Metamemory and cognitive aging

Chapter 7

Metamemory and cognitive aging: the Metamemory in Adulthood (MIA) questionnaire

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ABSTRACT

This chapter describes the results of psychometric analysis of the Dutch abridged Metamemory in Adulthood (MIA) questionnaire. The factor structure of the original version of the MIA was recovered well. The internal consistency of the MIA remained high, even though the number of items of some scales was substantially reduced. In addition, data on the relationship between the shortened MIA and age, sex, education, depression, anxiety, and subjective health are presented.

INTRODUCTION

Metamemory is defined as knowledge and beliefs about one's own memory functioning. The concept of metamemory may represent a key to understanding age changes in laboratory memory tasks as well as memory-related behaviour in everyday life. Hultsch, Herzog, Dixon and Davidson (1988) defined four broad dimensions of metamemory: memory knowledge (factual knowledge about memory tasks and memory processes), memory monitoring (self-knowledge about current memory use, contents, and states), memory-related affect (affective states generated by or associated with memory-demanding situations), and memory self-efficacy. Memory self-efficacy refers to the degree of belief one has in one's ability to mobilize the motivation, cognitive resources, and courses of action needed to exercise control over memory task demands (Bandura, 1988; Cavenaugh & Green, 1990; Lovelace, 1990). Memory self-efficacy beliefs determine, among others, how much effort will be invested in memory-specific tasks. The perceptions people hold about their memory functioning are of considerable interest to the study of memory complaints and memory performance. Even if these perceptions are not veridical estimates of the actual memory abilities of a person, they nevertheless may have a substantial impact in determining how much effort will be invested in daily memory tasks. If memory self-efficacy beliefs are low, less effort than necessary will be invested in memory tasks which leads to low memory performance. This in turn strengthens the subjects' beliefs about his or her inadequate memory functioning. So, poor memory performance becomes more a function of self-doubt than of an actual lack of ability.

A well-known instrument to study metamemory is the Metamemory in Adulthood (MIA) questionnaire of Dixon, Hultsch, and Hertzog (1988). In this questionnaire, subjects are asked to rate on a five-point Likert scale 108 statements describing their own memory functioning and their general knowledge of memory processes. The MIA is a multidimensional questionnaire consisting of seven factors or subscales. These are: use of memory strategies (Strategy), knowledge of basic memory processes (Task), evaluation of memory capacity (Capacity), perceived change in memory (Change), perceptions of the relationship between anxiety and memory (Anxiety), motivation to perform well in memory tasks (Achievement), and perceived sense of control over memory (Locus). The concept of memory self-efficacy can be defined by the subscales Capacity, Change and Anxiety (Hertzog, Hultsch, & Dixon, 1989). Data from several studies (see Hultsch, Hertzog, Dixon, and Davidson, 1988) have shown substantial change in Capacity, Change and Locus with aging; Task, Achievement, and Strategy change little with aging. The effects of sex or education are not examined systematically; if effects are found, they account only for small amounts of variance. Correlations between MIA subscales (especially Capacity and Change) and actual memory performance (tests) are mostly modest (r=.20–.30). Correlations of the MIA-subscales with mood state variables like depression and anxiety or personality traits (neuroticism, locus of control orientation) are either absent or low.

A Dutch version of the MIA was included in the postal questionnaire of the MAAS–A_1 panel study and administered to 2,043 subjects (see Chapter 7). In the present study we report on the psychometric characteristics of the Dutch MIA. One of the goals of this study was to reduce the number of items, without changing the factor structure.

METHODS

Subjects

Only subjects with complete data on the MIA scales were included in the study. For this reason 144 subjects were excluded, leaving a total number of 1,899 subjects. These subjects were divided in four age groups: young age (age classes 25, 30, and 35 years), young middle age (40, 45, and 50 years), old middle age (55, 60, and 65 years), and old age (70, 75, 80,

Table 7.1.
Descriptive characteristics of the subjects in the study.

			Age		Education		Sex (M/F)
	n	(%)	Mean	*SD*	Mean	*SD*	%
Total group	1899	(100)	52.0	16.9	3.3	1.9	46/54
Young age	476	(25)	30.6	4.1	4.3	1.8	41/59
Young middle age	501	(26)	44.8	4.2	3.6	1.8	50/50
Old middle age	513	(27)	59.8	4.1	2.7	1.7	49/51
Old age	409	(22)	75.6	5.2	2.5	1.9	44/56

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

and 85 years). Educational level was measured by a Dutch scoring system (de Bie, 1987) which consists of an eight-point scale, ranging from unfinished primary education (level 1) to university education (level 8). The mean age, sex, and educational level of the subjects are presented in Table 7.1.

The old age group was somewhat smaller than the other groups (22%). There were also slightly more women than men, especially in the young and old age groups. A significant decline in mean level of education was found from the youngest to the oldest age group ($F(3,1834)=97.4$, $p<.001$). Multiple range tests (Duncan, $p=.05$) showed that the groups were significantly different from each other, except for the old middle age and old age groups.

Statistical analysis

Confirmatory factor analyses (CFA) (PECON; ten Berge, 1986) were performed to see if the factor structure of the original MIA could be recovered. In PECON, the structure of a theoretical model (the factor structure of the original MIA) is represented by means of a weight matrix (the weight of an item being either 1 or 0). If these defined factors do account for a great part of the variance in the new data set, these factors summarize the information well. The amount of variance explained by these 'hypothesized' factors is then compared with the proportion of variance explained by a separate Principal Component Analysis (PCA). If the amount of variance explained by CFA is comparable to that of a PCA, the information in the data set is summarized well by the defined factor structure. Because the factor configuration in both the original and the Dutch MIA are equal by definition, the comparability of the two questionnaires can also be checked by looking at the degree of correspondence of the inter-correlations between the factors and the mean item loadings of both questionnaires. A series of PECON analyses were performed to reduce the number of items. An item was omitted from the list if the loading of a item on its factor was less than .50 or if the item loaded on other factors as well. The Strategy subscale was analysed separately. We expected that this scale would include two subscales: internal and external memory strategies. In addition to the confirmatory factor analysis, internal consistency estimates were calculated (Cronbach's *Alpha*). Regression analyses were conducted to look at the relationship between depression, anxiety, and subjective health and the scores on the MIA subscales, after controlling for the effects of age, sex, and education. The questionnaires used for anxiety, depression and subjective health are described elsewere (Section 4.1). Multivariate and additional univariate analyses of variance were used 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 as significant.

RESULTS

Factor analysis

A substantial number of items (34 items, or 31%) of the MIA could be eliminated without losing the factor structure. The number 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

Table 7.2.
Summary of the confirmatory factor analysis and reliability analysis of the abbreviated Metamemory in Adulthood questionnaire.

Scale MIA	no. of items	range factor loadings	variance explained (%)[1]	Cronbach's *Alpha*
Task	10	.54 to .71	6.93	.82
Capacity	12	.52 to .68	8.01	.84
Change	10	.62 to .81	9.63	.91
Anxiety	12	.54 to .71	8.73	.87
Achievement	7	.53 to .69	5.24	.73
Locus	7	.50 to .73	4.99	.75
All scales	58	—	43.42	—
Strategy-ex	8	.51 to .75	20.27	.77
Strategy-in	8	.52 to .77	23.61	.84
Both scales	16	—	43.88	—

Note. [1]Unique variance (corrected for the correlations between the factors).

Table 7.3.
Correlations among the subscales of the abridged Metamemory in Adulthood questionnaire

		1	2	3	4	5	6	7	8
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-ex	.18	−.22	−.28	.25	.08	−.01	—	
8.	Strategy-in	.28	−.05	−.20	.25	.21	.12	.44	—

(56%), two for Locus (22%), and two for the Strategy subscale (11%). The separate analysis for the Strategy subscale showed that the scale could be divided into two factors corresponding to a factor internal strategies and a factor external strategies. A summary of the CFA and reliability analysis of the abridged MIA is given in Table 7.2. The amount of variance explained in the CFA for the first six factors was 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.

Intercorrelations between the factors or subscales are presented in Table 7.3. The pattern of intercorrelation was comparable with the pattern in the original 108-version of the MIA (Hertzog, Hultsch & Dixon, 1989). Only the correlations between the subscales Change, Capacity, Anxiety, and Locus were slightly 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.

Discriminant validity

Subjective health was significantly correlated to depression and anxiety (.54), whereas a very high correlation was found between depression and anxiety (.81). Age, sex, and educational level correlated with subjective health, depression, and anxiety, although the strength of these correlations was generally low (range .05 to .29). Because we wanted to examine the effects of subjective health, anxiety, and depression on the MIA

Table 7.4.
Stepwise hierarchical multiple regression of age, education, depression, and subjective health on the subscales of the abridged Metamemory in Adulthood questionnaire.

Subscale	*Beta*	*T*	*p*	R^2 change	R^2 total
Task					
Age	.09	3.40	.000	.002	
Sex	.00	−.32	.750	.000	
Education	.11	4.17	.000	.010	.012
Capacity					
Age	−.13	−5.19	.000	.026	
Sex	.14	5.72	.000	.010	
Education	−.03	−1.10	.272	.001	
Subjective health	−.18	−6.26	.000	.044	
Depression	−.08	−2.89	.004	.001	.082
Change					
Age	−.42	−19.69	.000	.228	
Sex	.07	3.62	.000	.001	
Education	.01	.27	.269	.005	
Subjective health	−.23	−9.54	.000	.083	
Depression	−.13	−5.54	.000	.012	.339
Anxiety					
Age	.13	5.91	.000	.061	
Sex	.06	2.71	.007	.022	
Education	−.17	−7.42	.000	.057	
Subjective health	.24	9.47	.000	.119	
Anxiety	.14	3.91	.000	.030	
Depression	.08	2.30	.022	.003	.292
Achievement					
Age	.22	9.19	.000	.086	
Sex	.05	2.23	.026	.008	
Education	−.19	−7.66	.000	.034	
Anxiety	.09	3.91	.000	.008	.136
Locus					
Age	−.03	−1.07	.286	.002	
Sex	.00	.00	.999	.000	
Education	−.01	−.42	.675	.000	
Subjective health	−.09	−3.55	.000	.007	.009
Strategy-ex					
Age	.06	2.35	.012	.000	
Sex	.19	8.12	.000	.035	
Education	.19	7.36	.000	.021	
Subjective health	.15	5.94	.000	.019	.075
Strategy-in					
Age	.08	2.99	.003	.001	
Sex	.09	3.71	.000	.009	
Education	.18	6.97	.000	.019	
Anxiety	.11	3.77	.000	.019	
Subjective health	.07	2.44	.015	.004	.052

Table 7.5.
Mean item score per subscale of the abridged Dutch version of the Metamemory in Adulthood Questionnaire as a function of age (n=1,837).

		Young		Young middle aged		Old middle aged		Old	
		n=461		*n*=488		*n*=500		n=388	
Scales	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	.234	3.79	0.62	3.38	0.77	3.00	0.79	2.69	0.84
Anxiety	.066	2.55	0.65	2.74	0.71	2.88	0.73	3.05	0.75
Achievement	.086	3.60	0.57	3.70	0.58	3.95	0.59	4.04	0.52
Locus	.002	3.26	0.58	3.29	0.59	3.29	0.60	3.18	0.62
Strategy-ex	.001	3.32	0.73	3.35	0.80	3.31	0.80	3.45	0.86
Strategy-in	.002	3.44	0.68	3.52	0.72	3.55	0.74	3.53	0.78

subscales independently of the interacting variables age, sex, and educational level, a multiple hierarchical regression analysis was performed instead of a simple correlational analysis. Only subjects with complete data on all variables were included in the analysis (*n*=1,720). In step 1 age was entered in the regression model, in step 2 sex, in step 3 education level, and in step 4 subjective health, depression, and anxiety. The results are shown in Table 7.4. Subjective health, anxiety, and depression had no contribution in the subscale Task. On all other subscales anxiety and depression had either no contribution or only accounted for very small amounts of variance. Only in the Anxiety subscale of the MIA did anxiety account for 3% of the variance. More substantial contributions were found for subjective health on Change (R^2=8%) and Anxiety (R^2=12%). Lower health ratings were related to a more subjective decline in memory and more subjective anxiety-related to memory performance.

Effects of age, sex, and educational level

A multivariate analysis of variance (MANOVA) was conducted with the eight subscales of the abbreviated MIA as dependent variables and age, sex, and education as independent variables. Age had four levels corresponding to the age subsamples presented in Table 7.1. Educational level was reduced to three levels instead of eight: low level (educational level 1 and 2), medium level (level 3 to 5), and high level (6 to 8).

The 4 (age) x 2 (sex) x 3 (eduction) MANOVA on the eight subscales of the MIA revealed significant overall effects of age (F(24,5239)=20.33,

Table 7.6.
Mean item score per subscale of the abridged Dutch version of the Metamemory in Adulthood Questionnaire as a function of sex.

		Men n=841		Women n=996	
Scales	R^2	*M*	*SD*	*M*	*SD*
Task	.000	3.85	0.55	3.83	0.58
Capacity	.012	3.08	0.63	3.22	0.63
Change	.001	3.20	0.88	3.26	0.84
Anxiety	.018	2.69	0.72	2.89	0.73
Achievement	.007	3.76	0.59	3.86	0.59
Locus	.000	3.27	0.60	3.25	0.59
Strategy-ex	.033	3.19	0.76	3.48	0.80
Strategy-in	.009	3.43	0.72	3.58	0.74

Table 7.7.
Mean item score per subscale of the abridged Dutch version of the Metamemory in Adulthood Questionnaire as a function of educational level.

		Low level n=795		Medium level n=693		High level n=349	
Scales	R^2	*M*	*SD*	*M*	*SD*	*M*	*SD*
Task	.004	3.81	0.59	3.84	0.54	3.91	0.55
Capacity	.002	3.12	0.67	3.19	0.61	3.17	0.58
Change	.043	3.04	0.88	3.34	0.82	3.49	0.78
Anxiety	.095	3.04	0.74	2.69	0.68	2.46	0.62
Achievement	.070	3.97	0.56	3.77	0.59	3.55	0.57
Locus	.000	3.25	0.60	3.27	0.61	3.27	0.56
Strategy-ex	.010	3.29	0.84	3.35	0.80	3.51	0.67
Strategy-in	.009	3.44	0.77	3.54	0.71	3.62	0.66

p<.001), sex (F(8,1806)=16.96, p<.001), and education (F(16,3612)= 18.09, p<.001). There were no interaction effects. Additional univariate F-tests showed significant age differences on all subscales of the MIA, except for Task and Locus. Mean items scores on the factors for the total sample and the four age groups are shown in Table 7.5. Older adults reported less memory capacity (Capacity: F(3,1813)=12.54, p<.001), more decline in memory (Change: F(3,1813)=128.60, p<.001), and more feelings of anxiety in everyday memory tasks (Anxiety: F(3,1813)=18.70, p<.001). They were also more motivated to achieve well in everyday memory tasks (Achievement: F(3,1813)=32.30, p<.001) and used memory strategies more often (Strategy-in: F(3,1813)=6.65, p<.001; Strategy-ex: F(3,1813)=4.56, p<.01). 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 robust: age accounted for substantial portions of the variance (respectively 7, 9, and 23%).

Univariate analysis showed sex differences on four MIA subscales (Table 6). No interaction effects were found. Male subjects had lower scores on Capacity ($F(1,1813)=9.22$, $p=.002$), and both Strategy subscales (Strategy-in: $F(1,1813)=13.00$, $p<.001$; Strategy-ex: $F(1,1813)=53.04$, $p<.001$), whereas female subjects had higher scores for Anxiety ($F(1,1813)=23.46$, $p<.001$). A marginally significant effect was found on Achievement, with female subjects scoring higher than male subjects ($F(3,1813)=6.65$, $p=.020$). The sex effects were small in terms of the variance accounted for. The strongest effects were found for Anxiety (2%) and Strategy-ex (3%).

Effects of educational level were found on five subscales (Table 7.7). There were no interaction effects. Lower education was related to higher scores on Anxiety ($F(2,1813)=48.04$, $p<.001$) and Achievement ($F(2,1813)=29.67$, $p<.001$) but to lower scores on Task ($F(2,1813)=6.21$, $p=.002$) and both Strategy subscales (Strategy-in: $F(2,1813)=16.89$, $p<.001$; Strategy-ex: $F(2,1813)=19.61$, $p<.001$). The subjects with a lower education also noticed more decline in memory (Change: $F(2,1813)=4.84$, $p=.008$). The effects of educational level were, however, only substantial for Change (4% variance explained), Achievement (7%), and Anxiety (10%).

CONCLUSION

The main focus of this study was to examine the psychometric characteristics of the Dutch abridged MIA. The results show that the factor structure of the original version of the MIA was recovered well. The internal consistency of the MIA was high, even though the number of items of some scales was substantially reduced. This reduction of items makes the MIA more appropriate for large-scale population research.

Correlations of the MIA subscales with anxiety, depression, subjective health were in general low, which gave support to the discriminant validity of the MIA. Strongest age effects were found on Change, Anxiety and Achievement. Age had very little effect on the Capacity scale. These age effects were largely similar to those reported for the original MIA. Sex had an effect only on the Strategy and Anxiety scale. Education affected Change, Achievement, and Anxiety.

A study of test-retest reliability is currently being performed. The predictive validity between the Dutch abridged MIA and memory performance (tests) will be studied in the A_2-A_4 panel studies of MAAS.

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