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The Abridged Dutch Metamemory in Adulthood (MIA) Questionnaire: Structure and Effects of Age, Sex, and Education

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This study presents data on the factor structure, reliability, and discriminant validity of the Metamemory in Adulthood (MIA) questionnaire in a Dutch sample of 1,899 normal and healthy participants aged 24 to 86 years. The factor structure of the Dutch MIA corresponded with that of the original MIA. The Strategy scale could be divided into two subscales: External and Internal Memory Strategies. The number of items on the MIA could be reduced by 34% without loss of the factor structure or lowering of the internal consistency of the subscales. Data on the relation of the abridged MIA with age, sex, education, depression, anxiety, and subjective health are presented. The study supports the cross-national use of the MIA as a research and clinical instrument for the evaluation of subjective memory functioning.

Most research on memory and aging has shown that memory complaints are more frequent among older and middle-aged adults than among younger adults (e.g., Cutler & Grams, 1988). There is also ample evidence of an age-related decline in memory performance, especially when new information has to be acquired (Craik & Jennings, 1992). There is, however, no straightforward relation between memory complaints and memory performance; correlations between complaints and test performance are either absent or low. This finding has led to the notion that memory complaints and memory performance in elderly people are not solely determined by actual memory abilities or skills but are also related to contextual factors such as demographic variables (e.g., education), health, and psychological and social variables such as personality traits, affective state, environmental stress, or social support (Arbuckle, Gold, Andres, Schwartzman, & Chaikelson, 1992). There is also growing interest in the possible mediating role of self-knowledge and self-belief in one's own memory functioning, termed *metamemory,* in age-related changes in memory performance on the one hand and in age-related memory complaints and concern on the other (Light, 1991; Lovelace, 1990).

One of the most frequently used metamemory questionnaires in aging research is the Metamemory in Adulthood (MIA) questionnaire of Dixon, Hultsch, and Hertzog (1988). The MIA asks respondents to rate on a 5-point Likert scale 108 statements describing their own memory functioning and their general knowledge of memory processes. The questionnaire consists of seven factors, or subscales. These are reported use of various memory strategies (Strategy), knowledge of basic memory processes (Task), perceived memory capacity (Capacity), perceived change in memory functioning (Change), perceived feelings of stress and anxiety related to memory performance (Anxiety), perceived importance of having a good memory and performing well on memory tasks (Achievement), and perceived sense of control over memory (Locus). Studies with multiple samples have shown high internal reliabilities for the seven subscales, ranging from .71 to .93 (Hultsch, Hertzog, Dixon, & Davidson, 1988). The results of the first factor analysis of the MIA suggested, however, that the Strategy subscale could be divided into two factors despite its high internal reliability (Dixon & Hultsch, 1983). One factor could be labeled Internal Memory Strategies (e.g., imagery), whereas the other could be labeled External Memory Strategies (e.g., writing down appointments).

Correlations of the MIA subscales with instruments measuring mood, personality, and locus of control are low, which supports the discriminant validity of the MIA (Dixon et al., 1988). Only the MIA Anxiety subscale is related to trait anxiety and related affective states.

Data from three studies that comprise a total of six different samples all covering broad age ranges from young (18-20 years) to old (over 80 years) showed robust age differences for the MIA Change, Capacity, and Locus subscales (Cavanaugh & Poon, 1989; Dixon & Hultsch, 1983; Hultsch, Hertzog, & Dixon, 1987). Older respondents consider that they have less memory capacity than younger respondents, perceive more decline in their memory functioning, and believe that they have less control over their memory. Age had little or no relation to the Task, Achievement, and Anxiety subscales. Conflicting results were found for the MIA Strategy subscale. In the study of Cavanaugh and Poon (1989), the young respondents reported a more frequent use of memory strategies than the old respondents, whereas in the Victoria subsample of Hultsch et al. (1987) the opposite was found. Sex differences were examined only in the study of Hultsch et al. (1987). In both their Victoria and Annville samples, women reported greater anxiety in memory-de-

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manding situations and reported more use of memory strategies than did men. Thus far, no data are available on the possible effects of respondents' education on their MIA scores.

In this study we report on our findings obtained with the Dutch version of the MIA in a sample of more than 2,000 respondents ranging in age from 24 to 86 years. The MIA was chosen because the available psychometric data on reliability and validity support the use of this instrument for clinical and experimental purposes. Several issues were addressed in this cross-national replication study. Our first interest was in seeing how far the factor structure of the MIA would be recovered in the Dutch translation. A related issue concerned the possible division of the Strategy scale into two separate subscales: Internal and External Memory Strategies. One of our main goals in the study was to reduce the number of items in the MIA without having it lose its factor structure. This would make the MIA a more feasible instrument for large-scale population studies. We were also interested in the test–retest reliability of the MIA, given the fact that no data are available on this subject. We studied discriminant validity by correlating the MIA subscales with measures of anxiety, depression, and subjective health. Effects of age, sex, and education on the MIA were also examined. Finally, we compared patterns of self-appraisal of memory as measured by the MIA in a young group of participants and in an old group of participants who were very concerned about their memory. From a clinical perspective, we were interested in possible age differences in self-report of memory in these two groups.

Method

Participants and Procedure

This study was conducted as part of a large cross-sectional study of biological and psychological determinants of successful and pathological cognitive aging, which in turn is part of a large research program on cognitive aging, the Maastricht Aging Study (MAAS; Jolles, Houx, van Boxtel, & Ponds, 1995). In the first phase of this cross-sectional study an extensive postal questionnaire on subjective cognitive functioning in relation to age, health, and psychological factors was sent to 2,340 participants ranging in age from 24 to 86 years. This postal questionnaire included a Dutch translation of the MIA questionnaire.

Participants were recruited from a register of patients of general practices in the region of Maastricht, The Netherlands (Metsemakers, Höppener, Knottnerus, Kocken, & Limonard, 1992). Those with previous or current medical conditions with known impact on cognitive or motor functions were excluded from selection (e.g., cerebrovascular disease, dementia, major psychiatric disorders). Participant sampling was stratified by 13 discontinuous age classes (25 years ± 1, 30 years ± 1, 35 years ± 1, · · · , 80 years ± 1, 85 years ± 1) and sex. A total of 3,921 participants were drawn from the register. After screening by the general practitioner, 187 were excluded because of current illness or psychosocial indications. The remaining 3,734 participants were invited by their practitioners to participate in the study; 2,340 were willing to participate and received the postal questionnaire. In total, 2,043 respondents completed and returned the postal questionnaire in good order.

Only respondents with complete data on the MIA subscales were included in the study. For this reason 144 respondents were excluded, which left a total of 1,899 participants. These participants were divided into four age groups: young (age classes 25, 30, and 35 years), young middle-aged (40, 45, and 50 years), old middle-aged (55, 60, and 65 years), and old (70, 75, 80, and 85 years). Educational level was measured by a Dutch scoring system (de Bie, 1987) that consists of an 8-point scale ranging from *unfinished primary education* (Level 1) to *university education* (Level 8). The mean age, sex, and educational level of the participants are presented in Table 1.

The four groups were roughly equivalent in size, with a relative underrepresentation of the old group (22%). There were also slightly more women than men, especially in the young and old groups. A significant decline in mean level of education was found from the youngest to the oldest age group, $F(3, 1834) = 97.4, p < .001$. Duncan's multiple range tests ($p = .05$) showed that the groups were significantly different from each other, except for the old middle-aged and old groups.

The test–retest reliability of the MIA was studied in an additional longitudinal research project on cognitive aging and health (Houx & Jolles, 1994). All participants came for their first follow-up 5 years after initial testing. In order to assess test–retest stability, the MIA was completed twice, with an interval of 4 weeks, by a subsample of 48 participants (27 men, 21 women). They were all healthy community-dwelling individuals with a mean age of 67 years (range = 23–87 years).

Measures

MIA. The MIA questionnaire published by Dixon et al. (1988) was translated into Dutch and used in this study. We changed the order of the MIA questions by putting all of the Strategy questions together at the end of the questionnaire. This was done for the participants' convenience, because the type of question and the response format of the Strategy items are different from those of the items of the other subscales.

Missing data on the MIA were handled in the following way. The first step involved removing all participants who had left blank 5% or more of the MIA questions (6 or more questions). This very stringent criterion was used because this was the first psychometric analysis of the Dutch MIA, and we wanted to analyze only complete or near-complete questionnaires. A total of 144 respondents (7%) were removed from the sample on the basis of this criterion; most of them were in the two oldest age groups (young age group, 2%; young middle-aged group, 3%; old middle-aged group, 6%; old age group, 17%). Next we checked, for each subscale, whether at least 80% of the items were correctly filled in, following the guidelines given by Hertzog, Hultsch, and Dixon (1989). This was the case for all participants. The remaining questions with missing values were assigned a score of 3 (the middle of the 5-point scale).

Affective state, subjective health, and forgetfulness. Feelings of depression and anxiety were measured with the Depression and Anxiety subscales of the revised version of the Symptom Checklist (SCL-90: Derogatis, 1977; Dutch version: Arrindell & Ettema, 1986). The SCL-90 is a multidimensional self-report inventory of current psychopathology. Items are rated on a 5-point scale. The Anxiety subscale consists of 10 items and measures feelings of generalized anxiety (score range = 5–50). The Depression subscale contains 16 items that reflect symptoms of depression (score range = 16–80). The VOEG (Vragenlijst Omtrent Evaren Gezondheid, or Inventory of Subjective Health; Dirken, 1967) measures subjective health and contains 21 items on health complaints of a somatic and psychosomatic nature (score range = 0–21). The incidence of forgetfulness was assessed with the question "Do you consider yourself as being forgetful?" Participants who replied affirmatively also rated their worry about this forgetfulness on a 5-point scale ranging from *not worried* (1) to *very worried* (5).

Data Analysis

For the psychometric analysis of the Dutch MIA, we performed confirmatory factor analyses (CFAs) on the basis of "perfectly congruent

Table 1
Descriptive Characteristics of Participants

Group	*n*	%	Age *M*	Age *SD*	Education *M*	Education *SD*	Sex % male	Sex % female
Total group	1,899	100	52.0	16.9	3.3	1.9	46	54
Young	476	25	30.6	4.1	4.3	1.8	41	59
Young middle-aged	501	26	44.8	4.2	3.6	1.8	50	50
Old middle-aged	513	27	59.8	4.1	2.7	1.7	49	51
Old	409	22	75.6	5.2	2.5	1.9	44	56

Note. Data on educational level were missing for 61 participants (young, 15; young middle-aged, 13; old middle-aged, 13; old, 20).

weights" (ten Berge, 1986) using the software program PECON (Enzmann, 1993). This method determines the recoverability of components or factors from an original study in a replication study after rotation to perfect congruence. For this purpose, the scale configuration of the MIA was represented by means of a matrix of components' weights in which the items were either 0 or 1. The recoverability of the factors in a new data set (in this case the Dutch MIA) can be determined in several ways. First, one can compare the amount of variance explained in the original data set with the amount of variance explained in the new data set. However, data for the explained amount of variance in the original MIA are not available from the present literature. Second, the amount of variance explained in the CFA can be compared with the amount of variance explained by a separate principal-components analysis (PCA). If the amount of variance explained by CFA is comparable to that explained by PCA, the information in the data set is summarized well by the defined factor structure. Third, because the factor configuration in both the original and the Dutch MIA are equal by definition, one can also check the comparability of the two questionnaires by looking at the degree of correspondence of the intercorrelations between the factors and the item loadings of both questionnaires.

The Strategy subscale was analyzed separately because we suspected that this scale in fact consists of two scales. Moreover, separate analysis is also more appropriate given the specific phrasing of the questions of this scale as well as its different response format compared with the other MIA subscales.

One of our main goals in this study was to reduce the number of items in the Dutch MIA without loss of its factor structure. For this purpose a new series of PECON analyses were performed on the total sample. Items with loadings of less than .50 on their own factor or with high loadings on other factors were dropped from the list. A high loading on another factor was defined as an item loading that was less than .15 below the loading of the intended factor. To test the reliability of the shortening of the MIA, we repeated the same analyses for two split-half subsamples and a young and an old subsample.

To evaluate possible age differences in the factor structure of the abridged MIA, we repeated PECON analyses in a young, a middle-aged, and an old subsample. The covariance matrices for the summed responses to the eight scales of the abridged MIA for the three age groups were analyzed with the LISREL 7 program (Jöreskog & Sörbom, 1989). However, with large sample sizes, the chi-square statistic may be significant even when the differences between the observed and the estimated covariance matrices are small. A goodness-of-fit index that is less influenced by the sample size and that was used here is the Bentler–Bonnett normed fit index, which reflects the proportion of information in the covariance matrix that is accounted for by the model (Bollen, 1990). A fit index above .9 is assumed to indicate a reasonable fit.

In addition to the CFAs, internal consistency estimates were calculated (Cronbach's alpha). The test–retest stability was assessed with Pearson correlation coefficients. We conducted regression analyses to look at the relation between depression, anxiety, and subjective health and the scores on the MIA subscales, after controlling for the effects of age, sex, and education. We used multivariate and follow-up univariate analyses of variance to assess the effects of age, sex, and education on the MIA. Because the sample size in this study was very large, only probabilities of 1% or less were considered significant (unless reported otherwise).

Results

Factor Structure

The results of the CFA and reliability analyses of the 108-item version of the Dutch MIA are summarized in Tables 2 and 3.

The amount of variance explained by the six factors conjointly in the CFA was 34.9%, which was comparable to the 37.7% that a six-factor PCA accounted for. Internal consistency estimates (Cronbach's alpha) ranged from .69 for Locus to .91 for Change and were nearly identical to the internal consistency estimates reported by Dixon et al. (1988). The pattern of factor intercorrelations (Table 3) was almost similar to that reported by Hertzog et al. (1989), with the highest correlations between Capacity, Change, Anxiety, and Locus.

A high internal consistency was also found for Strategy (Cronbach's alpha = .85). Yet the separate CFA for Strategy clearly showed that the scale could be divided into two factors, each with nine items corresponding to Internal and External Memory Strategies. The amount of variance explained by these two strategy factors conjointly in the CFA was 40.5%, whereas a two-factor PCA accounted for 41.3%. The correlation between both factors was relatively high (.49) but was still low enough to suggest that the two factors accounted for different parcels of variance.

Abridgement of the MIA

Additional CFAs based on the total sample of 1,899 participants revealed that a substantial number of items (34 items, or 31%) on the MIA could be eliminated without loss of its factor structure. The numbers of items eliminated per subscale were six for Task (38%), five for Capacity (29%), eight for Change (44%), two for Anxiety (17%), nine for Achievement (56%),

Table 2
Summary of the Confirmatory Factor Analysis and Reliability Analyses of the 108-Item Version of the Metamemory in Adulthood (MIA) Questionnaire

MIA Subscale	No. of items	Range of factor loadings	% of variance explained[a]	Cronbach's alpha
Task	16	.20–.68	5.39	.81
Capacity	17	.39–.67	6.45	.85
Change	18	.17–.78	7.84	.91
Anxiety	14	.46–.71	7.19	.87
Achievement	16	.27–.59	4.45	.74
Locus	9	.33–.66	3.61	.69
All scales	90	—	34.93	—
Strategy	18	—	—	.85
Strategy-ex	9	.51–.76	18.31	.77
Strategy-in	9	.34–.73	22.22	.84
Both scales	18	—	40.53	—

Note. Based on 1,899 partcipants. The Strategy subscale was analyzed separately. Strategy-ex = External Strategies; Strategy-in = Internal Strategies.
[a] Unique variance (corrected for the correlations between the factors).

two for Locus (22%), and one for both Strategy subscales (11%). The results of the CFA and reliability analyses for the abridged MIA are summarized in Tables 4 and 5.

The amount of variance explained in the CFA by the first six factors increased to 43.3%. A six-factor PCA on the same data set accounted for an almost equal amount of variance (44.4%). Both Strategy subscales accounted for 43.9% of the variance, which was also comparable with the 44.3% that a two-factor PCA accounted for. Factor loadings of the items ranged from .50 to .81. Although the number of items of some scales was substantially reduced, the internal consistency estimates remained high or even increased and were comparable with those of the original subscales. The pattern of intercorrelations between the factors or subscales of the shortened version of the MIA was comparable with the pattern in the original 108-item version of the MIA (see Table 5). Only the correlations between the Change, Capacity, Anxiety, and Locus subscales were lower, which can be explained by the fact that most of the items from these scales were eliminated because they had high loadings on one or more of the other three subscales.

We performed additional analyses to verify the reliability of the abridgement of the MIA. CFAs were repeated in four subsamples: a young subsample (aged 24–51 years, n = 977), an old subsample (aged 54–86 years, n = 922), and two subsamples that were created by a random split of the total sample (first group: n = 949, mean age = 51.6 years, 48% men; second group: n = 950, mean age = 52.4 years, 45% men). In each subsample we checked which items would be dropped from the list according to the item selection criteria that were used for the total sample. When we allowed for some fluctuation around the item selection criteria (.48 and .52 for the .50 criterion; .13 and .17 for the criterion of difference between item factor loadings), the same 34 eliminated items in the total sample would now be dropped from the list in both the young and old subsamples and the first and second split-half groups.

Age Patterns in the Factor Structure

To control for possible age differences in the factor structure of the abridged MIA, we performed the same CFA and reliabil-

Table 3
Correlations Among the Seven Original Scales of the 108-Item Version of the Metamemory in Adulthood (MIA) Questionnaire and the Two Separate Strategy Scales

MIA subscale	1	2	3	4	5	6	7	8	9
1. Task	—								
2. Capacity	−.10	—							
3. Change	−.21	.65	—						
4. Anxiety	.20	−.46	−.61	—					
5. Achievement	.24	.09	−.20	.34	—				
6. Locus	−.01	.43	.43	−.28	.19	—			
7. Strategy	.27	−.18	−.29	.31	.22	−.01	—		
8. Strategy-ex	.17	−.23	−.21	.27	.11	−.06	.86	—	
9. Strategy-in	.30	−.09	−.29	.27	.26	.05	.86	.49	—

Note. Based on 1,899 participants. Strategy-ex = External Strategies; Strategy-in = Internal Strategies.

Table 4
Summary of the Confirmatory Factor Analysis and Reliability Analyses of the Abridged Metamemory in Adulthood (MIA) Questionnaire

MIA subscale	No. of items	Range of factor loadings	% of variance explained[a]	Cronbach's alpha
Task	10	.54–.71	6.93	.82
Capacity	12	.52–.68	8.01	.84
Change	10	.62–.81	9.63	.91
Anxiety	12	.54–.71	8.73	.87
Achievement	7	.53–.69	5.24	.73
Locus	7	.50–.73	4.99	.75
All scales	58	—	43.42	—
Strategy	16	—	—	.85
Strategy-ex	8	.51–.75	20.27	.77
Strategy-in	8	.52–.77	23.61	.84
Both scales	16	—	43.88	—

Note. Based on 1,899 participants. Strategy-ex = External Strategies; Strategy-in = Internal Strategies.
[a] Unique variance (corrected for the correlations between the factors).

ity analyses separately for three age groups. For this purpose the total sample was divided into a young subsample (24–41 years, $n = 643$), a middle-aged subsample (44–61 years, $n = 687$), and an old subsample (64–86 years, $n = 569$). Mean item loadings, the amount of variance explained by each factor, the internal consistency estimates, and the factor intercorrelations were very similar in the three age groups. In addition, we performed a LISREL analysis of the covariance matrices of the eight scales of the abridged MIA for the three age groups (model: equal factor covariance matrices). The goodness-of-fit index was .962 for the young subsample, .988 for the middle-aged subsample, and .956 for the old subsample, whereas the overall adjusted goodness-of-fit index was .955. The likelihood ratio chi-square test was significant, $\chi^2(72, N = 1{,}899) = 249.41$, $p < .001$, which is likely due to the large sample size. The Bentler–Bonnett normed fit index, which is less influenced by the sample size, was .930. These data further suggest that the factor structure of the abridged MIA is invariant over age.

Test–Retest Stability

The test–retest correlations for the abridged MIA were derived from a scoring of those items that were administered in the context of the entire 108-item instrument. The stability coefficients were satisfactory for both the 108-item instrument (range = .79 to .86) and the abridged version (range = .72 to .85), except for the Task subscale, for which correlations of .58 and .50 were found for the 108-item instrument and the abridged MIA, respectively.

Discriminant Validity

Age, sex, and educational level all correlated with subjective health, depression, and anxiety, although the strength of these correlations was generally low (ranging from .05 to .29). Because we wanted to examine the effects of subjective health, anxiety, and depression on the MIA subscales independently of the interacting variables of age, sex, and educational level, we performed a multiple hierarchical regression analysis. Only participants with complete data on all variables were included in the analysis ($n = 1{,}720$). In Step 1 age, sex, and educational level were entered in the regression model, and in Step 2 subjective health, depression, and anxiety were entered. Anxiety and depression either had no contribution or accounted for only very small amounts of variance in most subscales. Only in the

Table 5
Correlations Among the Subscales of the Abridged Metamemory in Adulthood (MIA) Questionnaire

MIA subscale	1	2	3	4	5	6	7	8	9
1. Task	—								
2. Capacity	−.08	—							
3. Change	−.25	.52	—						
4. Anxiety	.24	−.32	−.61	—					
5. Achievement	.26	.14	−.27	.35	—				
6. Locus	.04	.28	.15	−.06	.31	—			
7. Strategy	.27	−.16	−.28	.29	.17	.06	—		
8. Strategy-ex	.18	−.22	−.28	.25	.08	−.01	.86	—	
9. Strategy-in	.28	−.05	−.20	.25	.21	.12	.83	.44	—

Note. Based on 1,899 participants. Strategy-ex = External Strategies; Strategy-in = Internal Strategies.

Anxiety subscale of the MIA did anxiety account for 3% of the variance. More substantial contributions were found for subjective health on the Capacity (5%), Change (8%) and Anxiety (12%) subscales. Lower health ratings were related to lower ratings of memory capacity, a greater subjective decline of memory, and more subjective anxiety about memory performance.

Effects of Age, Sex, and Education

A multivariate analysis of variance (MANOVA) was conducted with the eight subscales of the abridged MIA as dependent variables and age, sex, and educational level as independent variables. Age had four levels corresponding to the age subsamples presented in Table 1. Educational level was compressed to three levels instead of eight: low (educational Levels 1 and 2), medium (Levels 3–5), and high (Levels 6–8). These levels roughly correspond with primary education, junior vocational training, and senior vocational or academic training.

The 4 (age) × 2 (sex) × 3 (education) MANOVA on the eight subscales of the MIA revealed significant overall effects of age, $F(24, 5239) = 20.33$, $p < .001$, sex, $F(8, 1806) = 16.96$, $p < .001$, and education, $F(16, 3612) = 18.09$, $p < .001$. There were no interaction effects.

Follow-up univariate F tests showed significant age differences on all subscales of the MIA, except for Task and Locus. We performed additional multiple comparison tests ($p < .01$) to see which of the group means were significantly different from each other. Mean item scores on the factors for the four age groups are shown in Table 6. Older adults reported less memory capacity (Capacity), $F(3, 1813) = 12.54$, $p < .001$ (young and old groups differed significantly from the other groups), more decline in memory (Change), $F(3, 1813) = 128.60$, $p < .001$ (significant differences between all age groups), and more feelings of anxiety about everyday memory tasks (Anxiety), $F(3, 1813) = 18.70$, $p < .001$ (significant differences between all age groups). Older adults were also more motivated to achieve well in everyday memory tasks (Achievement), $F(3, 1813) = 32.30$, $p < .001$ (significant differences between all age groups, except for the old middle-aged and old groups), and used memory strategies more often: Internal Strategies, $F(3, 1813) = 6.65$, $p < .001$ (the only significant difference was between the young and old middle-aged groups with $p < .05$); External Strategies, $F(3, 1813) = 4.56$, $p = .003$ (there was a significant difference between the old middle-aged and old groups with $p < .05$). In terms of the amount of variance explained, the effects of age on both Strategy subscales and Capacity were very small (less than 1% and 2%, respectively). The effects found on Anxiety, Achievement, and especially Change were more substantial: Age accounted for 6%, 8%, and 22% of the variance, respectively. A comparison between the reported use of strategies for each strategy scale revealed a significantly higher overall use of Internal Strategies compared with External Strategies (t test, $p < .001$). This was the case in each of the four age groups ($p < .05$).

Univariate analysis showed sex differences on four MIA subscales. Male participants had lower scores on Capacity, $F(1, 1813) = 9.22$, $p = .002$, and on both Strategy subscales: Internal Strategies, $F(1, 1813) = 13.00$, $p < .001$; External Strategies, $F(1, 1813) = 53.04$, $p < .001$. Female participants had higher scores for Anxiety, $F(1, 1813) = 23.46$, $p < .001$. The sex effects were small in terms of the variance accounted for: Anxiety, 2%; Internal Strategies, 1%; External Strategies, 3%; and Capacity, 1%.

Effects of educational level were found on six subscales. A lower level of education was related to higher scores on Anxiety, $F(2, 1813) = 48.04$, $p < .001$ (significant differences between all three groups), and Achievement, $F(2, 1813) = 29.667$, $p < .001$ (significant differences between all three groups), but to lower scores on Task, $F(2, 1813) = 6.21$, $p = .002$ (significant difference between the high- and low-level groups) and on both Strategy subscales: Internal Strategies, $F(2, 1813) = 16.89$, $p < .001$ (the low-level group differed significantly from the other two groups); External Strategies, $F(2, 1813) = 19.61$, $p < .001$ (the high-level group differed significantly from the other two groups). Participants with a lower education level also noticed more decline in memory (Change), $F(2, 1813) = 4.84$, $p = .008$ (significant differences between all three groups). The

Table 6
Mean Item Score per Subscale of the Abridged Metamemory in Adulthood (MIA) Questionnaire as a Function of Age

		Young (n = 461)		Young middle-aged (n = 488)		Old middle-aged (n = 500)		Old (n = 388)	
MIA subscale	R^2	M	SD	M	SD	M	SD	M	SD
Task	.002	3.80	0.56	3.83	0.55	3.85	0.56	3.88	0.58
Capacity	.024	3.30	0.58	3.16	0.63	3.13	0.63	3.01	0.68
Change	.220	3.79	0.62	3.38	0.77	3.00	0.79	2.69	0.84
Anxiety	.061	2.55	0.65	2.74	0.71	2.88	0.73	3.05	0.75
Achievement	.082	3.60	0.57	3.70	0.58	3.95	0.59	4.04	0.52
Locus	.001	3.26	0.58	3.29	0.59	3.29	0.60	3.18	0.62
Strategy-ex	.002	3.32	0.73	3.35	0.80	3.31	0.80	3.45	0.86
Strategy-in	.003	3.44	0.68	3.52	0.72	3.55	0.74	3.53	0.78

Note. Strategy-ex = External Strategies; strategy-in = Internal Strategies.

Table 7
Mean Item Score per Subscale of the Abridged Metamemory in Adulthood (MIA) Questionnaire for Nonforgetful and Forgetful Young and Old Participants

MIA subscale	Young nonforgetful (n = 26)		Young forgetful (n = 26)		Old nonforgetful (n = 51)		Old forgetful (n = 51)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Task	3.88	0.37	3.87	0.57	3.62	0.54	3.90	0.54
Capacity	3.28	0.50	2.47	0.68	3.45	0.55	2.34	0.71
Change	3.56	0.58	2.41	0.78	3.27	0.67	1.78	0.60
Anxiety	2.69	0.60	3.60	0.76	2.71	0.66	3.88	0.63
Achievement	3.63	0.60	4.18	0.45	3.95	0.55	4.27	0.40
Locus	3.31	0.43	3.26	0.53	3.37	0.54	3.00	0.74
Strategy-ex	3.06	0.95	3.72	0.74	3.26	0.82	3.70	0.78
Strategy-in	3.24	0.83	4.08	0.59	3.38	0.84	3.73	0.78

Note. Strategy-ex = External Strategies; strategy-in = Internal Strategies.

effects of educational level were substantial for Change (4% variance explained), Achievement (7%), and Anxiety (9%) but very small for the other three scales (less than 1%).

Differences on the MIA Between Forgetful and Nonforgetful Young and Old Participants

The total sample of 1,899 participants was divided into a young subsample (aged 24–51 years) and an old subsample (aged 54–86 years). Twenty-six participants in the young subsample and 51 in the old subsample considered themselves forgetful and were (very) worried about their forgetfulness. The young subsample had a mean age of 41 years (SD = 8.5) and a mean educational level of 2.7 (SD = 1.3) and consisted of 12 men and 14 women. The old subsample had a mean age of 69 years (SD = 8.7) and a mean educational level of 2.3 (SD = 1.6) and consisted of 21 men and 30 women. Both groups were perfectly matched with nonforgetful participants on age, education, and sex. Scores on the SCL-90 Depression and Anxiety scales as well as the VOEG Subjective Health scale were significantly higher ($p < .001$) for the forgetful participants and corresponded with the highest ranges of a norm group of healthy participants (Arrindell & Ettema, 1986).

Table 7 shows the mean item scores on the abridged MIA subscales for the four groups. A MANOVA was performed on the eight subscales of the MIA, with group (old vs. young) and forgetfulness (yes or no) as independent variables and scores on the SCL-90 Anxiety and Depression subscales and the VOEG Subjective Health subscale as covariates. A significant overall effect was found for forgetfulness, $F(8, 140) = 12.75, p < .001$, and group, $F(8, 140) = 5.16, p < .001$. Follow-up univariate F tests ($p < .05$) revealed significant differences on nearly every subscale of the MIA for the forgetful and nonforgetful groups, except for the Task and Locus subscales. The strongest differences were found for the Capacity, Change, and Anxiety subscales. Forgetful participants reported a far lower memory capacity, a greater decline in memory functioning, and higher anxiety related to memory performance. They were also more motivated to achieve well in everyday memory situations and used memory strategies more often. Follow-up univariate F tests for the young and old groups showed significant differences on Change and Achievement. Older participants reported a greater decline in their memory functioning and had a higher level of motivation to achieve well in memory. The Group × Forgetfulness interaction was not significant, which indicates that there were no age-specific differences on the MIA between forgetful and nonforgetful young and old participants.

Discussion

The main focus of this study was an examination of the psychometric characteristics of the Dutch MIA. The results showed that the factor structure of the original version of the MIA was recovered well. The Strategy scale could be divided into two subscales: Internal and External Memory Strategies. Almost one third of the items could be eliminated from the list without loss of the original factor structure. The internal consistency of the abridged subscales remained high despite the substantial reduction in the number of items in some of the scales. Moreover, the factor structure of the abridged version of the MIA was invariant over age. The test–retest stability of the complete MIA as well as that of the abridged MIA were satisfactory. Only the Task subscale had a low test–retest stability, which is possibly due to the mostly long and complex statements that are used for the items of this scale. The discriminant validity of the MIA was supported by the fact that no relation was found between depression and anxiety and the MIA when we controlled for the possible confounding variables of age, sex, and education. The only substantial relation found was between the SCL-90 Anxiety score and MIA Anxiety, which corresponds with the findings of Hultsch et al. (1988). Subjective health accounted for substantial amounts of variance in the MIA subscales of Capacity, Change, and Anxiety.

Age effects were found on five of the seven subscales of the MIA: Capacity, Change, Anxiety, Achievement, and Strategy. In contrast to the results of previous studies, no age effect was found on the Locus scale, whereas substantial age effects were found for the Anxiety and Achievement scales.

The rather small age effect on the Capacity scale contrasts with the large age effect on the Change scale, which was also noticed by Hultsch et al. in their 1987 study. As an explanation, they suggested that because of the phrasing of the questions, participants rated their memory functioning on the Change scale relative to their own past memory performance, whereas on the Capacity scale the rating of memory functioning was adjusted to what they expected to be normal for their age. Hultsch and colleagues also suggested that the elderly would thus not perceive their decrease in memory functioning as a problem. This, however, is not in line with the age effects found on the Anxiety and Achievement scales in this study. Although the decline in memory performance is probably perceived as a normal aging phenomenon by the elderly participants, it nevertheless causes them greater anxiety and an increased desire not to fail in everyday memory-demanding situations.

The age effects on the two Strategy scales were very small. Moreover, between-groups comparisons did not reveal a steady increase in strategy use over the four age groups. The suggestion of Dixon and Hultsch (1983) that elderly participants rely more on external strategies, whereas younger participants use internal strategies more often was not supported by our findings. Several studies have also found a strong age-independent preference for using external memory strategies versus internal memory strategies (Cavanaugh, Grady, & Perlmutter, 1983; Lovelace & Twohig, 1990). In the present study the opposite was found, with a more frequent use of internal strategies over external strategies, independent of age.

There appear to be few and only small sex differences on the MIA, which further supports the conclusion by Hultsch et al. (1987) that gender does not play an important role with regard to the MIA. We found education to have effects on five subscales, especially Change, Anxiety, and Achievement. Given that there was a significant decrease in mean educational level with increasing age, it is important to notice that these effects were independent of age (no interaction between age and education).

A comparison between subsamples of participants who considered themselves forgetful and who were (very) worried about this forgetfulness and groups of participants who did not consider themselves forgetful showed that forgetful participants were far more anxious and depressed. They also considered themselves less healthy. There were no age-specific differences on the MIA between forgetful and nonforgetful young and old participants. However, in their self-appraisal of memory the forgetful participants especially reported a far lower memory capacity, a greater memory decline, and higher anxiety related to memory. Although we do not have information about the actual memory skills of the forgetful participants, these findings are important when treatment of memory problems is considered. Such treatment should not only explain the relation between affective state and experienced memory problems but should also focus on modifying negative beliefs about memory competence (Cavanaugh & Green, 1990; Lachman, Weaver, Bandura, Elliott, & Lewkowicz, 1992).

In sum, the present study supports the cross-national use of the MIA as a multidimensional research and clinical instrument for measuring the self-appraisal of memory. A substantial shortening of the MIA seems to be warranted and would make the questionnaire more practical for large-scale population research. Studies on the relation between the MIA and memory performance are currently in progress and will be reported on later.

References

Arbuckle, T. Y., Gold, D. P., Andres, D., Schwartzman, A., & Chaikelson, J. (1992). The role of psychosocial context, age, and intelligence in memory performance of older men. *Psychology and Aging, 7,* 25–36.

Arrindell, W. A., & Ettema, J. H. M. (1986). *SCL-90. Een multidimensionele psychopathologie indicator* [The SCL-90. A multidimensional instrument for the assessment of psychopathology]. Lisse, The Netherlands: Swets & Zeitlinger.

Bollen, K. A. (1990). Overall fit in covariance structure models: Two types of sample size effects. *Psychological Bulletin, 107,* 256–259.

Cavanaugh, J. C., Grady, J. G., & Perlmutter, M. (1983). Forgetting and use of memory aids in 20- to 70-year-olds' everyday life. *International Journal of Aging and Human Development, 17,* 113–122.

Cavanaugh, J. C., & Green, E. E. (1990). I believe, therefore I can: Self-efficacy beliefs in memory aging. In E. A. Lovelace (Ed.), *Aging and cognition: Mental processes, self-awareness and interventions* (pp. 189–229). Amsterdam, The Netherlands: Elsevier Science.

Cavanaugh, J. C., & Poon, L. W. (1989). Metamemorial predictors of memory performance in young and older adults. *Psychology and Aging, 4,* 365–368.

Craik, F. I. M., & Jennings, J. M. (1992). Human memory. In F. I. M. Craik & T. A. Salthouse (Eds.), *Handbook of aging and cognition* (pp. 51–110). Hillsdale, NJ: Erlbaum.

Cutler, S. J., & Grams, A. E. (1988). Correlates of self-reported everyday memory problems. *Journal of Gerontology: Social Sciences, 43,* 82–90.

de Bie, S. E. (1987). *Standaardvragen 1987—Voorstellen voor uniformering van vraagstellingen naar achtergrondkenmerken en interviews* [Toward a standardization of questions concerning demographic variables in population studies] (2nd ed.). Leiden, The Netherlands: Leiden University Press.

Derogatis, L. R. (1977). *SCL-90: Administration, scoring, and procedures manual-I for the R(evised) version.* Baltimore, MD: Johns Hopkins University School of Medicine, Clinical Psychometrics Research Unit.

Dirken, J. M. (1967). *Het meten van stress in industriële situaties* [The measurement of stress in industrial situations]. Groningen, The Netherlands: Wolters.

Dixon, R. A., & Hultsch, D. F. (1983). Structure and development of metamemory in adulthood. *Journal of Gerontology, 38,* 682–688.

Dixon, R. A., Hultsch, D. F., & Hertzog, C. (1988). The Metamemory in Adulthood (MIA) questionnaire. *Psychopharmacology Bulletin, 24,* 671–688.

Enzmann, D. (1993). *PECON 2.0 (PErfect CONgruence).* Berlin: Sozialpädagogisches Institut Berlin.

Hertzog, C., Hultsch, D. F., & Dixon, R. A. (1989). Evidence for the convergent validity of two self-report metamemory questionnaires. *Developmental Psychology, 25,* 687–700.

Houx, P. J., & Jolles, J. (1994). Vulnerability factors for age-related cognitive decline. In R. L. Isaacson & K. F. Jenssen (Eds.), *The vulnerable brain and environmental risk* (pp. 25–41). New York: Plenum Press.

Hultsch, D. F., Hertzog, C., & Dixon, R. A. (1987). Age differences in metamemory: Resolving the inconsistencies. *Canadian Journal of Psychology, 41,* 193–208.

Hultsch, D. F., Hertzog, C., Dixon, R. A., & Davidson, H. (1988). Memory self-knowledge and self-efficacy in the aged. In N. L. Lowe & C. J. Brainerd (Eds.), *Cognitive development in adulthood: Progress in cognitive developmental research* (pp. 65–92). New York: Springer-Verlag.

Jolles, J., Houx, P. J., van Boxtel, M. P. J., & Ponds, R. W. H. M. (1995). *Maastricht Aging Study: Determinants of cognitive aging.* Maastricht, The Netherlands: Neuropsych.

Jöreskog, K. G., & Sörbom, D. (1989). *LISREL 7: A guide to the program and applications.* Chicago: SPSS Inc.

Lachman, M. E., Weaver, S. L., Bandura, M., Elliott, E., & Lewkowicz, C. J. (1992). Improving memory and control beliefs through cognitive restructuring and self-generated strategies. *Journal of Gerontology: Psychological Sciences, 47,* 293–299.

Light, L. L. (1991). Memory and aging: Four hypotheses in search of data. *Annual Review of Psychology, 42,* 333–376.

Lovelace, E. A. (1990). Aging and metacognitions concerning memory function. In E. A. Lovelace (Ed.), *Aging and cognition: Mental processes, self awareness and interventions* (pp. 157–188). Amsterdam, The Netherlands: Elsevier Science.

Lovelace, E. A., & Twohig, P. T. (1990). Healthy older adults' perceptions of their memory functioning and use of mnemonics. *Bulletin of Psychonomic Society, 28,* 115–118.

Metsemakers, J. F. M., Höppener, P., Knottnerus, J. A., Kocken, R. J. J., & Limonard, C. B. G. (1992). Computerized health information in the Netherlands: A registration network of family practices. *British Journal of General Practice, 42,* 102–106.

ten Berge, J. M. F. (1986). Rotation to perfect congruence and the cross-validation of components' weights across populations. *Multivariate Behavioral Research, 21,* 41–64.

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