

Assessment of capabilities in persons with advanced stage of dementia: Validation of The Montessori Assessment System (MAS)

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Abstract

This study evaluated the validity and reliability of the Montessori Assessment System. The Montessori Assessment System assesses preserved abilities in persons with moderate to severe dementia. In this respect, this instrument provides crucial information for the development of effective person-centered care plans. A total of 196 persons with a diagnosis of dementia in the moderate to severe stages of dementia were recruited in 10 long-term care facilities in France. All participants completed the Montessori Assessment System, the Clinical Dementia Rating Scale and/or the Mini Mental State Examination and the Severe Impairment

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Battery-short form. The internal consistency and temporal stability of the Montessori Assessment System were high. Additionally, good construct and divergent validity were demonstrated. Factor analysis showed a one-factor structure. The Montessori Assessment System demonstrated satisfactory psychometric properties while being a useful instrument to assess capabilities in persons with advanced stages of dementia and hence to develop person-centered plans of care.

Keywords

assessment, Montessori, person-centered care, preserved abilities, severe dementia

Introduction

Advanced stages of dementia, i.e. moderate to severe, represent a major challenge for our societies and for individuals, including caregivers and persons with dementia. A majority of the residents in long-term care facilities are considered to have severe dementia (Canadian Study of Health and Aging Workgroup, 1994; Clare, Woods, Whitaker, Wilson, & Downs, 2010). In France, the PAQUID study showed that 66% of persons with severe dementia (having an MMSE score <10) live in long-term care facilities (Helmer et al., 2006).

Currently, there is no widely accepted consensus on definitive criteria of advanced stages of dementia (Palm et al., 2016). But even in the absence of widely accepted criteria, advanced stages of dementia usually are characterized by the addition of different growing challenges that include more cognitive deficits, more frequent and severe behavioral problems, and more important functional loss and frequent comorbidities, such as motor and sensory deficits, compared to earlier stages of dementia. Persons with moderate to severe dementia are typically considered as having severe disability and as being more and more dependent on caregivers. This increased dependence leads to increased caregiver time, burden, and stress (Tariot, 2003). The significant prevalence, disability, burden, and cost associated with severe dementia clearly make this an important societal health problem. Designing care and intervention plans to face those challenges is an urgent need, especially as improvement in quality of care in residential setting for persons with advanced stages of dementia has been stressed (Ballard et al., 2001).

Developing interventions for persons with advanced dementia is challenging. Pharmacologic interventions in the US are required to demonstrate improvement in cognitive functioning on measures such as the Alzheimer's Disease Assessment Scale - cognitive subscale (ADAS-COG) (Podhorna, Krahne, Shear, & Harrison, 2016). However, when such improvement is achieved, at least on a statistically significant level, it does not necessarily result in better clinical outcomes, such as reducing challenging behaviors associated with dementia (Farlow et al., 2010). Government agencies also are requiring significant reductions in the use of psychotropic medications for behaviors associated with advanced dementia. In France, where the government bears the cost of pharmacologic intervention for dementia, there is a similar and perhaps stronger impetus to develop more effective, non-pharmacologic interventions for this population.

These forces are converging with a call for a person-centered approach to dementia care (Kitwood, 1997; Mast, Shouse, & Camp, 2015). This approach involves focusing on an individual's remaining capacities to provide personally meaningful and engaging activity

as a treatment modality. Person-centered care constitutes, in this view, an emergent theoretical framework for such interventions to improve proactively quality of life and independence, while concurrently reducing behavioral challenges in persons with dementia.

The Montessori method as applied to persons with dementia (Camp, 1999; Camp, 2010; Camp, Bourgeois, & Erkes, *in press*) is a good example of the person-centered approach. It is based on the philosophy and principles of the scientific pedagogy developed by Maria Montessori (Lillard, 2005), a physician who specialized in rehabilitative medicine and applied these techniques in an educational setting. The Montessori method promotes positive engagement in meaningful activities at any stage of dementia. Montessori-based activities are adapted to fit the interests of the person, to circumvent deficits, and to tap into preserved abilities to enable success. Adaptation of activities involves several principles based on rehabilitation techniques. These include breaking tasks down into steps, using templates and visual cues in the material, using manipulatives, demonstrating, giving guidance and then withdrawing guidance to enable independence to be achieved, matching speed, etc.

The benefits of Montessori method applied to dementia include: an increase of engagement and positive affects during Montessori-based activities (see for example Orsulic-Jeras, Judge, & Camp, 2000), an increase in independence of daily living activities, such as eating (Lin, Huang, Watson, Wu, & Lee 2011), and a reduction of behavioral problems (De Witt-Hoblit, Miller, & Camp, 2016; Lin et al., 2009; Roberts, Morley, Walters, Malta, & Doyle, 2015), especially for persons with severe dementia and language issues (Van der Ploeg et al., 2013). Finally, intervention programs based on the Montessori approach also may have positive impact on institutional issues such as satisfaction at work, staff turn-over, residents' census, or psychotropics' administration (De Witt-Hoblit et al., 2016; Roberts et al., 2015). Of course, to be most effectively implemented, this person-centered approach must be coupled with an assessment system to identify capacities in persons with dementia and pair these with specific interventions for use in plans of care.

The recommended cognitive assessment tools for persons with dementia, as the Severe Impairment Battery (Saxton et al., 1990), along with its short version (SIB-S) (Saxton et al., 2005), and the Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975; Hermann, Gauthier, & Lysy, 2007; Vellas et al., 2005), have been designed to assess deficits, loss, and decline, especially to allow staging and follow-up of persons with dementia. Having a mental status score of a person with dementia does not produce a plan of care or intervention, and in the trenches of long-term care knowing a person's stage of dementia, or even evolution of cognitive impairments, does not provide a great deal of assistance to caregivers.

Camp et al. developed an assessment tool using Montessori-based activities for persons with dementia specifically designed to provide information relevant to the creation of person-specific interventions for individuals with moderate to severe dementia (Camp, Skrajner, Lee, & Judge, 2010), especially when used in conjunction with use of a detailed personal history and personal preferences interview. This Myers-Menorah Park/Montessori Assessment System (MMP/MAS) was translated into French and further modified to develop a new tool for assessing abilities in persons with advanced stages of dementia: the Montessori Assessment System (MAS). The main aim of the present study was to validate the MAS by investigating its psychometric proprieties in a population of elderly persons with moderate to severe dementia living in nursing homes in France.

Design and methods

Participants

A total of 196 eligible long-term care residents from 10 nursing homes in France were considered for inclusion. The main inclusion criterion for the selection of residents was the presence of a diagnosis of dementia in accordance with the criteria of ICD-10 (World Health Organization, 2010). For our study, we included residents with moderate to advanced dementia corresponding to MMSE scores below 20. If a resident refused or was incapable to complete the MMSE (e.g. due to severe aphasia), the severity of dementia symptoms was rated on the Clinical Dementia Rating Scale (CDR) and had to correspond to a moderate to severe stage. No specific exclusion criteria were applied.

Measures

Clinical Dementia Rating Scale. The CDR (Berg, 1988) was used to evaluate stage of severity of dementia. The CDR is a five-point scale with scoring from 0 (no impairment), 0.5 (very mild dementia) to 3 (severe dementia). CDR-1 indicates a mild stage, CDR-2 a moderate stage, and CDR-3 a severe stage. The CDR score was based on information obtained about the patient's everyday performance in six domains (Berg, 1988).

Mini-Mental Status Examination. The MMSE (Folstein et al., 1975) is a brief 30-point questionnaire that is used to assess cognitive function, including orientation, registration, attention and calculation, recall, and language. The MMSE has been validated and extensively used in both clinical practice and research (Folstein et al., 1975; Hermann et al., 2007).

Severe Impairment Battery (short form). The Severe Impairment Battery-short form (SIB-S) (Saxton et al., 2005) has been used as a cognitive outcome measure for severe dementia assessment. It is composed of 26 simple one-step commands and gestural cues, and it allows for a variety of simple responses. The six major subscales are: attention, orientation, language, memory, visuo-spatial ability, and construction. In addition, there are also brief evaluations of praxis, social interaction, and orienting to name. The possible scores range from 0 to 50 (Saxton et al., 2005).

The MAS. The MAS is derived from a preliminary version, the MMP/MAS (Camp et al., 2010). In this latter version, the MAS consists of eight activities based on Montessori principles. Those activities tap into a variety of skills and abilities typically not addressed in other assessments, such as both reading aloud and then following along as another person reads aloud, different fine and gross motor skills, the ability to follow directions, the ability to imitate, the ability to use templates, the ability to sort items into categories, the ability to use external aids to circumvent memory deficits, the ability to express opinion, etc.

The MAS activities are briefly presented below:

Hand washing: A simple three steps hand-washing task, using a cloth, that assesses a range of motor skills, ability to follow directions, and ability to imitate actions.

Short story: A short story reading and discussion activity with large print. It assesses many skills and abilities such as reading out loud with different font sizes, using a book, following on the book when another person is reading, chatting about topics of interest, etc.

Visual perception: A brief color and depth perception activity, assessing basic visual abilities.

Happy/unhappy category sorting: A category sorting activity with photos of faces to sort into two categories (Happy/Not Happy), using labels and templates. It assesses abilities such as basic motor skill, the ability to categorize, to recognize basic facial emotions, to give opinions, to use templates, etc.

Water/land category sorting: A category sorting activity with items presented with an increasing level of abstraction (e.g. “lake” or “mountain”) to sort into two categories (Water/land), using labels and templates. It assesses abilities such as basic motor skill, the ability to categorize, to access abstract concept, to give opinions, to use templates, etc.

Fine motor skills and color matching: A gripping, transfer and matching activity using spiked colored balls and bowls, tweezers, and an ice-cream scoop. It assesses ability to grip and transfer, the ability to manipulate simple daily living tools, to identify and match colors, to return items once the items are used, etc.

Dressing vest: An adapted dressing and undressing activity with a modified vest made simply to rest on one’s neck (there are no arm holes) and one button and a zipper bag. It assesses many motor skills involved in dressing.

Calendar: An adapted temporal orientation task where the participant is encouraged to use a large-print calendar to give the correct date of the day. It assesses the ability to use an external aid to circumvent memory deficit (i.e. to use externally stored information if this information is not stored internally). This activity is only presented if the participant has previously shown the ability to read.

Administration principles. The administration of the MAS aims to enhance the person with dementia’s engagement and to maximize chances of success in the different activities (notably to assess conditions that allow the person to succeed). All activities are presented with a progressive level of assistance if needed. Tasks are first presented with complete verbal instructions. Then, if the person is not able to succeed, the task is broken down into steps and step-by-step instructions are used. If this is not sufficient, the examiner presents the task with physical demonstration. The last step uses hand-over-hand guidance. At the end of each activity and at the end of the administration of the MAS, the participant is asked if he or she enjoyed the experience and if he or she would like to do something similar on another occasion. This gives useful information on the participant’s preferences and assesses the ability to express opinion. Other Montessori-based principles such as using invitation, offering choices, presentation at a slow pace, etc. are also used in the administration of the MAS. Finally, the activities may be presented separately to avoid fatigue or frustration.

Scoring system. The MAS is based on a triple scoring system. First, quantitative scores for each activity and a global quantitative score for the complete battery are generated.

The maximum total score is 445. Second, a measure of the level of assistance needed by the participant to complete each activity is generated. Finally, a qualitative measure is taken based on the observation of the abilities that have been demonstrated to be preserved during the administration. This system allows obtaining crucial, clinically relevant information that may be directly transferred into care plans and scores that may be used for follow-up assessments.

Procedures. This study was conducted in 10 long-term care nursing homes in the southern part of France between January 2016 and March 2016. At the beginning of the study, consensus meetings were organized by two fully trained clinical psychologists to instruct and to ensure that standardized procedures were applied for all measures and assessments.

Complete demographic and clinical characteristics of the residents were obtained through chart review and clinical interview. Without knowledge of the results of the MMSE, SIB, and MAS testing, a registered nurse in each of the participating nursing homes who knew the residents well scored the residents on the CDR.

The protocol, including the MMSE, the SIB, and the MAS, was administered within a maximum period of one week. Given the format of the MAS (i.e. eight independent subscales), single or multiple administration sessions could be considered. The MAS was administered to 72 residents a second time 15 days after its first completion to establish test-retest reliability.

These three measurements were administered to the residents by 10 trained final year students in psychology at the University Paul Valéry Montpellier 3 (Montpellier, France). Two registered psychologists conducted these students' training during three group sessions.

To establish the MAS inter-rater reliability, 10 trained and licensed psychologists who were employees of the care nursing homes scored the capacities of 53 residents in parallel with students' administration and scoring of the MAS, during the first administration of the MAS.

Residents' legal representatives signed informed consent prior their participant in the study. All residents gave their written or oral assent. The protocol complied with the Helsinki Declaration. In the cases where the protocol had to be administered in multiple sessions (within several periods of a day or of a week), the oral assent of the resident was systematically requested to continue their participation in the study.

Data procedure analysis. Statistical analyses were performed using the Statistical Package of the Social Sciences Version 20.0 for Windows software (SPSS). Residents' characteristics are presented as percentages for categorical variables and as means and standard deviations for continuous variables. As the MMSE, the SIB, and the MAS are rated on various range scales, their raw scores were standardized using z-score transformation.

The internal consistency of the MAS was examined with the item-to-total correlation and Cronbach's alpha. Good internal consistency was considered as $0.7 > \alpha < 0.9$ (Bland & Altman, 1997). Here, item represented the individual score of each MAS activity, i.e. (1) hand washing, (2) short story, (3) visual perception; (4) happy/unhappy category sorting, (5) water/land category sorting, (6) fine motor skills, (7) dressing vest, and (8) calendar.

The Kaiser–Meyer–Olkin (KMO) method was used to measure sampling adequacy. Bartlett's test of sphericity was computed to test the null hypothesis that the variables in the correlation matrix were uncorrelated (a significant value is required to reject the null hypothesis). Principal component analysis (PCA) was carried out and eigenvalues and scree plots were examined to determine the structure of the data.

Construct validity was evaluated with Pearson correlations computed between the MAS, the MMSE, the SIB, and the CDR total score. Correlations above 0.5 were considered as strong, between 0.3 and 0.5 as moderate, and below 0.3 as weak (Cohen, 1988). Discriminant validity was conducted using correlational analyses between the MAS and selected demographical variables (i.e. age, years of scholarship and length of institutionalization). Gender effect was explored with independent Student's t-tests for independent samples.

Inter-rater and test-retest reliabilities were assessed by calculating the intra-class correlation coefficient (ICC) and 95% confidence intervals.

As recommended by Schafer and Graham (2002), the likelihood method was applied to handle missing data that were missing completely at random. Two-tailed p-values were considered to indicate statistical significance.

Results

Demographic and clinical characteristics of the sample

Demographic and clinical characteristics of the eligible sample ($n = 196$) are presented in Table 1.

The study sample was typical for French psychogeriatric nursing home residents at this time, with a preponderance of older individuals, many of whom were female, and with low educational attainment. Most of these residents had moderate to severe dementia symptoms on the CDR.

Table 1. Demographic and clinical characteristics of the residents.

	Eligible sample ($n = 196$)	Eligible sample without missing data ($n = 152$) ^b
<i>Demographical data (N = 196)</i>		N.A.
Age (y)	$86.3 \pm 7.8 [58 - 106]^a$	
Female, % (N)	78% (153)	
Education (y)	$9.2 \pm 2.7 [4 - 18]$	
Length of stay nursing home (y)	$2.6 \pm 2 [0.1 - 13]$	
<i>Clinical Dementia Rating Scale (N = 196)</i>		N.A.
Total score	$1.9 \pm 0.8 [1 - 3]$	
Severity of dementia symptoms, % (N)		
CDR-1 mild	30.1% (59)	
CDR-2 moderate	47.4% (93)	
CDR-3 severe	22.5% (44)	
<i>Mini Mental State Examination</i>		
Complete, % (N)	90.3% (177)	
Total score	$11.5 \pm 4.6 [0 - 20]$	$11.1 \pm 4.8 [0 - 20]$
<i>Severe Impairment Battery</i>		
Complete, % (N)	92% (180)	
Total score	$38.4 \pm 9.6 [3 - 64]$	$37.4 \pm 8.6 [3 - 64]$

N.A.: not applicable; y: years.

^a[minimum–maximum].

^bLikelihood method was applied to estimate missing data.

Missing data (MMSE, SIB, and MAS)

As illustrated in Table 1, most eligible residents fully completed the MMSE (90.3%) and the SIB (92%).

With respect to the MAS two residents refused to complete the evaluation. Another one was unable to complete any activities, and one was hospitalized while participating in the study. As shown in Table 2, most residents fully completed the MAS (89.3%). Note that, in such cases, the average time to complete the MAS was 49 minutes ($SD = 21$, range = 16–135) and the average number of sessions was 1.2 ($SD = 0.5$, range = 1–3).

Considered separately, from 90.8% to 96.4% of the residents were engaged in each MAS activity.

Tables 1 and 2 indicate no deviance between descriptive data computed from the eligible sample ($n = 196$) and those obtained after applying the likelihood method.

It should be noted that missing data relative to MMSE, SIB, and MAS were not necessarily homogeneously distributed throughout the group.

One hundred and fifty-two participants had complete data for all three instruments. Separate analyses were conducted for the data of these 152 participants. The psychometric proprieties of the MAS examined on the sample of residents who fully completed MMSE, SIB, and MAS ($n = 152$) are presented in online supplementary materials. These results are in accordance with those computed on the eligible sample without missing data ($N = 196$) after applying the likelihood method. Therefore, data for the full sample are described in this article.

Descriptive statistics of the MAS

Skewness and kurtosis for each MAS activity respectively ranged from -1.7 to -0.8 and from -0.5 to 2, indicating no strong deviation from normality considering that absolute values for skewness and kurtosis of greater than 3 and 20, respectively, are judged to be extreme (Weston & Gore, 2006). Thus, the computation of a PCA could be considered appropriate. There were no outliers and no apparent problems with restriction of range.

Reliability

The Cronbach alpha coefficient for the MAS was good ($\alpha = 0.85$). The item-total correlations for the eight subscales of the MAS ranged from 0.62 to 0.94, with a mean of 0.79.

Principal component analysis

There were no outliers and no apparent problems with restriction of range. Bartlett test of sphericity ($\chi^2 = 1235.8$; df 28; $p < 0.001$) and Kaiser–Meyer–Olkin measure of sampling adequacy (0.90) indicate MAS data matrix is very well suited to PCA. One unique principal component that explained 66.7% of score variance was found with factor loading ranging from 0.66 to 0.92, with a mean of 0.81.

Convergent validity

Given the component structure of the MAS, the total score of the instrument was used. The MAS was strongly positively associated with both MMSE ($r = 0.67$) and SIB ($r = 0.81$),

Table 2. Descriptive data of the Montessori Assessment System.

	Eligible sample with missing data (n = 196)	Eligible sample without missing data (n = 196) ^b
Refusal, % (N)	1% (2)	
Unable to complete any activity, % (N)	0.5% (1)	
Other	0.5% (1)	
Number of activities completed		
1	0.5% (1)	
2	1% (2)	
3	1.5% (3)	
4	–	
5	–	
6	1% (2)	
7	5.1% (10)	
8	89.3% (174)	
Activity 1 – Hand washing		
Complete, % (N)	95.4% (187)	
Score	11.8 ± 3.5 [0 – 15] ^a	11.7 ± 3.6 [0 – 15]
Activity 2 – Short story		
Complete, % (N)	95.9% (188)	
Score	57.7 ± 19.5 [0 – 75]	56.8 ± 20.5 [0 – 75]
Activity 3 – Visual perception		
Complete, % (N)	96.4% (189)	
Score	14.5 ± 6.6 [0 – 25]	14.4 ± 6.7 [0 – 25]
Activity 4 – Happy/unhappy category sorting		
Complete, % (N)	94.8% (186)	
Score	83 ± 24.8 [7 – 110]	80.8 ± 27.7 [7 – 110]
Activity 5 – Water/land category sorting		
Complete, % (N)	94.3% (185)	
Score	80.2 ± 25.3 [8 – 105]	77.5 ± 28.7 [8 – 105]
Activity 6 – Fine motor skills and color matching		
Complete, % (N)	94.8% (186)	
Score	68.3 ± 16.6 [6 – 80]	66.8 ± 18.4 [6 – 80]
Activity 7 – Dressing vest		
Complete, % (N)	90.8% (178)	
Score	24.9 ± 10.2 [0 – 35]	23.2 ± 11.6 [0 – 35]
Activity 8 – Calendar		
Complete, % (N)	93.8% (184)	
Score	3.3 ± 1.6 [0 – 5]	3.2 ± 1.6 [0 – 5]
Total score	334 ± 104 [14 – 444]	333 ± 104 [14 – 444]

^a[minimum–maximum].^bAfter applying the likelihood method.

and strongly negatively correlated with the CRD total score ($r = -0.52$). Moderate associations were observed between the number of sessions to complete the MAS, the MAS total score ($r = -0.44$), the MMSE ($r = -0.36$), the SIB ($r = -0.41$), and the CDR ($r = 0.32$).

Discriminant validity

To investigate the divergent validity, the MAS total score was correlated with selected demographical parameters. These analyses revealed no significant relationship with age ($r = 0.04$) and length of institutionalization ($r = 0.07$). Education was weakly associated with the MAS total score ($r = 0.16$). No significant gender effect was observed ($t = -0.87$, $p = 0.38$).

Test-retest reliability

Seventy-two residents completed the MAS twice, with 15 days of interval between administrations. The ICC between the MAS total scores was excellent, $r = 0.90$ with a 95% confidence interval from 0.79 to 0.95, suggesting adequate temporal stability.

Inter-rater reliability

As previously mentioned, the capacities of 53 residents on the MAS were scored in parallel by two raters during the first administration of the instrument. The ICC for inter-rater reliability was 0.95 with 95% confidence of interval from 0.81 to 0.98, which corresponds to a high level of reliability.

Discussion and implications

The present study describes the psychometric properties of a new instrument dedicated to the assessment of capabilities in persons with moderate to severe dementia, the MAS. The results showed the MAS to be a valid and reliable instrument for the assessment of capabilities in persons with advanced stages of dementia.

Exploratory factor analysis of the MAS supported a single-factor solution explaining 67% of the variance in total score. Given this breadth of items, the internal consistency-based reliability estimate for the MAS was good and the test-retest variability was high after an average interval of 15 days. This indicates that the MAS provides a reliable assessment of a broad range of capabilities and is also well suited for longitudinal assessments.

Specific and strong relationships were highlighted between the MAS total score, the MMSE, and the SIB, as measures of global cognition. These results indicated that the MAS present a construct that is conceptually similar to global cognition.

Even if severity of dementia, as assessed by the CDR, was strongly associated with the MAS total score, 91% to 96% of residents were engaged in each MAS activity. In addition, most residents fully completed the MAS with an average completion time of 49 minutes and in one session. While some residents required breaking the MAS into more than one session, this was infrequent, though the MAS's modular composition allows for this. This last observation contrasted with the poor sustained attentional capacities that are generally described in persons with advanced stages of dementia (Saxton & Boller, 2006). Thus, the MAS proved to be a relatively easy and quick assessment to administer, with 89% of the total sample completing all activities and another 5% of the sample completing seven out of eight activities.

The single-factor solution was surprising given the diversity of items included in the MAS. Nevertheless, this result is in line with the unique-factor solution reported in validation studies of tools specifically dedicated to global cognitive assessment of persons with

advanced stage of dementia, such as the SIB divided into nine subscales (Cruz-Orduña et al., 2015). Furthermore, in our study, we observed a collinearity between the total scores of the MAS and the SIB ($r = 0.81$). All of these observations support the notion that the total score of the MAS represents a reliable indicator of the global cognitive status in advanced dementia. However, we would like to stress that the main clinical goal of the MAS is not to provide a unique indicator that would exclusively reflect a global appreciation of the cognitive status or a stage of dementia. There are already well validated internationally recognized tools dedicated to this matter. Indeed, up to now, the focus on most mental status assessments in persons with dementia has been on the detection of deficits to establish a diagnosis, and perhaps a means of staging the progression of dementia within an individual (Sheehan, 2012). This approach does not readily translate into development of plans of care, especially as dementia progresses. What is needed, especially if delivery of person-centered care is desired, is a focus on the individual's capabilities, personal history, and personal interests (Mast et al., 2015). Knowledge of these attributes, rather than a score on an assessment, are required to create models of care which aspire to create a sense of being at home and part of a community for memory care residents.

The MAS was created with these goals in mind, and residents responded to this different approach. For example, many of the MAS administrators reported that residents thanked them at the end of the MAS, and said that they would be happy to take part in similar activities. This was in distinct contrast to the frustration often seen in persons with dementia during more standard assessments. The result was that both the person giving and the person receiving the MAS generally had a pleasant experience.

Results from the MAS, especially qualitative observational data, translate readily into plans of care. Total scores are not as important in this regard as performance on individual tasks. For example, performance on the hand washing activity provides information on a resident's capacity to imitate action, as well as the amount of assistance necessary to complete the hand washing, both of which are directly applicable to fostering independence in personal care activities such as brushing one's teeth, combing hair, getting dressed, etc. Thus, if the resident can complete the activity only with hand-over-hand assistance initially, similar levels of assistance should be provided for brushing teeth, combing hair, etc. For such a resident, giving verbal instructions would not be an effective way to foster independence, and probably would lead to failure and frustration. Performance on the short story activity provides information on a person's capacity to be part of a structured reading and discussion group for individuals with dementia (Stevens, King, & Camp, 1993). If the person with dementia can read a page of the story aloud, and take turns reading a page and then quietly following along while someone else reads a different page aloud, it should be easy to transition this person into an existing reading group. If the person, however, has difficulty reading aloud but has shown good capacities in listening and discussing about the story while someone else reads, then the person could be invited to listen as a story is read and take part in the discussion of the story. Motor skills demonstrated in MAS tasks likewise relate to capacity to demonstrate or reacquire abilities of daily living. If the person can hold and manipulate tools in the transfer task of the MAS, the person could potentially help stir batter in a cooking activity, use a tool to help make a birdhouse, etc. If motor skills are lacking, the person potentially could dictate content of an advice column or recipe book. If the resident can button buttons on the vest used in the MAS and/or use its fasteners, this also translates into allowing the resident to dress more independently. However, if assistance is needed in this MAS task, more physical assistance may be needed initially for dressing for

this person. MAS performance also guides in the development of individualized external cues, based on capacities demonstrated by the individual. Ability to categorize relates to the ability to express preferences using external aids (Bourgeois, Camp, Antenucci, & Fox, 2016). Residents can put pictures or words into categories of things they like or do not like, for example. Ability to use memory aids may help to effectively reduce memory-related challenging behaviors, such as repetitive questioning (Bourgeois, 2014). Knowing where to find externally stored answers to questions, and having the capacity to acquire that information, can greatly reduce anxiety and frustration in residents and staff members. The MAS can provide information on a resident's capacity to read, manipulate external aids, level of abstraction in the resident's thinking, etc. which can guide in the creation of these memory aids (such as whether a resident has taken medications; where the resident's clothes are now [at the laundry]; when a family member is coming to visit; etc.). To illustrate how data obtained from the MAS may be used and transformed into recommendations for plans of care, we present the case of Mrs VP with her MAS results and the ways they may be used (see Appendix 1).

Of course, MAS results should be combined with information acquired from personal history and preferences data, ideally acquired at intake from both a resident and family members. For example, two residents in memory care both show the ability to categorize. One is interested in sports, while the other likes classical music. Sports-related categorizations activities could be developed for the first resident, and music-related categorization activities could be developed for the second resident. These activities could be used by staff or by family members during visits.

In conclusion, the MAS has the capacity to play a major role in developing plans of care while furthering the overall goal of creating person-centered care environments for individuals with dementia, especially those with moderate to severe dementia.

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Declaration of conflicting interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr Cameron Camp is a consultant and trainer for the French organization AG&D. J Erkes is the Director of Research for AG&D. Dr Camp plans to work with AG&D to commercially develop and distribute the MAS within French-speaking Europe and other parts of the world where French is used extensively, and to then create and similarly evaluate an English language version of the MAS.

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Appendix I – Clinical example of the MAS application

- Clinical presentation

Mrs VP is a woman over 90 years old, living for several years in the dementia unit of a French nursing home. She has a diagnosis of Alzheimer disease and has a right leg hemiplegia due to a stroke. She is using a wheelchair with staff assistance to get around. She also suffers from severe arthritis in the left shoulder and hands. Her MMSE score is 12/30.

Staff gave some information about the challenges Mrs VP exhibits. She is presented as totally dependent for daily living activities (clothing, washing, toileting, eating), very frequently displays repetitive questioning (e.g. about the day, the place, what to do during the day) and presents frequent challenging behaviors as agitation, aggression, and shouting. She is described as mildly depressed. She has been given psychotropic medication to manage challenging behaviors.

- MAS administration and results

The MAS administration lasted 1 hour and 15 minutes in one session. Mrs VP was focused, engaged, and very cooperative. She smiled a lot, thanked the examiner and asked for another visit, explaining that she was happy to give opinions and to have social contact.

She was unable to use tweezers and to perform the dressing vest activity due to arthritis and pain. She asked to stop the Category sorting activity, as she did not like it.

Quantitative results and qualitative observations show that Mrs VP has retained many abilities.

1. MAS quantitative results

1. Hand washing	14/15
2. Short story	59/75
3. Visual perception	20/20
4. Happy/unhappy category sorting	82/110
5. Water/land category sorting	46/105
6. Fine motor skills and color matching	68/80
7. Dressing vest	0/35
8. Calendar	5/5
Total score	294/445

2. Understanding of instructions and level of help needed

1. Complete verbal instructions ^a	1 activity/8
2. Verbal instructions, one step at a time ^a	8 activities/8
3. Physical demonstration ^a	4 activities/8
4. Hand-by-hand guidance ^a	0 activity/8

^aNumbers of activities with successful use of level help.

3. Observed abilities on the MAS: (+) Able, (-) Unable

a. Motor skills

Gross motor skills

- (+) Wide arm movements (Hand washing)
- (+) Turn book pages (Short story)
- (+) Pick cards (Category sorting activities)
- (+) Give objects back (book and cards) (Category sorting activities)
- (+) Manipulate cards (pick cards and put on the template) (Category sorting activities)
- (+) Global movements with precision (move balls with tweezers or spoon) (Fine motor skills and color matching)

- (+) Close the book (Category sorting activities)
- (-) Global movements (put the vest on) (Dressing vest)
- (-) Fold clothes (the vest) (Dressing vest)
- (-) Put objects in a bag (the vest) (Dressing vest)

Fine motor skills

- (+) Grasp and transfer with fingers (cloth) (Hand washing)
- (+) Rub hands to wash (with cloth) (Hand washing)
- (-) Using small tool to grasp (tweezers) (Fine motor skills and color matching)
- (+) Grasp and transfer with hands (Fine motor skills and color matching)
- (+) Use a spoon (ice-cream spoon to grip and transfer the balls) (Fine motor skills and color matching)
- (-) Use buttons (Dressing vest)
- (-) Use zipper (to close the bag) (Dressing vest)

b. Sensory skills

- (+) Hear (All activities)
- (+) Contrast perception (light/dark) (Visual perception)
- (+) Deep perception (Visual perception)
- (+) Primary colors identification (Fine motor skills and color matching)

c. Social and communication skills

- (+) Follow instructions (All activities)
- (+) Give opinion (about an activity) (All activities)
- (+) Present arguments and explain choices (Category sorting activities)
- (+) Identify basic emotional expressions (Happy/unhappy category sorting)
- (+) Answer questions and tell stories about oneself (Short story)
- (+) Give opinion about a text (Short story)

d. Cognitive skills

Related to reading

- (+) Date reading (Calendar)
- (+) Spontaneous use of a written memory aid to circumvent memory deficit (Calendar)
- (Not needed) Use of written memory aid with help (Calendar)
- (+) Arial 80 font reading (Short story)
- (+) Arial 48 font reading (Short story)
- (+) Arial 24 font reading (Short story)
- (-) Arial 12 font reading (Short story)
- (+) Reading a text with large font (Arial 42) out loud (Short story)
- (+) Reading isolated word (on cards) (Category sorting activities)
- (+) Follow a basic written cue (next reader) (Short story)

Other cognitive skills

- (-) Temporal orientation without help (Calendar)
- (+) Follow a text on a book when another person is reading (Short story)

- (+) Understand the global sense of a text (answer question about the text) (Short story)
- (+) Identify simple shapes (square/rectangle) (Category sorting activities)
- (+) Use a template to put things on the right place (put cards on the right template) (Category sorting activities)
- (-) Categorize words (Water/land category sorting)
- (+) Count objects (to three) (Fine motor skills and color matching)
- (+) Match colors (transfer balls in the matching bowls) (Fine motor skills and color matching)
- (+) Recognize basic kitchen tools (return the right tool at the end of the activity) (Fine motor skills and color matching)

- MAS-based recommendations for Mrs VP's plan of care:

Levels of help needed:

- Putting things at the right distance (within arm's reach) allowed Mrs VP to grab them
- Verbal instructions, one step at a time, were able to be followed
- Physical demonstration, one step at a time, helped her complete tasks
- Physical cueing to initiate reading (by pointing the first line) enabled her to read

For daily living activities, to maintain or regain independence and reduce challenging behaviors:

- Put things at the right distance and invite her to do as much as possible by herself
- Using one step at a time verbal instructions and physical demonstration (for washing and toileting, eating...)

Creation of an individualized written external aid with practice using it to lower repetitive questioning

Ask Mrs VP to give her opinions and give her choices during the day (clothes, activities, food, etc.) as she is able to give opinion and feels happy and calmer when it happens

Have participating residents invite her to join a reading and discussion group activity

Have participating residents invite her to the weekly philosophy café

Invite her to assist the activity leader by having her read instructions during large group activities (where she usually shouts to catch attention)

Have participating residents invite her to join a cooking club (where she can read recipes and instructions aloud if she has trouble manipulating cooking ingredients or utensils)