaction with Life Scale
15 (Diener, Emmons, Larsen & Griffin, 1985), which was included in the self-administered
16 questionnaire. Scores range from 7 to 35 with higher scores indicating higher well-being.

17 ***Usability data***

18 Usability data were collected during the test-retest interviews by asking the respondents how
19 they perceived responding to the scales. Moreover, 11 interviewers answered questions on the
20 usability of the SPWB (e.g. *'How easy or difficult was it for the respondents to answer to the*
21 *scales?'*, *'What kind of respondents has difficulty responding?'* and *'To what extent was there a*
22 *need to repeat or explicate the statements to the respondents?'*.

23

1 *Statistical analyses*

2 Analysis of variance (ANOVA) and chi square -tests were used to analyze the differences in
3 baseline characteristics of the study population by age group. We conducted both exploratory
4 and confirmatory factor analyses for the scale items to assess the validity of the factor structure
5 of the SPWB. The analysis comprised of 911 participants with full information on the scales.
6 Standard methods in structural equation modeling were used for model comparisons: for nested
7 factor models, comparisons were based on the likelihood ratio test, and for non-nested models,
8 the Akaike and Bayesian information criteria were used. To simultaneously account for all
9 uncertainty involved in the model, maximum-likelihood estimation of factor model parameters
10 was based on treating the items as ordinal-category variables with the logit-link. For exploratory
11 factor models, factors were permitted to correlate via geomin rotation. Factor analyses were
12 conducted as three-group models accounting for the age-groups in Mplus, version 7. The factor
13 model parameters are reported for the best fitting model.

14 The internal consistency reliability of the SPWB total scale and of the six subscales
15 separately were analyzed using Cronbach's alpha coefficients (α). These analyses included 911
16 participants without any missing information on the scales. Because reverse-coded items may
17 affect the psychometric properties of measurement scales and cause confusion among older
18 respondents (Lindwall et al., 2012), the analyses were conducted with and without reverse-coded
19 items. Moreover, the analyses were conducted stratified by MMSE score (<24 vs. ≥ 24). 24 is a
20 commonly used cut-point for detecting cognitive decline (Folstein, Folstein & Fanjiang, 2001;
21 Creavin et al., 2016) and has shown high sensitivity and specificity for detecting increased risk
22 of dementia (Creavin et al., 2016). To evaluate whether there is differences in the internal
23 consistency reliability of the scales between the age groups, the analyses were also stratified by

1 age group. For the sensitivity analyses, the Cronbach's alpha coefficients were calculated
2 stratified by sex and interviewer (i.e. for six interviewers who each conducted at least 60
3 interviews). Correlation coefficients of the individual items with the total SPWB and
4 intercorrelations between the six subscales were calculated. The construct validity of the SPWB
5 in relation to depressive symptoms, quality of life and life satisfaction was estimated with
6 Pearson correlation coefficients. We expected that depressive symptoms, an indicator of mental
7 ill-being, will correlate negatively with the SPWB, and that quality of life and life satisfaction,
8 indicators of positive psychological functioning, will correlate positively with the SPWB (Keyes,
9 2005). The test-retest reproducibility of the subscales and of the total SPWB was estimated with
10 intra-class correlation (ICC) coefficients for agreement. Kendal's Tau B was used to analyze
11 agreement between the individual items. The analyses were conducted with IBM SPSS Statistics
12 24. Statistical significance was set at $p < .05$.

13 *Qualitative analysis*

14 Participants' answers to the usability questions were categorized to ascertain common
15 experiences about responding to the scales. The interviewers' answers were first categorized
16 question by question based on common themes, after which the categorizations were combined
17 to describe the interviewers' common experiences of administering the SPWB to older people.

18 **Results**

19 *Descriptive characteristics of the study population*

20 Of the present participants, 46% (450) were 75-year-old, 33% (321) 80-year-old and 20% (197)
21 85-year-old. As shown in Table 1, compared to the younger age groups, the 85-year-olds had less
22 education, less often perceived their financial situation and self-rated health as good or very
23 good, more often had difficulties in walking two kilometers, had more depressive symptoms, and

1 had poorer quality of life. Moreover, cognitive ability was slightly lower among the 85-year-olds
2 than among the younger age groups. In total, 8% of the participants had an MMSE score below
3 24 (range 16-23); of these, 32% were 75-year-old, 27% 80-year-old and 41% 85-year-old. The
4 85-years-olds had lower total SPWB scores, which were stemming from their lower scores in the
5 environmental mastery, personal growth and purpose in life subscales compared to the younger
6 age groups (Table 1).

7 *Structural validity*

8 The results of the exploratory factor analyses stratified by age-group are shown in
9 Supplementary Tables 1-3. Table 2 shows that within each age-group all of the EFA or CFA
10 models with fewer than six factors had a significantly worse fit to data. Also, the information
11 criteria indicated that the six-factor EFA model lost significantly less information than the CFA
12 model. Therefore, we report the results of the EFA models. The common cut-points for number
13 of factors to retain (Cattell scree test, eigenvalues above unity, and Horn's parallel analysis)
14 indicated that there were eight unique dimensions of variation in the data. This is not consistent
15 with the six factors expected based on the underlying theory.

16 In the exploratory factor model enforced into six factors, the factor loadings did not
17 group according to the theoretical six-factor model, but instead were divided somewhat
18 unsystematically. Some individual items loaded on two different factors. The factor loadings
19 were organized differently in the three age-groups. The total variance explained by the model in
20 each age group was around 55%. Most notably, one of the factors correlated negatively with
21 other factors among the 85-year-olds. A large proportion of the reverse-coded items loaded in the
22 same factor among the 75- and 85- year-olds (Supplementary Tables 2, 3 and 4). Based on the

1 eigenvalues presented in Supplementary Figure 1, the best data fit would be for an eight-factor
2 model.

3 ***Internal consistency reliability***

4 Based on the Cronbach's alphas, the internal consistency reliability of the total SPWB was high
5 ($\alpha = 0.88$). For the subscales, the Cronbach's alphas were modest ($\alpha < 0.80$; Nunnally 1978),
6 except for the purpose in life subscale, which showed low internal consistency reliability ($\alpha =$
7 0.44). The Cronbach's alphas did not change materially when the reverse-coded items of the
8 scales were removed from the analysis. Removing individual items one at a time from the scales
9 decreased the alphas, except for two items of the purpose in life subscale ('*Some wander*
10 *aimlessly through life, not being one of them*' and '*Having done all there is to do in life*'; precise
11 scale items can be found at MIDUS 2 scales documentation, ICPSR 2010, 22-24). If these items
12 were removed, the Cronbach's alphas slightly improved ($\alpha = 0.47$ and $\alpha = 0.50$, respectively).
13 The Cronbach's alphas did not differ materially between people with MMSE <24 or ≥ 24 , except
14 for the purpose in life scale, in which the alpha was lower among those with MMSE <24 (Table
15 3). Only marginal differences were observed in the alphas between the sexes and between age
16 groups, except for a sex difference in the internal consistency reliability for the purpose in life
17 subscale (Cronbach's alpha was 0.52 for men and 0.38 for women). The Cronbach's alphas
18 showed some variation between the interviewers, but no systematic bias was detected (data not
19 shown).

20 All but one of the individual items correlated positively with the total score of the scales
21 (Table 4). The one exception that correlated negatively with the total score was the item '*Having*
22 *done all there is to do in life*' of the purpose in life subscale. The intercorrelations between the
23 subscales of the SPWB were moderate (Table 5).

1 ***Construct validity***

2 Correlations between the subscales of the SPWB and cognitive ability were modest or non-
3 existent. The total score and the subscale scores of the SPWB correlated positively with quality
4 of life and life satisfaction, and negatively with depressive symptoms (Table 6).

5 ***Test-retest reliability***

6 The intra-class correlation coefficient between the test and retest total SPWB score was $r=0.64$
7 ($p=0.002$). For the subscales the coefficients were: autonomy $r=0.49$ ($p=.019$), environmental
8 mastery $r=0.61$ ($p=.002$), personal growth $r=0.85$ ($p<.001$), positive relations $r=0.76$ ($p<.001$),
9 purpose in life $r=0.79$ ($p<.001$) and self-acceptance $r=0.77$ ($p<.001$), respectively. The Kendall's
10 Tau B coefficients for the correlations between the individual items of the scales ranged from
11 0.16 to 0.61 and were statistically significant for 35 of the 42 items (Table 3).

12 ***Usability of the scales***

13 Mean time to complete the SPWB was 17 minutes, ranging from 6 to 45 minutes. Half of the
14 respondents reported that answering was not especially difficult, and half that it required a great
15 deal of pondering. The interviewers reported that they often had to clarify or repeat statements to
16 confirm that the respondent had understood them correctly. The challenges were most common
17 when the respondent needed to select whether they agree or disagree with a negatively phrased
18 statement. Items including two-part statements, estimation of other people's views, or comparing
19 oneself to other people were considered confusing by both the respondents and interviewers.
20 Furthermore, the six-point rating scale sometimes required further clarification, as only response
21 options 1 and 6 were worded. The interviewers also reported that participants with cognitive
22 decline or problems in hearing or seeing often needed further clarification for some of the items.

23

1 **Discussion**

2 The present results on the validity, internal consistency reliability and test-retest reproducibility
3 of the SPWB indicated that the validity of the SPWB was questionable among a heterogeneous
4 group of older people. Moreover, the reliability of the scales was modest. However, the scales
5 were feasible to use, since most of our participants were able to answer them with little or no
6 clarification by the interviewers, but yet, others needed more assistance in understanding the
7 statements and the rating scale. Based on these findings, we cannot recommend using the SPWB
8 among older people without modifying the scales. Especially the results on the unclear structural
9 validity highlight the need for further examination of what constitutes psychological well-being
10 in old age. Moreover, we suggest further refinement of the individual items to optimally
11 operationalize the theoretical model. Our results indicate that the SPWB, initially developed for
12 use among adults of all ages (Ryff, 1989), need more development to be optimized for use
13 among older people aged 75 years or more. Currently, measurements of positive psychological
14 functioning targeted specifically for use with the oldest age groups are lacking.

15 For the total SPWB, the Cronbach's alphas showed high internal consistency reliability,
16 which, however, was not supported by the modest subscale alphas and factor correlations in the
17 EFA. Aside the purpose in life subscale, the results corresponded with those reported in earlier
18 studies using the 42-item version of the scales among older people (e.g. Choi & Kim, 2011;
19 Davison et al., 2012; Morozink et al., 2010). Our participants were recruited from a probability
20 sample drawn from the national population register, and all individuals willing to take part, and
21 able to communicate and give their consent, were included in the study. Thus, the sample was
22 representative of 75-, 80- and 85-year-old people with respect to a wide variety of characteristics
23 relating to, e.g., socio-economic background, health and functional status. In earlier studies using

1 the SPWB among older people, participants with cognitive decline have been excluded (e.g.
2 Davison et al., 2012; Guindon et al., 2004; Schanowitz & Nicassio, 2006). The fact that the
3 Cronbach's alphas found in this study were practically parallel among people with and without
4 cognitive decline, does not support the exclusion of older people from psychological aging
5 research based solely on their MMSE score. As recommended, especially for studies among
6 participants with cognitive decline (Mody et al., 2008), our interviewers were trained to give
7 participants as much time as they needed to answer, and if necessary, to clarify the questions.
8 This presumably alleviated problems in responding that might have arisen due to cognitive
9 deficits. It is imperative that people who are able to understand and sign an informed consent are
10 included regardless of their potential diagnosis (Mody et al., 2008). Our results strongly support
11 this view of inclusion. Based on our experiences, among older people who may be frail or have
12 cognitive decline, face-to-face interviews may be the most feasible way to administer
13 psychological scales.

14 The construct validity of the SPWB as a measure of positive psychological functioning
15 was supported by the positive correlations of the total and subscale scores with quality of life and
16 life satisfaction, and the negative correlations with depressive symptoms. Although the SPWB
17 correlated with the other measures, they do not excessively overlap with them. This suggests that
18 the SPWB measure an entity different from those measured by the other scales of positive or
19 negative well-being employed in the current study. The subscale scores were fairly comparable
20 to an earlier study among cognitively intact older people aged 64 to 98 years (Davison et al.,
21 2012). This provides some support for the validity of the SPWB. However, the low structural
22 validity found in the EFA and CFA models did not support the theoretical factor structure of the
23 SPWB. This is in line with some earlier studies that have questioned the validity of the six-factor

1 model (Springer et al., 2006; Springer & Houser, 2006) or reported overlap between the
2 subscales of the SPWB (Clarke et al., 2001; Springer & Hauser, 2006). It is possible that
3 psychological well-being in old age is different from that in earlier ages, which might explain the
4 inconclusive factor structure. It is also possible that the complexity of some of the items of the
5 scale underlie the current results.

6 The purpose in life subscale seemed especially problematic, since it showed low
7 Cronbach's alphas and variability based on sex and cognitive ability. The internal consistency
8 reliability of the purpose in life subscale has been questioned previously. For example, Triadó et
9 al. (2007) found a relatively low Cronbach's alpha (0.58) for the subscale in the 54-item version
10 of the SPWB. Guindon et al. (2004), in turn, did not find a coherent factor of purpose in life in
11 their study among older people when using the 18-item version of the SPWB. In the present
12 study, the internal consistency reliability of this subscale was most notably reduced by two
13 items: *'Some wander aimlessly through life, not being one of them'* and *'Having done all there is*
14 *to do in life'* (see Midus 2 scales documentation for exact phrasing of the items; ICPSR 2010, 22-
15 24.) The first is an example of an item including two claims while also requiring comparison of
16 oneself to other people, which the respondents considered confusing. The latter reverse-scored
17 statement correlated negatively with the total score of the SPWB. This might suggest that, in old
18 age, 'having done all there is to do in life' indicates good rather than low psychological well-
19 being. According to Erik Erikson's psychosocial theory of life-span development, it is of vital
20 importance that, in old age, people accept their life as it has been and attain a sense of integrity
21 (Erikson, 1980). Moreover, maintaining the current situation and feeling content with it, is a sign
22 of positive development in old age (Baltes, Staudinger & Lindenberger, 1999). In the present
23 study, the purpose in life scores were lower among the 85-year-olds than 75- and 80-year-olds,

1 and similar differences have been reported in earlier studies (Ryff, 1989; Springer et al., 2011).
2 This could be interpreted as a sign of a lower sense of purpose in the latest years of life, or as a
3 sign of positive psychological development, where the positive feeling of having done all there is
4 to do in life has increased. We conclude that, to optimize assessment of positive psychological
5 functioning among older people, this topic should be studied further.

6 Surprisingly little attention has been paid to the usability of long psychological scales
7 among older people. Usability refers to how well the users, i.e. researchers and respondents, can
8 learn and use the scale and how satisfied they are with the process of answering the items.
9 Questions that are easy to understand and respond to are essential when designing a valid scale.
10 In our study, both respondents and interviewers reported rather positive experiences in using the
11 SPWB. However, they also reported issues that might need further development, the most
12 notable being items that included a negation and/or required comparison to other people (e.g.,
13 *'Attitude about myself not as positive as most people have about themselves'*). Even minor
14 changes in wording may significantly influence people's responses to survey questions (Knäuper
15 et al., 2016), while the mix of positively and negatively worded items, in particular, may cause
16 method effect and bias the results of psychological measures among participants of all ages
17 (Lindwall et al., 2012). However, as discussed by Ryff and Singer (2006), negatively scored
18 items, which may or may not be negatively worded, are used to reduce measurement error and
19 avoid bias towards agreement with items in questionnaires (acquiescence response bias). In the
20 current study, we noticed that reverse-coded items mostly loaded on the same factor despite of
21 the subscale they represented. Therefore, in further development of the SPWB for use among
22 older people, the use of reverse-coded and negatively phrased items should be carefully re-
23 considered. It is also worth noting that the 6-point rating scale with worded anchors only for

1 'totally disagree' and 'totally agree' was challenging for some of our participants. As stated
2 before (Villar et al., 2010), a simpler rating scale might work better with older people. Therefore,
3 adding wording to all the options on the 6-point rating scale might facilitate responding. These
4 results based on our usability data highlight the need to consider user perspective in the
5 methodological development of measurements targeted for older people.

6 The strengths of this study include the use of a large population-based sample comprising
7 three different age cohorts and including participants with some cognitive decline. We used the
8 42-item version of the SPWB, which is recommended for valid assessment of each of the
9 subscales without extensive respondent burden (Morozink et al., 2010; Ryff, 2014). Employing
10 the SPWB in face-to-face interviews can be considered a strength of the study, since many of our
11 respondents needed clarification for some statements and probably would not have been able to
12 answer the scales via self-administered questionnaire. The qualitative usability data may prompt
13 interest in further refining the scales to better serve the needs of aging research.

14 A potential weakness of this study is that the SPWB was administered by a total of 24
15 interviewers during the AGNES cohort study data collection. Our principle was that instead of
16 presenting the questions in exactly the same way to everybody, it was important to ensure that
17 each participant understood the items correctly, even if they needed to be presented in slightly
18 different words. This presumably helped some of our participants to give more valid answers.
19 Nevertheless, we cannot rule out possible differences between interviewers in how they clarified
20 the items. It has been argued that, owing to less pressure for social desirability, psychological
21 measurements show better validity and reliability if employed via self-administered
22 questionnaires (Springer & Houser, 2006). Yet, assistance from the interviewers most likely
23 helped people with cognitive decline answer the scales. Another limitation is that the study

1 comprised only people aged 75, 80, or 85 years. Nevertheless, this rather limited range captured
2 interesting age differences, even though it does not represent the full spectrum of older people.
3 Moreover, the AGNES study participants were on average somewhat healthier and had better
4 functioning than those who refused to participate (Portegijs et al., 2019). It is presumable that
5 those who did not participate, might have had even more problems in answering the scales.
6 Therefore, it is possible that our results give slightly too positive an idea of the validity of the
7 scales. In addition, we should bear in mind that there might be cultural differences in self-
8 evaluations of psychological functioning (Karasawa et al., 2011). Finally, the results of the test-
9 retest study should be interpreted with caution, since we used a relatively small sample for the
10 reproducibility analyses.

11 The present results raised concern on the use of the SPWB among older people aged 75
12 years or more and questioned the structural validity of the scales. Therefore, future efforts to
13 develop the SPWB specifically for older people should take into account that the indicators of
14 psychological well-being in old age may differ from those in earlier ages. Moreover, optimizing
15 the clarity of the items by avoiding negative wordings, comparisons of oneself with others, and
16 items including two statements, would probably yield a more valid and reliable assessment of
17 psychological well-being in old age.

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Table 1. Descriptive characteristics of the total study population and by age group

	All (n=968)	75-year-olds (n=450)	80-year-olds (n=321)	85-year-olds (n=197)	p-value*
	% (n)	% (n)	% (n)	% (n)	
Sex (female)	57 (555)	58 (259)	56 (178)	60 (118)	.605
Perceived financial situation					.004
Good or very good	61 (588)	65 (291)	63 (201)	49 (96)	
Moderate	37 (356)	33 (144)	36 (116)	49 (96)	
Poor	2 (15)	2 (10)	1 (2)	2 (3)	
Self-rated health					<.001
Good or very good	47 (457)	56 (251)	43 (140)	34 (66)	
Moderate	48 (466)	41 (187)	53 (169)	57 (113)	
Poor or very poor	5 (45)	3 (15)	4 (12)	9 (18)	
Difficulties in walking 2 km					<.001
No difficulties	65 (620)	73 (328)	63 (200)	48 (92)	
Minor difficulties	20 (191)	16 (69)	23 (72)	26 (50)	
Major difficulties/need help/cannot	15 (142)	11 (49)	14 (43)	26 (50)	
	M(SD)	M(SD)	M(SD)	M(SD)	
Years of education	11.6 (4.6)	12.1 (4.2)	11.7 (5.3)	10.2 (4.0)	<.001
Cognitive ability (MMSE)	27.3 (2.4)	27.7 (2.1)	27.2 (2.4)	26.3 (2.7)	<.001
Depressive symptoms (CES-D)	8.6 (7.0)	7.9 (6.5)	8.7 (7.4)	10.0 (7.5)	.002
Quality of life (OPQOL-brief)	54.5 (5.9)	55.5 (5.3)	54.4 (5.7)	52.3 (6.7)	<.001
Emotional well-being (Satisfaction with Life Scale)	26.7 (5.3)	26.9 (5.1)	26.6 (5.5)	26.3 (5.5)	.467

<i>Scales of Psychological Well-Being</i>	M(SD)	M(SD)	M(SD)	M(SD)	p-value*
Autonomy	31.2 (4.8)	31.4 (4.7)	31.0 (4.9)	31.1 (4.9)	.553
Environmental mastery	34.0 (4.7)	34.4 (4.6)	34.0 (4.6)	33.4 (4.9)	.040
Personal growth	28.1 (5.1)	28.9 (5.2)	28.0 (4.9)	26.5 (5.1)	<.001
Positive relations	33.7 (4.7)	34.0 (4.5)	33.8 (4.5)	33.0 (5.2)	.056
Purpose in life	29.5 (4.6)	30.4 (4.4)	29.2 (4.6)	27.9 (4.5)	<.001
Self-acceptance	31.3 (4.8)	31.6 (4.6)	31.1 (4.7)	31.2 (5.2)	.348
Total score	187.8 (20.9)	190.6 (20.5)	187.0 (20.2)	182.4 (21.8)	<.001

* Analyses of variance (ANOVA) for the continuous variables and chi-square test for the categorized variables

Note. Perceived financial situation n=959; self-rated health n=968; difficulties in walking 2 km n=953; years of education n=958; MMSE n=964; CES-D n=960; OPQOL-brief n=947; Satisfaction with Life Scale n=915

Table 2. Model fit statistics for the Scales of Psychological Well-Being from exploratory and confirmatory factor analysis (CFA) models.

Age	Model type	<i>k</i>	<i>ll</i>	par	Information criteria		Likelihood ratio test			Best fitting [#]	
					AIC	BIC	χ^2	<i>df</i>	<i>p</i>		
75	EFA	6	-23276.039	446	47444	49254	Ref.	--	--	×	
		5	-23351.964	409	47522	49182	152	37	<0.0005		
		4	-23428.712	371	47599	49105	305	75	<0.0005		
		3	-23574.453	332	47813	49161	597	114	<0.0005		
		2	-23774.392	292	48133	49318	997	154	<0.0005		
		1	-24134.257	251	48771	49789	1716	195	<0.0005		
	CFA	6	-23978.018	266	48488	49568	Ref.	--	--		
		1	-24134.239	251	48770	49789	312	15	<0.0005		
	80	EFA	6	-16789.271	443*	34465	36108	Ref.	--	--	×
			5	-16821.531	406*	34455	35961	65	40	0.008	
4			-16983.064	368*	34522	35888	388	70	<0.0005		
3			-16977.055	329*	34612	35833	376	117	<0.0005		
2			-17117.919	289*	34814	35886	657	157	<0.0005		
1			-17403.670	248*	35303	36224	1229	198	<0.0005		
CFA		6	-17327.566	263*	35181	36157	Ref.	--	--		
		1	-17403.666	248*	35303	36224	152	15	<0.0005		
85		EFA	6	-10339.679	443*	21565	22980	Ref.	--	--	×
			5	-10382.648	406*	21577	22874	86	37	<0.0005	
	4		-10424.153	368*	21584	22759	169	75	<0.0005		
	3		-10477.855	329*	21614	22664	276	114	<0.0005		
	2		-10576.056	289*	21730	22653	473	154	<0.0005		
	1		-10736.457	248*	21969	22761	794	154	<0.0005		
	CFA	6	-10707.124	263*	21940	22780	Ref.	--	--		
		1	-10736.456	248*	21969	22761	59	15	<0.0005		

Note: EFA = exploratory factor analysis; CFA = confirmatory factor analysis; *k* = number of factors

ll = log-likelihood; par = number of model parameters; AIC = Akaike Information Criterion
BIC = Bayesian Information Criterion; *df* = degrees of freedom; *p* = *p*-value

* Number of parameters reduced due to unused response categories.

[#]Model selection sequence in each age group: 1) within EFA and CFA models the best fitting model would be the one with the lowest number of factors that also had a non-significant likelihood ratio test statistic 2) Between EFA and CFA models the best model was one with the lowest information criteria estimates.

Table 3. Internal consistency reliability of the SPWB: Cronbach's Alphas with and without reversed items and separately for subgroups with and without cognitive decline (n=911)

	Cronbach's Alpha	Cronbach's Alpha without reversed items	Cronbach's Alpha, MMSE \geq 24	Cronbach's Alpha MMSE < 24
Autonomy	0.61	0.56	0.62	0.53
Environmental mastery	0.69	0.58	0.70	0.54
Personal growth	0.64	0.55	0.65	0.54
Positive relations	0.70	0.66	0.71	0.68
Purpose in life	0.44*	0.40	0.44#	0.31 α
Self-acceptance	0.70	0.67	0.71	0.62
Total score	0.88	0.86	0.88	0.83

number of participants with full data in the SPWB

*0.47 if deleted item: 'Some people wander aimlessly through life, but I am not one of them'; 0.50 if deleted item: 'I sometimes feel as if I've done all there is to do in life'

#0.46 if deleted item "Some people wander aimlessly through life, but I am not one of them"; 0.51 if deleted item: "I sometimes feel as if I've done all there is to do in life"

α 0.44 if deleted item "Some people wander aimlessly through life, but I am not one of them"

Table 4. Items of the Scales of Psychological Well-Being (Ryff 1989; MIDUS 2: ICPSR, 2010) organized by subscales, item-total correlations of the individual items of the SPWB with the total score and Kendal's Tau B coefficients for test-retest reproducibility of the individual items. The items can be found in MIDUS 2 scales documentation (ICPSR, 2010, 22-24).

Item	Mean (SD)	Item-total correlation	Kendal's Tau B	p-value*
<i>Autonomy</i>				
Aut1	4.7 (1.2)	0.40	0.32	.017
Aut2	4.2 (1.3)	0.28	0.26	.048
Aut3 R	4.2 (1.4)	0.24	0.26	.038
Aut4	4.4 (1.1)	0.37	0.32	.017
Aut5 R	4.1 (1.4)	0.37	0.43	<.001
Aut6 R	4.9 (1.2)	0.36	0.50	<.001
Aut7	4.7 (1.1)	0.28	0.19	.152
<i>Environmental mastery</i>				
Env1	4.8 (1.0)	0.40	0.21	.126
Env2 R	4.7 (1.2)	0.46	0.49	<.001
Env3 R	4.9 (1.2)	0.31	0.34	.014
Env4	5.3 (0.9)	0.37	0.47	.001
Env5 R	4.4 (1.4)	0.36	0.26	.044
Env6 R	4.7 (1.2)	0.51	0.26	.050
Env7	5.3 (0.8)	0.43	0.51	<.001
<i>Personal growth</i>				
PGr1 R	4.0 (1.5)	0.42	0.28	.027
PGr2	4.2 (1.2)	0.41	0.44	.001
PGr3 R	3.9 (1.4)	0.39	0.36	.005
PGr4	4.7 (0.9)	0.30	0.26	.064
PGr5	4.7 (1.1)	0.30	0.28	.041
PGr6 R	3.1 (1.5)	0.30	0.47	<.001

PGr7 R	3.5 (1.4)	0.33	0.61	<.001
<i>Positive relations</i>				
Pre1	4.3 (1.1)	0.42	0.42	.002
Pre2 R	5.0 (1.1)	0.48	0.50	<.001
Pre3 R	4.7 (1.4)	0.36	0.55	<.001
Pre4	5.4 (0.8)	0.47	0.42	.005
Pre5	4.4 (1.0)	0.40	0.48	<.001
Pre6 R	4.7 (1.3)	0.44	0.53	<.001
Pre7	5.3 (0.9)	0.45	0.36	.014
<i>Purpose in life</i>				
PiL1 R	3.8 (1.7)	0.21	0.50	<.001
PiL2	4.9 (1.1)	0.30	0.54	<.001
PiL3 R	4.3 (1.4)	0.32	0.24	.064
PiL4 R	4.8 (1.2)	0.25	0.16	.238
PiL5	4.1 (1.3)	0.36	0.48	<.001
PiL6	4.3 (1.4)	0.07	0.20	.126
PiL7 R	3.4 (1.4)	-0.10	0.37	.004
<i>Self-acceptance</i>				
SAc1	4.7 (1.2)	0.46	0.59	<.001
SAc2	4.3 (1.0)	0.46	0.38	.006
SAc3 R	4.9 (1.2)	0.38	0.38	.004
SAc4	4.2 (1.1)	0.37	0.32	.017
SAc5 R	4.6 (1.2)	0.50	0.26	.051
SAc6 R	3.6 (1.3)	0.27	0.24	.068
SAc7	4.8 (1.0)	0.44	0.50	<.001

Note. R = Reverse-coded item; Aut = Autonomy, Env = Environmental mastery, PGr = Personal growth, PRe = Positive

relations, PiL = Purpose in life, SAc = Self-acceptance

* for Kendal's Tau B coefficients

Table 5. Intercorrelations between the subscales of SPWB

	1	2	3	4	5	6
1. Autonomy	1.00					
2. Environmental mastery	.49	1.00				
3. Personal growth	.29	.36	1.00			
4. Positive relations	.43	.59	.42	1.00		
5. Purpose in life	.25	.40	.51	.39	1.00	
6. Self-acceptance	.48	.66	.38	.59	.36	1.00

Note. Pearson correlation coefficients; all correlations are significant at the .001 level (two-tailed)

Table 6. Correlations of SPWB with cognitive ability, depressive symptoms, quality of life and life satisfaction

	Autonomy	Environmental mastery	Personal growth	Positive relations	Purpose in life	Self- acceptance	Total score of SPWB
Cognitive ability (MMSE)	.03	.11**	.18**	.07*	.24**	.04	.16**
Depressive symptoms (CES-D)	-.31**	-.60**	-.34**	-.47**	-.38**	-.54**	-.60**
Quality of life (OPQOL-brief)	.31**	.56**	.43**	.52**	.39**	.51**	.62**
Life satisfaction (Satisfaction with Life Scale)	.22**	.47**	.21**	.36**	.24**	.55**	.46**

Note. Pearson correlation coefficients

* correlation is significant at the .05 level (two-tailed)

** correlation is significant at the .001 level (two-tailed)

Supplementary Table 1. Geomin-rotated loadings and item residual variances for subjects aged 75 years (N=428).

Item	Factor						u ²
	1	2	3	4	5	6	
Aut1	0.203	0.122	0.096	0.038	0.565	0.006	0.504
Aut2	0.437	-0.128	0.004	-0.255	0.357	0.054	0.649
Aut3 R	0.131	0.484	-0.099	-0.038	0.198	-0.025	0.721
Aut4	0.366	-0.033	-0.087	0.018	0.439	0.356	0.463
Aut5 R	0.010	0.427	0.030	0.083	0.544	-0.069	0.457
Aut6 R	0.409	0.547	-0.119	-0.128	0.215	-0.037	0.471
Aut7	0.368	-0.021	0.162	-0.034	0.188	-0.002	0.739
Env1	0.587	0.031	-0.043	0.103	0.205	0.069	0.521
Env2 R	0.497	0.424	0.029	0.016	0.015	-0.182	0.448
Env3 R	0.040	0.508	0.287	-0.013	-0.118	0.049	0.536
Env4	0.563	0.055	0.088	0.198	-0.011	0.047	0.497
Env5 R	0.384	0.433	-0.068	-0.087	-0.090	-0.165	0.620
Env6 R	0.410	0.483	0.062	0.103	0.020	-0.142	0.408
Env7	0.356	0.065	0.459	0.066	-0.093	0.002	0.471
PGr1 R	-0.067	0.369	-0.063	0.432	0.133	0.023	0.587
PGr2	-0.205	0.004	0.311	0.348	0.233	-0.099	0.654
PGr3 R	-0.041	0.322	0.019	0.357	0.100	0.280	0.566
PGr4	0.175	-0.043	0.295	0.314	0.130	0.220	0.489
PGr5	0.007	-0.089	0.281	0.399	0.089	0.029	0.671
PGr6 R	-0.179	0.342	-0.197	0.448	-0.069	0.147	0.651
PGr7 R	-0.161	0.544	0.097	0.031	0.240	-0.016	0.628
PRe1	0.019	-0.021	0.428	-0.035	-0.008	0.404	0.555
PRe2 R	-0.026	0.433	0.471	-0.081	0.007	-0.013	0.513
PRe3 R	0.294	0.379	0.218	-0.075	-0.036	-0.076	0.599
PRe4	0.006	0.033	0.881	0.016	-0.017	-0.023	0.207
PRe5	0.048	0.051	0.349	0.092	0.060	0.363	0.567
PRe6 R	-0.047	0.515	0.244	0.079	0.030	0.060	0.560
PRe7	0.129	0.097	0.503	-0.017	0.016	0.035	0.617
PiL1 R	0.056	0.012	-0.265	0.634	-0.298	-0.124	0.611
PiL2	0.157	0.045	0.389	0.298	0.039	0.080	0.518
PiL3 R	0.217	0.310	0.026	0.435	0.015	-0.018	0.508
PiL4 R	0.175	0.524	0.062	0.133	-0.021	0.197	0.472
PiL5	0.168	-0.121	0.178	0.551	0.014	-0.022	0.565
PiL6	0.375	-0.164	0.085	0.111	-0.035	0.042	0.810
PiL7 R	-0.256	0.139	0.008	0.034	0.008	-0.114	0.910
SAc1	0.208	0.179	0.315	-0.002	-0.024	0.052	0.699
SAc2	0.528	0.035	0.089	0.175	0.102	0.188	0.436
SAc3 R	0.075	0.620	0.135	0.073	0.016	0.059	0.453
SAc4	0.261	-0.002	0.120	-0.056	-0.015	0.582	0.454
SAc5 R	0.160	0.602	0.095	0.070	-0.083	0.156	0.417
SAc6 R	-0.065	0.591	-0.045	-0.093	-0.042	0.289	0.626
SAc7	0.479	0.025	0.211	-0.002	-0.095	0.275	0.468
				Percent of total variance:			55.51
Factor correlations							
1	--						
2	0.269	--					
3	0.429	0.318	--				
4	0.180	0.261	0.298	--			
5	0.141	-0.005	0.172	0.297	--		
6	0.242	0.021	0.306	0.159	0.075	--	

Note: R = Reverse-coded item; Aut = Autonomy, Env = Environmental mastery, PGr = Personal growth, PRe = Positive relations, PiL = Purpose in life, SAc = Self-acceptance
The items can be found in MIDUS 2 scales documentation (ICPSR 2010, 22-24).

Supplementary Table 2. Geomin-rotated loadings and item residual variances for subjects aged 80 years (N=302).

Item	Factor						u ²
	1	2	3	4	5	6	
Aut1	0.051	0.086	-0.055	0.270	0.499	-0.056	0.588
Aut2	-0.023	0.109	0.133	0.087	0.491	-0.525	0.439
Aut3 R	-0.135	-0.073	0.178	-0.159	0.353	0.167	0.734
Aut4	0.414	-0.026	-0.053	0.030	0.543	0.049	0.526
Aut5 R	0.057	-0.006	-0.013	0.009	0.549	0.276	0.576
Aut6 R	-0.405	-0.015	0.531	-0.020	0.385	0.003	0.340
Aut7	0.136	-0.094	0.286	0.062	0.305	-0.212	0.694
Env1	0.124	0.245	0.031	0.306	0.300	0.021	0.529
Env2 R	-0.130	0.288	0.095	0.006	0.371	0.223	0.564
Env3 R	0.006	-0.065	0.667	-0.033	0.015	0.217	0.489
Env4	-0.048	0.193	0.338	0.304	0.054	-0.198	0.567
Env5 R	-0.064	0.044	0.486	-0.158	0.104	0.112	0.700
Env6 R	0.018	0.191	0.459	0.051	0.161	0.133	0.480
Env7	0.131	0.276	0.520	0.019	0.097	-0.077	0.391
PGr1 R	-0.089	-0.156	0.088	0.338	0.026	0.434	0.643
PGr2	-0.081	-0.164	0.044	0.711	0.064	0.093	0.503
PGr3 R	0.202	0.063	0.197	0.007	0.046	0.458	0.659
PGr4	0.067	0.093	0.479	0.343	-0.159	-0.064	0.499
PGr5	0.163	-0.016	0.241	0.418	0.023	-0.005	0.583
PGr6 R	-0.017	-0.033	-0.343	0.253	-0.100	0.515	0.665
PGr7 R	-0.035	-0.046	-0.031	0.093	0.047	0.548	0.675
PRe1	0.558	-0.006	0.273	-0.021	0.028	0.123	0.560
PRe2 R	-0.056	0.110	0.568	0.008	0.045	0.276	0.446
PRe3 R	0.015	0.049	0.432	-0.098	0.197	0.365	0.491
PRe4	0.011	-0.168	0.802	0.226	-0.121	0.013	0.327
PRe5	0.443	-0.111	0.409	0.102	-0.036	-0.009	0.548
PRe6 R	-0.059	0.008	0.430	-0.015	-0.054	0.370	0.640
PRe7	0.041	0.033	0.773	0.093	-0.112	-0.012	0.371
PiL1 R	-0.040	-0.368	0.101	0.006	0.033	0.408	0.686
PiL2	0.286	0.075	0.218	0.289	0.019	0.230	0.546
PiL3 R	0.149	0.171	0.040	0.025	-0.072	0.627	0.585
PiL4 R	0.029	0.001	0.507	-0.001	0.123	0.351	0.459
PiL5	0.222	0.143	-0.087	0.461	-0.001	0.272	0.585
PiL6	0.145	-0.003	0.322	0.009	0.129	-0.159	0.784
PiL7 R	-0.247	-0.393	-0.054	0.047	0.041	0.238	0.658
SAc1	0.005	0.572	0.303	0.067	-0.136	0.032	0.459
SAc2	0.153	0.297	0.212	0.374	0.227	-0.023	0.257
SAc3 R	-0.233	0.022	0.598	0.043	-0.016	0.157	0.552
SAc4	0.396	0.033	0.169	0.174	0.215	-0.086	0.534
SAc5 R	-0.103	0.414	0.221	-0.009	0.178	0.293	0.476
SAc6 R	-0.252	0.400	-0.016	0.044	0.050	0.167	0.761
SAc7	0.338	0.279	0.428	0.013	0.030	-0.047	0.389
Percent of total variance:							54.66
Factor correlations							
1	--						
2	0.240	--					
3	0.213	0.407	--				
4	0.390	0.297	0.422	--			
5	0.077	0.281	0.469	0.262	--		
6	-0.427	0.002	0.195	0.032	0.178	--	

Note: R = Reverse-coded item; Aut = Autonomy, Env = Environmental mastery, PGr = Personal growth, PRe = Positive relations, PiL = Purpose in life, SAc = Self-acceptance

The items can be found in MIDUS 2 scales documentation (ICPSR 2010, 22-24).

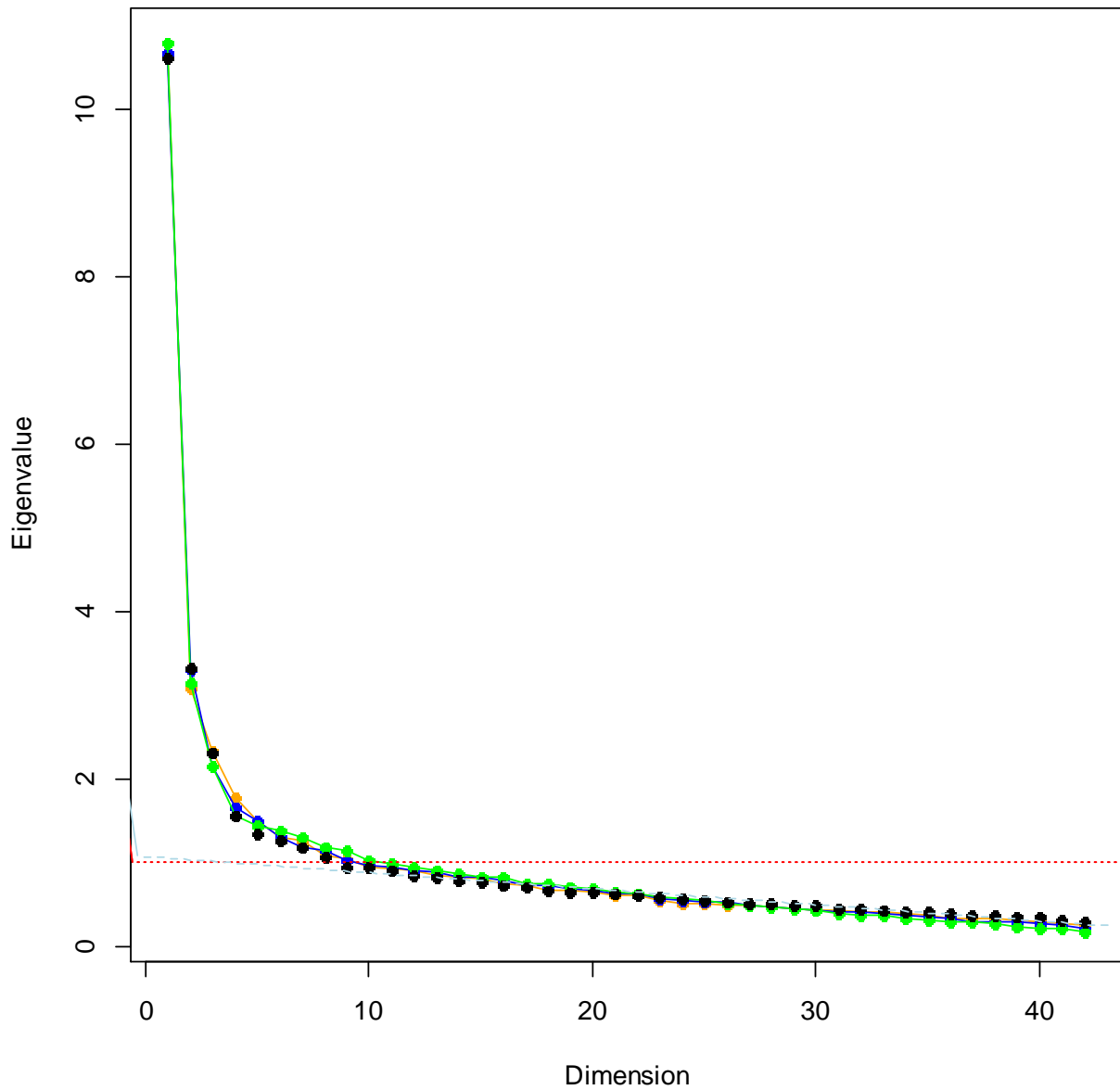
Supplementary Table 3. Geomin-rotated loadings and item residual variances for subjects aged 85 years (N=180).

Item	Factor						u ²
	1	2	3	4	5	6	
Aut1	0.051	0.077	0.230	-0.009	0.406	0.281	0.539
Aut2	0.043	0.700	0.030	-0.029	0.150	0.065	0.385
Aut3 R	-0.069	-0.102	0.517	-0.086	-0.058	0.173	0.690
Aut4	0.273	0.057	-0.106	-0.063	0.466	0.199	0.518
Aut5 R	-0.090	-0.141	0.560	0.055	0.495	-0.041	0.435
Aut6 R	0.023	-0.002	0.528	-0.201	0.216	0.101	0.510
Aut7	0.207	0.180	-0.009	0.040	-0.031	0.356	0.717
Env1	0.266	0.194	0.267	0.075	0.324	0.039	0.500
Env2 R	0.151	-0.127	0.500	-0.104	-0.111	0.060	0.624
Env3 R	0.173	0.176	0.473	-0.095	-0.023	0.025	0.588
Env4	0.520	0.069	0.042	0.047	0.005	0.206	0.570
Env5 R	0.123	-0.032	0.425	-0.146	-0.046	-0.052	0.734
Env6 R	0.340	-0.052	0.509	0.007	-0.091	-0.196	0.522
Env7	0.595	0.116	0.110	-0.093	0.032	0.108	0.413
PGr1 R	0.054	-0.341	0.267	0.471	-0.028	0.080	0.581
PGr2	0.530	0.183	-0.121	0.506	0.061	-0.011	0.478
PGr3 R	0.371	-0.324	0.096	0.010	0.140	0.021	0.727
PGr4	0.496	-0.046	0.035	-0.043	-0.005	0.184	0.652
PGr5	0.253	-0.075	-0.009	0.171	0.213	0.401	0.620
PGr6 R	-0.002	-0.046	0.319	0.559	-0.034	-0.300	0.532
PGr7 R	0.238	-0.238	0.259	0.231	0.087	-0.223	0.704
PRe1	0.160	0.351	0.316	0.126	0.041	0.145	0.585
PRe2 R	-0.048	0.342	0.674	-0.015	0.033	0.147	0.360
PRe3 R	0.420	0.021	0.323	0.053	-0.074	-0.051	0.629
PRe4	0.213	0.185	0.271	0.020	-0.018	0.498	0.365
PRe5	0.022	0.364	0.268	0.005	0.207	0.107	0.642
PRe6 R	-0.007	0.052	0.735	0.069	0.113	-0.003	0.431
PRe7	0.309	0.074	0.175	0.020	0.125	0.347	0.517
PiL1 R	-0.091	-0.531	0.061	0.357	0.022	0.123	0.545
PiL2	0.691	0.114	0.052	0.059	-0.252	-0.020	0.518
PiL3 R	0.325	-0.312	0.331	-0.001	0.072	-0.158	0.620
PiL4 R	0.383	-0.008	0.384	-0.113	-0.171	0.021	0.563
PiL5	0.747	-0.173	-0.146	0.470	0.010	0.015	0.379
PiL6	0.065	0.120	0.097	-0.079	0.138	0.226	0.817
PiL7 R	-0.253	0.026	0.271	0.455	-0.312	0.006	0.599
SAc1	0.703	0.063	0.016	-0.236	-0.210	0.015	0.430
SAc2	0.539	0.045	0.016	-0.070	0.316	-0.060	0.471
SAc3 R	0.297	-0.097	0.455	-0.144	-0.030	0.041	0.532
SAc4	0.364	0.245	0.076	-0.194	0.250	-0.009	0.509
SAc5 R	0.035	0.028	0.642	-0.179	0.209	-0.185	0.445
SAc6 R	0.023	0.098	0.529	0.035	0.038	-0.500	0.585
SAc7	0.450	-0.137	0.035	-0.430	0.119	0.241	0.391
				Percent of total variance:			54.70
Factor correlations							
1	--						
2	0.252	--					
3	0.485	0.012	--				
4	-0.117	-0.125	-0.116	--			
5	0.348	0.168	0.159	-0.034	--		
6	0.300	0.270	0.202	-0.074	0.177	--	

Note: R = Reverse-coded item; Aut = Autonomy, Env = Environmental mastery, PGr = Personal growth, PRe = Positive relations, PiL = Purpose in life, SAc = Self-acceptance

The items can be found in MIDUS 2 scales documentation (ICPSR 2010, 22-24).

Supplementary Figure 1. Eigenvalues within age groups (orange: 75, blue: 80, green: 85, black: pooled).



Note: Red dotted line: eigenvalue of one; light blue dashed line: linearity of eigenvalues from dimension 9 onwards. Horn's parallel analysis also suggests that eight factors emerge from the data.