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# How to measure self-management abilities in older people by self-report. The development of the SMAS-30

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## Abstract

This paper presents the results of two studies carried out in order to design and test a self-report instrument to measure Self-Management Ability (the SMAS-30) in aging individuals. SMA refers to the core behavioral and cognitive abilities which presumably contribute to sustainable well-being in later life. Robust findings of the studies (n = 275 and n = 1338) showed that SMA could be measured reliably as a composite concept of abilities systematically linked to dimensions of well-being in adults aged 65 and over, with the different sub-scales revealing a profile of inter-related abilities. A sub-sample of participants in Study 2 (n = 86) showed that the SMAS-30 had high reproducibility over a period of 16 weeks. The validity of the SMAS-30 was supported by meaningful associations with other constructs in both studies. As expected, the older and frailer the people, and the poorer their perceived health, the lower their SMA. Moreover, SMA was positively related to several dimensions of subjective well-being and the related concepts of general self-efficacy and mastery.

**Key words:** Aged, Quality of life, Questionnaire design, Self-management

**Abbreviations:** CFA – Confirmatory Factor Analysis; CI – Confidence Interval; DM – Double Monotonicity; ICC – Intraclass Correlation; IFI – Incremental Fit Index; MH – Monotone Homogeneity; PCA – Principal Components Analysis; RMSEA – Root Mean Square Error of Approximation; SEM – Standardized Error of Measurement; SMA – Self-Management Ability; SMAS-30 – Self-Management Scale-30; SPF theory – Social Production Functions theory; SRMR – Standardized Root Mean Square Residual; SSMA theory – Theory of Successful Self-Management of Aging

## Introduction

In recent years it has been increasingly widely acknowledged that aging successfully is partly a matter of how individuals self-regulate or self-manage their own lives and the aging process. This self-regulation is often mainly related to the physical health aspects of aging, such as exercise and diet [see, e.g., 1–3]. However, the social and psychological aspects of life, such as social contacts, adaptation, and well-being, have proven to be just as important for elderly people to 'age well' [4]. Despite acknowledgement of the importance of each individual's own contributions to the process of aging successfully, and despite the existence of psychosocial theories about 'successful aging' [see, e.g., 5–9], it is remarkable that there are relatively few suggestions as to how elderly people can

achieve better self-regulation of their general and sustainable well-being [10]. There are also no concrete guidelines for the evaluation of this self-regulation. In the literature there are reports of several measurement instruments that can be used to measure well-being or life-management strategies [e.g., 11], but there are no instruments available that can be used to measure self-regulating abilities in relation to well-being. Without such measurement instruments it is not really possible to evaluate the effectiveness of interventions aimed at self-regulation and well-being, and they are also important for diagnostic and prospective research. The aim of the studies described in this paper was to develop and test a new instrument to measure the abilities which are presumably important for elderly people to realize and sustain their well-being.

*Successful self-management of aging*

A theory that offers concrete guidelines on how people can achieve better self-regulation with regard to well-being is the theory of successful self-management of aging [SSMA theory, 10], which is based on the theory of 'social production functions' [SPF theory, 12, 13]. Successful aging, according to this theory, is a life-span process of realizing and sustaining well-being. Therefore, the successful self-management of aging concerns the ways in which people are able to realize well-being and in particular, how they can sustain it, even when their resources decline. The SSMA theory does not regard successful aging primarily as a process of neutralizing losses and discrepancies, but focuses on an individual's reserve capacity to realize and sustain physical and social well-being [10].

Two kinds of resources to realize well-being can be distinguished: *direct resources* and *self-management abilities*. The *direct resources* contribute in a direct way to (aspects of) well-being, such as food and shelter for physical well-being, and friends for social well-being, and they tend to decline with age. *Self-management abilities* are needed to manage direct resources in such a way that (aspects of) physical and social well-being are achieved, maintained, and restored when lost. An example is the ability to look ahead and, in this way, to invest in resources which contribute to well-being in the long run, such as investing in good health and good social relationships.

Six core self-management abilities are considered in the theory, and together they form the composite construct of 'SMA' (Self-Management Ability). In the literature, all six abilities have been shown, although sometimes by another name or in an indirect way, to be strongly related to indicators of well-being and to undergo a clear decline with aging (see [10] for a review). This combination of their importance for well-being and the risk of decline due to the physical and psychosocial losses that are associated with higher age, makes these abilities especially important for successful aging. The six abilities are:

(1) the ability to ensure multifunctionality of resources (the ability to gain and maintain resources or activities which serve multiple dimensions of well-being at the same time, in a mutually reinforcing way);
(2) the ability to maintain variety in resources (the ability to achieve and maintain various resources for each dimension of well-being);
(3) the ability to keep a positive frame of mind (the ability to maintain a positive perspective regarding the future, rather than to focus on loss);
(4) the ability to invest in resources for longer-term benefits (investment behavior);
(5) the ability to be self-efficacious with regard to managing resources (the ability to gain and maintain a belief in personal competence to achieve well-being);
(6) the ability to take the initiative (the ability to be instrumental or self-motivating with regard to the realization of dimensions of well-being).

It is necessary to relate every ability explicitly to the dimensions of well-being, which are specified in the SPF theory: namely, comfort and stimulation for physical well-being; affection, behavioral confirmation, and status for social well-being [12–14]. Examples of abilities that are directed at dimensions of well-being are taking the initiative with regard to comfort, or being self-efficacious in receiving and giving affection. Only in this way can these abilities contribute to the successful self-management of aging. Other theories on successful aging [see, e.g., 5–9] only define abilities or strategies, but the SSMA theory defines both the abilities and the dimensions

of well-being to which these abilities can best be directed in order to age successfully.

Although the theory distinguishes six self-management abilities, they are not assumed to be independent. Several abilities are often implemented at the same time, and reinforce each other. For instance, having a positive frame of mind promotes investment behavior, and being self-efficacious promotes taking the initiative. Therefore, it is assumed that the six abilities, systematically linked to the various dimensions of well-being, form one composite concept, namely SMA.

*Overview of the research and expectations*

The six SMAs systematically linked to the five dimensions of well-being were integrated in a matrix which formed the basis for the design of the instrument to measure SMA (see Table 1). This integration implies that each SMA was given 'content' by connecting it with the five main dimensions of well-being. Two abilities deviated from this principle: multifunctionality because, by definition, it refers to more than one dimension of well-being at the same time, and positive frame of mind because it was considered to be a more general cognitive ability.

The two studies concerning the development and testing of the SMA measurement instrument are described below. In the first study (the design study) a large pool of items to measure SMA was designed and tested in a pilot sample of people aged 65 years and older. On the basis of this study, the final instrument – the SMAS-30 – was developed. In the second study, the test and validation study, the final instrument was tested in a large sample of community-dwelling elderly people, 65 years of age and older. In this study, Confirmatory Factor Analysis (CFA) was applied to test the measurement model of the scale. The reproducibility and validity of the instrument were also investigated. Our aim was to develop a scale that consists of six inter-related, cumulative sub-scales, the sum of which can be used to create a composite SMA score.

To test the validity of the SMAS-30, we investigated the relationship of SMA scores with concepts that, according to the SSMA theory, are related to SMA. These included age, frailty, perceived health, subjective well-being, general self-efficacy and mastery. SMA and age were expected to be negatively related. Chronological age can be considered as a proxy for all kinds of losses and deficits which occur in aging. These losses, in turn, are related to a decline in SMA [see, e.g., 7, 15–19]. SMA and frailty were also expected to be negatively related. Frailty means loss of direct resources in several domains of functioning [15], and these losses are also related to a decline in SMA [see, e.g., 7, 16–18, 20]. Third, greater SMA was expected to be related to better perceived health. Perceived health can be considered as part of the well-being dimension of 'comfort', which, according to the theory, is fostered by SMA. Lastly, we expected that greater SMA would be related to more positive well-being (positive affect, life-satisfaction, and overall well-being) and to less 'negative well-being' (negative affect and psychological distress), because SMAs are abilities that foster the realization of well-being [e.g., 16, 18, 21–26].

As a partly overlapping construct, general self-efficacy was expected to be related to SMA, because SMA also includes aspects of self-efficacy. Another partly overlapping construct was mastery. We expected that people with greater SMA would feel more in control of their lives, and would therefore have a higher sense of mastery.

**Table 1.** Self-management abilities systematically linked to dimensions of well-being

| | Comfort | Stimulation | Affection | Behavioral confirmation | Status |
|---|---|---|---|---|---|
| *Multifunctionality* | | | | | |
| Variety | 2 | 1 | 4 | 5 | 3 |
| *Positive Frame of Mind* | | | | | |
| Investment Behavior | 5 | 2 | 3 | 1 | 4 |
| Self-efficacy | 4 | 2 | 3 | 5 | 1 |
| Taking Initiatives | 4 | 3 | 1 | 2 | 5 |

Numbers in the cells are the numbers of the items, corresponding to Appendix A.

## Methods

### *Design of item*

Based on the SSMA theory [10], a pool of 74 items was formulated by a panel of eight experts, consisting of health care professionals and researchers specialized in geriatrics, gerontology and health sociology. For every 'cell' of the matrix (see Table 1) several equivalent items were designed, to make it possible to choose the best items after testing. Each item measured an ability, mainly in relation to a specific dimension of well-being. We tried to cover the full range of well-being dimensions, and included the activities that the expert panel thought would be appealing to most people. The content of items related to social well-being was also based on the results of several focus group discussions and other qualitative studies of how people realize and experience social well-being (a total of 31 people between 22 and 75 years of age, including 14 in-depth interviews) [27]. To achieve sufficient differentiation in the answers to the questions, we tried to create six-point Likert-scales for all dimensions. For some dimensions, however, other scales with less or more points were considered to be more suitable. We tried to give the answers to the questions on all dimensions the same labels, but, because the labels had to fit the questions, this was not always possible. The 74 items were tested in a pre-pilot study of ten elderly people, and some questions were subsequently adapted on the basis of the results. All 74 items were used in Study 1, but on the basis of the results the item pool was reduced to 30 items (see Appendix A) for Study 2.

Each of the initial sub-pools for Taking Initiatives, Investment Behavior, and Self-efficacy consisted of 15 items. An example of a question about Taking Initiatives with regard to Behavioral Confirmation was 'How often do you make an effort to have friendly contacts with other people?'', with answers on a six-point Likert-scale ranging from *never* to *very often*. An example of a question about Investment Behavior with regard to Stimulation is: 'Do you ensure that you have enough interests on a regular basis (such as a hobby) to keep you active?', with answers on a six-point Likert-scale ranging from *never* to *very often*. An example of a question about Self-efficacy with regard to Affection is: 'Are you able to let others know that you care about them?' The answers to this question were on a 1–10 continuum, from 1 = *I'm certain that I can not* to 10 = *I'm completely certain that I can*. The initial sub-pool for Variety consisted of 14 items. An example of a question about Variety with regard to Affection is 'With how many people do you have a confidential relationship?', with the answer options of *none*, *one*, *two*, or *three or more*. The initial sub-pool for Multifunctionality consisted of eight items, each referring to two or more dimensions of well-being, such as 'The activities I enjoy, I do together with others' (Behavioral Confirmation and Stimulation), with answers on a five-point Likert-scale ranging from *strongly disagree* to *strongly agree*. Finally, the initial item-pool for Positive Frame of Mind consisted of seven items which were not related to specific well-being dimensions, such as 'When you have a bad day, how often do you think that things will be better tomorrow?', with answers on a six-point Likert-scale ranging from *never* to *very often*.

### *Respondents*

*Study 1*

Individuals aged 65 years and older, living in the Netherlands, were recruited between September and December 2000 from two Internal Medicine wards in the University Hospital Groningen, from homes for the elderly, from sheltered living accommodation, and from recreational clubs for the elderly. We recruited people from various different locations to make our sample as diverse and as representative as possible, including both healthy and unhealthy elderly people. Respondents were excluded if they were too ill, cognitively impaired, or communication was hindered too much by visual problems, deafness, or aphasia. The sample in Study 1 consisted of 275 elderly people with a mean age of 78.4 years (SD = 7.05 years), ranging from 64 to 99 years. Of the respondents, 72.4% were women, 58.2% were living alone, and 82.8% were living independently (i.e., not in a residential or nursing home). The majority of the respondents completed the questionnaires themselves, but 18.5% of the respondents were not able to do this (because of visual handicaps, inability to write because of rheumatoid arthritis, etc.) and were therefore interviewed.

*Study 2*

In August 2001, a questionnaire[1] was sent to a random sample of 3000 community-dwelling elderly people, aged 65 years and older, randomly drawn from the registers of six municipalities of different sizes in the north of the Netherlands, in which the incomes are comparable to those of the national mean. A total of 45% of the addressees returned the questionnaire (n = 1338). Although this response rate might seem low, it is comparable with [28, 29], or even quite high [30–32] compared to similar studies in which the respondents received a questionnaire by mail.

The percentage of males (41%) and females (59%) remained about the same as in the community sample, and was comparable to that of people of 65 years and older in the general population [33]. The distribution of the respondents over the six municipalities was about the same as the distribution of the original community sample (about 17% from each municipality). The average age was 74.2 (SD = 6.59 years), the oldest respondent being 98 years old. At the time of completion of the study, 99% of the respondents were living independently, and 1% had been admitted to a residential home. In some cases of non-response to the questionnaires, the addressees or family members of the addressees contacted us by phone or by letter to explain why the questionnaire was not returned. Some of the reasons were: death, admission to a nursing home, poor physical condition, cognitive disorders, too busy, not in the mood, and concerns about privacy.

*Sub-sample Study 2*

From the sample in Study 2, all respondents who were slightly or moderately frail were asked to participate in an intervention study [34, 35]. Those who responded were randomly assigned to either the experimental or the control group. The 96 respondents in the control group received the SMAS-30 again after 16 weeks, and 90% of the sub-sample returned the questionnaire (n = 86). Reasons given for not returning the questionnaires were health problems and finding the questions unpleasant. The sub-sample was comparable to the main sample, but contained fewer men (mean age 73.7 years, SD 6.27 years, range 66–91 years, 35% male).

[1] The questionnaire had four versions, which partly differed with regard to the measurement scales. The Positive Affect Negative Affect Scale and Social Production Function Instrument for the Level of well-being were not administered to the whole sample. Therefore, the number of respondents included in the analyses is different for each measurement scale.

*Measures*

*Frailty* was measured in both studies with the Groningen Frailty Indicator [15, 36], a short, easy to administer 15-item screening instrument to determine level of frailty (KR-20 = .76/.71). The scores range from 0 (not frail) to 15 (severely frail). *Perceived health* was measured in Study 1 according to the SF-20 sub-scale of general health perceptions [37]. A higher score indicates better perceived health ($\alpha = 0.86$). *Life-satisfaction* was measured in Study 1 with Cantril's ladder [38], a ten-point rating scale in the form of a ladder on which people have to indicate their perceived position between the worst imaginable life (0) and the best imaginable life (10). *Psychological distress* was measured in Study 1 with the 12-item version of the General Health Questionnaire [39]. A higher score on this scale indicates more psychological distress ($\alpha = 0.90$). In Study 2 we measured the cognitive and affective components of well-being. The cognitive component of subjective well-being, *life-satisfaction*, was measured according to the Satisfaction with Life Scale [40], a five-item scale which measures life-satisfaction as a cognitive-judgmental process ($\alpha = 0.85$). A higher score indicates more satisfaction with life. The affective components of subjective well-being were measured according to the Positive Affect Negative Affect Scale, a 20-item scale measuring the positive and the negative affective components of well-being [41]. The Positive Affect Scale ($\alpha = 0.82$) consists of ten items measuring *positive affect*, and the Negative Affect Scale ($\alpha = 0.85$) consists of ten items measuring *negative affect*. The higher the sum scores on both sub-scales, the more positive and the more negative affect, respectively. *Overall subjective well-being* was measured with the SPF-IL(s) (the Social Production Function Instrument for the Level of well-being, 15-item version) [14]. This scale integrates both affective and cognitive components of well-being, and measures levels of physical and social well-being

($\alpha = 0.84$). A higher score indicates greater well-being. *General self-efficacy* was measured in Study 1 with the 12-item Dutch version of Sherer's Self-Efficacy Scale [42]. A higher score indicates a higher sense of general self-efficacy ($\alpha = 0.75$). *Mastery* was measured in the sub-sample of Study 2 according to the Pearlin and Schooler Mastery Scale, a seven-item scale ($\alpha = 0.76$) [43]. A higher score on this scale indicates a stronger sense of mastery. Age, partner status, and living situation were also measured in both studies.

### *Selection of items and changes to the scale*

Items were removed from the original pool on the basis of several criteria. First, items were removed if they were not easily understood by the respondents (seven items, because several respondents commented that the question was unclear or ambiguous), if they had more than 4% missing values (five items), or if they had a very skewed distribution (ten items). The best items per sub-scale were then selected according to three criteria: the five dimensions of well-being should (where applicable) be represented in the items (so there should preferably be one best question for every cell of the matrix in Table 1; every sub-scale should be sufficiently reliable (preferably an alpha of at least 0.70 [44], inter-item correlations between 0.20 and 0.70 [45] and item-total correlations of above 0.20 [45]); and there should be as few items as possible, without loss of content or psychometric quality. The selection according to these criteria resulted in 30 items (five per sub-scale). The items which were finally selected seemed to represent SMA best on theoretical grounds, and had good internal consistency (see below and Table 2).

Based on the results of the first study, we made some small changes to the measurement instrument. The answer categories for three of the sub-scales were changed, either because the variance in scores was too low or the categories were too difficult. For Variety, we extended the Likert-scale with two categories. The category *three or more* was changed to *three or four*, and the categories *five or six* and *more than six* were added. The ten-point scale of Self-efficacy was also changed into a five-point Likert-scale (*I'm sure that I can not* to *I'm sure that I can*). Lastly, the formulation of three categories of Multifunctionality was changed slightly, because it still seemed to be too complicated. An overview of the final scale (SMAS-30), which was used in the second study, is given in Appendix A.

### *Analyses*

In the analyses, a three-step approach was followed, focusing first on all items together (exploratively), then on the separate sub-scales (to investigate their unidimensionality), and lastly on the composite SMA score formed by the sum of the sub-scales.

Exploratively, the internal consistency of all 30 items together was investigated in both studies using Cronbach's $\alpha$, and exploratory Mokken

**Table 2.** Descriptive statistics for sub-scales and total SMAS-30, for Study 1 and Study 2

| Scale | Study 1 (N = 275) | | Study 2 (N = 1338) | |
|---|---|---|---|---|
| | Mean | $\alpha^c$ | Mean | $\alpha^c$ |
| Multifunctionality[a] | 73.2 (23.7)[b] | 0.71 | 71.2 (23.4) | 0.74 |
| Variety | 66.3 (19.8) | 0.67 | 54.4 (16.6) | 0.72 |
| Positive Frame of Mind | 60.0 (16.2) | 0.83 | 58.2 (16.3) | 0.84 |
| Investment Behavior | 56.9 (15.5) | 0.75 | 59.5 (14.2) | 0.72 |
| Self-efficacy | 70.4 (16.8) | 0.82 | 74.6 (14.2) | 0.73 |
| Taking Initiatives | 50.5 (15.4) | 0.72 | 54.5 (14.4) | 0.75 |
| Total SMAS-30 | 63.3 (13.5) | 0.91[d] | 62.4 (12.3) | 0.91[d] |

[a]Range of all (sub-)scales: 0 to 100.
[b]Standard deviations are in parentheses.
[c]$\alpha$ is standardized item alpha.
[d]The alpha for total SMAS-30 is the alpha of all items together.

Scale Analysis and Principal Component Analysis (PCA) were carried out on all these items together in Study 1. Mokken Scale Analysis for polytomous items is a non-parametric probabilistic item–response model which tests whether the scale is cumulative and measures a single trait, representable as a unidimensional continuum [46]. The first Mokken model concerns 'monotone homogeneity' (MH), which implies that the probability of a positive response to the items increases when the value of the subject on the latent trait increases.[2] Mokken Scale Analysis also gives scalability criteria: Loevinger's *H*. An *H* lower than 0.30 indicates that the items do not form a scale, an *H* between 0.30 and 0.40 indicates a weak scale, an *H* between 0.40 and 0.50 indicates a medium scale, and an *H* above 0.50 indicates a strong scale.

As a second step, the internal consistency and unidimensionality of the separate sub-scales was investigated. To test for internal consistency, Cronbach's $\alpha$ was computed for each sub-scale in both studies. The unidimensionality of the sub-scales was also investigated in both studies by applying Mokken Scale Analysis. If sub-scales were unidimensional, their item scores could be summed, and the sum scores could be used to compute an overall score for the composite concept of SMA. The scores for the 30 items were transformed to a 20-point scale, and a sum score was computed for each sub-scale. Correlations between the sub-scales were calculated in both studies. PCA and Mokken Scale Analysis were performed on the sub-scale scores, and finally the overall SMA score was computed by calculating the mean of the sub-scale scores.

Additionally, in Study 2, the measurement model of the SMAS-30 was tested by applying CFA, which made it possible to test the theoretical structure. Contrary to methods such as PCA – which is purely explorative –, CFA starts from a hypothesized theoretical model and tests whether this model fits the observed data. We analyzed the covariance matrix, using the Maximum Likelihood Method. Missing values were imputed by simple group mean imputation. The indicators in the CFA were the single items. Covariances between latent variables were freed, as were error variances of latent and observed variables. Several indices were used to assess the model fit [47–49]. First, the $\chi^2$-goodness-of-fit statistic as a test for exact fit was considered. Because this statistic is dependent upon sample size, and because exact fit might not be a realistic assumption, we also used the standardized root mean square residuals (SRMR) as a measure of close fit (a less strict measure than exact fit). The SRMR should preferably be less than 0.08. Third, we used the root mean square error of approximation (RMSEA), a measure of the discrepancy between the population covariance matrix and the model of approximation. The RSMEA should preferably be below 0.09 to represent a reasonable error of approximation, and should be below 0.05 to indicate a close fit. Moreover, the RMSEA should be within its 90% confidence interval. Finally, the incremental fit index (IFI) was considered. This is an index which compares the target model with a more restricted, nested baseline model. The IFI should be at least 0.90 to indicate that specified relationships between the variables are supported by the data; for a good model, it should be 0.95 or higher.

To investigate reproducibility, we calculated the Intraclass Correlation (ICC) (two-way random and absolute agreement) between overall SMA on both measurements in the second study as a measure of reliability. Second, SMAS scores on both measurements were placed in six categories, and Gamma was computed as another measure of reliability. Gamma indicates the difference in the proportion of times that two measures have the same order, minus the proportion of times that their order is reversed [50]. As a measure of agreement, the standardized error of measurement (SEM) was computed as the square root of the within-subject variance. The SEM shows the variability over time in measurements of the same individual, and is expressed in the same dimension as the measurement scale [44].

To investigate validity, correlations were calculated between the overall score and the other measures. Hierarchical regression analyses were also carried out with psychological distress, life

[2] The second model, the model of 'double monotonicity' (DM), is a more restricted model, and tests whether the order of probabilities of positive responses to all items is the same for all subjects. This second model was less important here, because we primarily wanted to investigate the unidimensionality of the scales, and did not expect to find any order in the difficulty of the items.

satisfaction or overall well-being as the dependent variable, and age, frailty and perceived health as control variables in the first step, general self-efficacy or mastery as predictor in the second step, and SMA as predictor in the third step. This is a stringent statistical approach to examine the empirical uniqueness of SMA in relation to related constructs [11]. The analyses test how much of the variance in SMA is maintained after all related variables have been considered as predictors.

All analyses were carried out in SPSS 10.0.7 [51], except for the Mokken Scale Analyses, which were carried out in MSPWin 5.0 [52], and the CFA, which were carried out in Lisrel 8.3 [53].

## Results

### *Internal consistency and exploratory factorial structure of all items*

The 30 items together had a high internal consistency ($\alpha = 0.91$ in both studies). An exploratory PCA of all items in Study 1 revealed eight components with Eigenvalues greater than 1, the first two of which were strong and interpretable components with Eigenvalues of 8.94 and 2.50, respectively, and explained variances of 29.8% and 8.3%. All items loaded high on the first unrotated component (all loadings higher than 0.30), but 4 of the 5 items of Positive Frame of Mind loaded somewhat higher on the second component. This first exploratory PCA shows that all items loaded high on the first factor, and thus they correlate well enough to assume that they all pertain to one concept. This indication was also obtained by Mokken Scale Analysis for polytomous items in Study 1. This analysis scaled 27 of the 30 items together, forming a weak ($H = 0.30$), but still MH scale. When forced to scale the three excluded items with the others, Loevinger's coefficient only decreased to 0.29, which is just sufficient to form a scale. The 30-item scale was still MH. This implies that at least 27 of the 30 items could be regarded as forming one dimension, and also that all 30 items together could be used to measure and order respondents on the basis of the ordinal latent trait of SMA. However, some items may be less indicative of the construct than others.

### *Internal consistency of the sub-scales*

Table 2 shows descriptive statistics for all sub-scales in both studies. A higher score indicates more of a self-management ability. For every sub-scale, the percentage of missing values for these items ranged from 0.7% to 6.2%. Cronbach's αs for the sub-scales were satisfactory, and ranged from 0.67 to 0.84. All sub-scales were approximately normally distributed.

### *Unidimensionality of the sub-scales*

A common procedure in scale construction is to create sums from unidimensional sub-scales, to use these sums in factor analyses, and to compute an overall composite score with these sum scores. To this purpose, the unidimensionality of the separate

**Table 3.** Scaling coefficients $H_i$ (Mokken Scale Analyses) for items of sub-scales SMAS-30, Study 1 (N = 275) and Study 2 (N = 1338)

| Item | Multifunctionality | | Variety | | Positive Frame of Mind | | Investment Behavior | | Self-efficacy | | Taking Initiatives | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Study 1 $H_i$[a] | Study 2 $H_i$ | Study 1 $H_i$ | Study 2 $H_i$ | Study 1 $H_i$ | Study 2 $H_i$ | Study 1 $H_i$[b] | Study 2 $H_i$ | Study 1 $H_i$ | Study 2 $H_i$ | Study 1 $H_i$ | Study 2 $H_i$ |
| 1 | 0.35 | 0.44 | 0.41 | 0.43 | 0.52 | 0.54 | 0.44 | 0.31 | 0.36 | 0.39 | 0.39 | 0.43 |
| 2 | 0.34 | 0.40 | 0.30 | 0.35 | 0.55 | 0.57 | 0.45 | 0.45 | 0.48 | 0.43 | 0.45 | 0.47 |
| 3 | 0.38 | 0.40 | 0.36 | 0.41 | 0.53 | 0.55 | 0.44 | 0.39 | 0.50 | 0.39 | 0.43 | 0.44 |
| 4 | 0.33 | 0.35 | 0.27 | 0.26 | 0.52 | 0.53 | 0.43 | 0.42 | 0.45 | 0.33 | 0.33 | 0.36 |
| 5 | 0.33 | 0.47 | 0.36 | 0.39 | 0.55 | 0.54 | 0.28 | 0.33 | 0.53 | 0.42 | 0.26 | 0.37 |
| $H$[b] | 0.35 | 0.41 | 0.35 | 0.37 | 0.53 | 0.55 | 0.40 | 0.38 | 0.46 | 0.39 | 0.37 | 0.41 |

[a] $H_i$ = Scaling coefficient item.
[b] $H$ = Scaling coefficient total scale.
Scaling Coefficient: $30 \leq H_i \leq 40$ means a weak scale; $40 \leq H_i \leq 50$ means medium scale; >50 means strong scale.

sub-scales in both studies was investigated with Mokken Scale Analysis. All sub-scales fulfilled the MH criteria, so they can be considered to be unidimensional. In Study 1, Multifunctionality, Variety, Investment Behavior, and Taking Initiatives were weak scales, according to the criteria for Loevinger's scaling coefficient (Table 3). In Study 1, Self-efficacy formed a medium scale and Positive Frame of Mind formed a strong scale. In Study 2, Variety, Investment Behavior, and Self-efficacy were weak scales, Multifunctionality and Taking Initiatives were moderate scales, and Positive Frame of Mind was a strong scale.

Correlations between the different sub-scales of the SMAS ranged from 0.25 to 0.69 (mean correlation 0.46) in Study 1, and from 0.24 to 0.76 (mean correlation 0.48) in Study 2. Taking Initiatives, Investment Behavior, and, in particular, Variety correlated strongly (between 0.59 and 0.69), as did Multifunctionality and Variety (0.57). As expected, the SMA sub-scales are closely related to each other, but do not measure the same ability.

*Overall scale as the mean of the sub-scale scores*

Because all the sub-scales were unidimensional, their sum could be used to create a composite overall SMA score. Transforming sum scores into an overall scale yields a stronger scale, and also shows a profile of inter-related abilities. A PCA was carried out in both studies on the sums of the sub-scales, providing evidence for the unidimensionality of the SMAS-30 as the mean of the sub-scale scores (Table 4). This indicates that the overall SMA score, as the mean of the sub-scale sums, is a strong measure of the composite concept of SMA. This unidimensionality of the overall SMAS-30 was also confirmed in both studies with Mokken Scale Analysis[3] (Table 4). The sums together formed a medium, MH scale. The overall SMA scores were normally distributed, and the internal consistency of the overall SMAS-30 was high ($\alpha = 0.85$). Both PCA and Mokken showed that Positive Frame of Mind scaled lowest with the overall scale, which is in agreement with the findings of the exploratory factor analyses of the 30 separate items.

**Table 4.** Component loadings (PCA) and scaling coefficients $H_i$ (Mokken Scale Analysis) over sub-scale scores SMAS-30, for Study 1 (N = 275) and Study 2 (N = 1338)

| | Study 1 | | Study 2 | |
|---|---|---|---|---|
| | Component loading | $H_i$ | Component loading | $H_i$ |
| Multifunctionality | 0.71 | 0.44 | 0.65 | 0.40 |
| Variety | 0.82 | 0.46 | 0.80 | 0.50 |
| Positive Frame of Mind | 0.54 | 0.34 | 0.56 | 0.33 |
| Investment Behavior | 0.84 | 0.50 | 0.85 | 0.52 |
| Self-efficacy | 0.78 | 0.46 | 0.80 | 0.52 |
| Taking Initiatives | 0.82 | 0.54 | 0.84 | 0.52 |
| Total SMAS (H) | | 0.46[a] | | 0.46[a] |
| Eigenvalue | 3.44 | | 3.45 | |
| Explained Variance | 57.4% | | 57.5% | |

[a]With Mokken Scale Analysis, for both samples the total SMAS-30 was MH.

*Testing the measurement model with CFA*

Each measure of SMA (except positive frame of mind) was designed with regard to the five dimensions of well-being. We tested this matrix model where the SMAs are each linked to the dimensions of well-being.

The indices in Table 5 clearly showed that the model had a good fit, as can be seen from a relatively small $\chi^2$, small residuals indicated by SRMR, indicating good global fit, a small RMSEA within its 90% confidence interval, and a large IFI, which indicates that it is a good model. Together, these CFAs showed that, as expected, the underlying factors of the items were, indeed, both the abilities and the well-being dimensions.

*Reproducibility*

We expected to find considerable reproducibility of scores in the sub-sample of the second study, because the factors that presumably affect SMA are not expected to change much during a period of this length (16 weeks). The ICC between the

[3] Because Mokken Scale Analysis for polytomous items can only scale items with up to ten ranked response options, sub-scale scores were brought back to the original sums (thus without transformation to a 20-point scale).

**Table 5.** Goodness-of-fit statistics for the matrix measurement model tested with CFA

| | $\chi^2$ | df | *p*-value | SRMR[a] | RMSEA[b] | 90% Confidence Interval of RMSEA | IFI[c] |
|---|---|---|---|---|---|---|---|
| Matrix Measurement Model | 1103.61 | 321 | 0.0 | 0.033 | 0.04 | 0.041–0.047 | 0.95 |

[a]SRMR, Standardized Root Mean Square Residual.
[b]RMSEA, Root Mean Square Error of Approximation.
[c]IFI, Incremental Fit Index.

two measures of SMAS was 0.76 (95% CI: 0.64–0.85), and was comparable to that of related concepts in other studies (e.g. the SOC scale had ICCs of 0.77, 0.71, and 0.76 over a period of 4 weeks [11]). The SEM was 49.97 (range of total SMAS-30: 0–100). Comparing the measures of SMA divided into six categories revealed a Gamma of 0.67 (95% CI: 0.53–0.81). The SMAS-30 was therefore found to have good reproducibility.

**Table 6.** Two separate regression models predicting psychological distress (GHQ) and life-satisfaction (Cantril's Ladder), Study 1[a]

| Variable | GHQ Beta (*p*) | Cantril's Ladder Beta (*p*) |
|---|---|---|
| *Step 1* | | |
| GFI | 0.28 (0.001) | −0.31 (<0.001) |
| Age | −0.05 (0.467) | 0.08 (0.182) |
| Perceived Health | −0.40 (<0.001) | 0.44 (<0.001) |
| Adj. $R^2$ | 0.35 | 0.45 |
| Sig. *F* change | <0.001 | <0.001 |
| *Step 2* | | |
| GFI | 0.21 (0.009) | −0.25 (0.002) |
| Age | −0.07 (0.284) | 0.10 (0.087) |
| Perceived Health | −0.40 (< .001) | 0.44 (<0.001) |
| General Self-efficacy | −0.21 (0.001) | 0.20 (0.001) |
| Adj. $R^2$ | 0.39 | 0.48 |
| $R^2$ changed | 0.039 | 0.033 |
| Sig. *F* Change | 0.001 | 0.001 |
| *Step 3* | | |
| GFI | 0.22 (0.008) | −0.21 (0.004) |
| Age | −0.06 (0.399) | 0.16 (0.006) |
| Perceived Health | −0.41 (< 0.001) | 0.39 (< 0.001) |
| General Self-efficacy | −0.23 (0.002) | 0.08 (0.246) |
| SMAS | 0.04 (0.583) | 0.27 (<0.001) |
| Adj. $R^2$ | 0.39 | 0.52 |
| $R^2$ changed | 0.001 | 0.044 |
| Sig. *F* change | 0.583 | <0.001 |

[a]Adj. $R^2$ indicates the explained variance. $R^2$ changed = change in $R^2$ by adding a second predictor. Sig. *F* change shows if the difference in *F*-values for the different steps of the regression analysis is significant.

*Relationships with other concepts*

Correlations between SMA and age, frailty, perceived health, and well-being measures were, as expected, all moderate [45] and in the right direction. The older the people, the lower their SMA (−0.36 and −0.23). A higher level of SMA was also associated with less frailty (−0.44 and −0.42), better perceived health (0.34), higher life-satisfaction (0.46 and 0.45), a lower level of psychological distress (−0.30), less negative affect (−0.23), more positive affect (0.66), and more overall well-being (0.72). SMA had correlations in the expected direction with general self-efficacy (0.49) and mastery (0.24).

SMA did not explain a unique portion of the variance in psychological distress once the control variables and general self-efficacy were included (Table 6). However, SMA uniquely contributed to the explained variance in life-satisfaction (0.044), and even removed the significant effect of general self-efficacy. This indicates that the concept of SMA (partly) differs from that of self-efficacy, and that it contributes uniquely to the prediction of certain other concepts such as life-satisfaction. SMA did not explain a unique portion of the variance in psychological distress once the control variables and mastery were included (Table 7). However, SMA uniquely contributed to the explained variance in life-satisfaction (0.083) and overall well-being (0.191). Mastery was not predictive of life-satisfaction, which indicates that the concept of SMA also (partly) differs from that of mastery, and that it can contribute uniquely to the prediction of certain concepts, especially positive aspects of well-being.

## Conclusions and discussion

Although there is still much research that can be done to improve the scale, the results presented

here indicate that the SMAS-30 is a promising self-report questionnaire for measuring SMA in elderly people.

The CFA showed one well-fitting valid model that measured the inter-related six abilities, systematically linked to five dimensions of well-being, as they were used to construct the scale. SMA can thus be measured as a composite, overall concept of abilities that are systematically linked to dimensions of well-being. The concept of SMA is a composite concept, not a second order latent factor. This means that SMA is not a factor of a higher order than the separate abilities, but that it is composed of all 'cells' in the matrix presented in Table 1. To make the composite score a stronger scale, and to be able to show a profile of inter-related abilities, sub-scale sums are used to create the overall score. With regard to the sub-scales, we have shown that they all contribute to the overall construct. The sub-scales are internally consistent and unidimensional, which means that they can be summed to form a composite score. All findings from the design study (Study 1) with regard to structure and validity were confirmed when the scale was tested (in Study 2) in a large community sample. This indicates that the findings are robust. In addition, the SMAS-30 shows good reproducibility over a period of 16 weeks. Correlations with partly overlapping constructs (self-efficacy and mastery) provide evidence for the validity of the SMAS-30. Moreover, the SMAS-30 has its own unique predictive value for the positive dimension of well-being, after these partly overlapping constructs have been controlled for. The SMAS-30 was also found to have the expected relationships with age, frailty, health perceptions, and various different measures of well-being. Although the SMAS-30 appears to be a promising measurement instrument, it has some limitations and points for possible improvement.

**Table 7.** Three separate regression models predicting psychological distress (GHQ), life-satisfaction (SWLS) and overall well-being (SPF-IL(s)), Study 2[a]

| Variable | GHQ Beta ($p$) | SWLS Beta ($p$) | SPF-IL(s) Beta ($p$) |
|---|---|---|---|
| *Step 1* | | | |
| GFI | 0.14 (0.272) | 0.12 (0.352) | −0.14 (0.279) |
| Age | −0.10 (0.408) | 0.02 (0.892) | 0.08 (0.497) |
| Perceived Health | 0.00 (0.977) | 0.29 (0.021) | −0.18 (0.168) |
| Adj. $R^2$ | −0.02 | 0.03 | −0.00 |
| *Step 2* | | | |
| GFI | 0.11 (0.353) | 0.13 (0.304) | −0.11 (0.365) |
| Age | −0.09 (0.394) | 0.01 (0.913) | 0.07 (0.560) |
| Perceived Health | 0.07 (0.552) | 0.27 (0.031) | −0.22 (0.069) |
| Mastery | −0.51 (<0.001) | 0.16 (0.168) | 0.37 (0.002) |
| Adj. $R^2$ | 0.23 | 0.05 | 0.12 |
| $R^2$ changed | 0.248 | 0.025 | 0.132 |
| Sig. $F$ Change | <.001 | 0.168 | 0.002 |
| *Step 3* | | | |
| GFI | 0.14 (0.224) | 0.05 (0.696) | −0.21 (0.063) |
| Age | −0.11 (0.310) | 0.05 (0.647) | 0.12 (0.225) |
| Perceived Health | 0.07 (0.510) | 0.26 (0.034) | −0.25 (0.024) |
| Mastery | −0.47 (<.001) | 0.08 (0.499) | 0.26 (0.015) |
| SMAS | −0.14 (0.201) | 0.31 (0.010) | 0.46 (<0.001) |
| Adj. $R^2$ | 0.24 | 0.12 | 0.31 |
| $R^2$ changed | 0.017 | 0.083 | 0.191 |
| Sig. $F$ change | 0.201 | 0.010 | <.001 |

[a]Adj. $R^2$indicates the explained variance. $R^2$ changed = change in $R^2$ by adding a second predictor. Sig. $F$ change shows if the difference in $F$-values for the different steps of the regression analysis is significant.

First, whilst regarding all items as one scale succeeds reasonably well, empirically the sub-scales cannot be clearly distinguished because of their theoretical connections and some partial overlap between items. Individuals should be compared on self-management abilities simultaneously, because their variances are correlated and they share a common conceptual meaning: namely, forming a dimension of overall SMA. Future research could focus on validating the separate sub-scales.

Second, future research could also focus on possible shorter forms of the scale, since high correlations were found between some sub-scales. Moreover, some items seemed to be less indicative of SMA (lower loadings), and should possibly be replaced by other items in further research.

Third, another aspect of the scale that may need to be considered is the character of the Positive Frame of Mind sub-scale. This sub-scale does not directly relate to the five dimensions of well-being, and should probably be redesigned to link up with these dimensions. As already mentioned, more analyses should be performed on the other sub-scales as independent scales, possibly leading to changes in the ordering of the items.

Lastly, future research on the SMAS-30 should further investigate its usefulness in practice. In these studies, the SEM was relatively large and as a

consequence, results for individual subjects should be interpreted with caution. In two intervention studies with elderly participants, the SMAS-30 has proved that it can measure changes in SMA due to the interventions [34, 35, 54], and thus it does what it was meant to do. This is a good start. Thus, despite its limitations, the present study shows that the SMAS-30 may make an important contribution to the measurement of self-regulation of well-being and testing the effectiveness of self-management interventions. Whereas most research on self-management has been based on general measures of control, such as self-efficacy or mastery, the SMAS-30 was found to measure unique features involved in the self-regulation of well-being in elderly people.

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## Appendix A

SMAS-30, English Version

Taking Initiatives

1. How often do you take the initiative to keep yourself busy?
2. How often are you engaged in making your home or room as comfortable as possible?
3. How often do you take the initiative to get in touch with people who are dear to you?
4. Do you sometimes try to be good at something?
5. How often do you make an effort to have friendly contacts with other people? Answers: never – hardly ever – sometimes – regularly – often – very often

Investment Behavior

1. Do you ensure that you have enough interests on a regular basis (such as a hobby) to keep you active?
2. Do you make sure that you get enough physical exercise in order to stay fit longer?
3. Do you occasionally do something so that your contact with your acquaintances remains good?
4. Do you devote some time and attention to those who are dear to you in order to maintain good contact?
5. Do you keep busy with the things you are good at so that you stay good at them? Answers: never – hardly ever – sometimes – regularly – often – very often

Variety

1. How many hobbies or activities do you have on a regular basis?
2. Do you have different ways to relax when necessary?
3. Do you have different occasions on which you have friendly contacts with others?
4. With how many people do you have a confidential relationship?
5. Are there certain things that you are good at? Answers: none – one –two – three or four – five or six – more than six

Multifunctionality

1. The activities I enjoy, I do together with others.
2. I sometimes help the people I care about.
3. Others benefit from the things I do for my pleasure.
4. I generally spend my holidays with others.
5. I practice my hobbies together with others. Answers: strongly disagree – disagree – neither agree nor disagree – agree – strongly agree

Self-efficacy

1. Are you able to find agreeable activities?
2. Are you capable of taking good care of yourself?
3. Are you able to have friendly contacts with others?
4. Are you able to let others know that you care about them?
5. Are you good at something? Answers: I'm certain that I can not – I don't think I can – sometimes I can, sometimes I can not – I think I can – I'm certain that I can

Positive Frame of Mind:

1. How often are you able to see the positive side of the situation when something disagreeable happens?
2. When things go against you, how often do you think that it could always be worse?
3. When you are not doing well, how often do you think that there are others who are worse off?
4. When you have a bad day, how often do you think that things will be better tomorrow?
5. When things are not going so well, how often do you succeed in thinking positively? Answers: never – hardly ever – sometimes – regularly – often – very often

NOTE: This is a translation of the Dutch items. The English items have not been tested.

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