



Clinical Evaluation of the Mini-Mental State Exam with Culturally Deaf Senior Citizens

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Abstract

The Mini-Mental State Exam (MMSE) is commonly used to screen cognitive function in a clinical setting. The measure has been published in over 50 languages; however, the validity and reliability of the MMSE has yet to be assessed with the culturally Deaf elderly population. Participants consisted of 117 Deaf senior citizens, aged 55–89 ($M = 69.44$, $SD = 8.55$). Demographic information, including state of residence, age, and history of depression, head injury, and dementia diagnoses, were collected. A standard form of the MMSE was used with modification of test administration and stimuli including translation of English test items into a sign-based form and alteration of two items in order to make them culturally and linguistically appropriate. Significant correlations were observed between overall test score and education level ($r = .23$, $p = .01$) as well as test score and age ($r = -.33$, $p < .001$). Patterns of responses were analyzed and revealed several items that were problematic and yielded a fewer correct responses. These results indicate that clinicians need to be aware of cultural and linguistic factors associated with the deaf population that may impact test performance and clinical interpretation of test results. On the basis of these data, there is an increased risk of false positives obtained when using this measure. Further research is needed to validate the use of this measure with the culturally Deaf population.

Keywords: MMSE; Deaf; American Sign Language

Introduction

The Mini-Mental State Exam (MMSE) is commonly used as an early evaluation of important cognitive and emotional abilities commonly associated with organic brain disease (Folstein, Folstein, & McHugh, 1975). It provides a brief assessment of areas of cognition including language skills (confrontation naming, repetition, comprehension, reading, and writing), memory (registration and short-delayed free recall), simple and complex attention, orientation to time and place, and construction (Folstein et al., 1975). It has been widely used as a screening tool for cognitive function and as a predictive indicator of probable Alzheimer's disease (Tierney, Szalai, Dunn, & McDowell, 2000). The MMSE has also shown utility for the assessment of consent and capacity in individuals with Alzheimer's disease (Kim & Caine, 2002). Studies of the MMSE and its use in the detection and diagnosis of dementia have shown to be valid and reliable when applied to various groups of older adults, including those identified as "very old" (75+) (Hopp, Dixon, Grut, & Blackman, 1997). In addition to the initial detection of dementia, the MMSE has also shown validity and reliability in the identification of the changes during the duration of dementia (Mendiondo, Wesson, Kryscio, & Schmitt, 2000). Tasks within the MMSE have been shown to discriminate between various types of dementia. Ala, Hughes, Kyrouac, Ghobrial, and Elble (2001) identified the differences in the pentagon-copying task on the MMSE between individuals with dementia with Lewy bodies and those with Alzheimer's disease.

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The MMSE has been published in over 50 languages and has been shown to be valid for Spanish (Gonzalez, Mungas, Reed, Marshall, & Haan, 2001), Arabic (Al-Rajeh, Ogunniyi, Awada, Daif, & Zaidan, 1999), Chinese speaking (Katzman, Zhang, & Ouang, 1988), and Nigerian (Ogummiyi, Osumtokun, & Lekwauwa, 1991) elderly populations. Several studies have investigated the influence of factors on test outcomes such as premorbid intelligence, level of education, gender, race, ethnicity, and language (Brown, Schinka, Mortimer, & Graves, 2003; Espino et al., 2004; Jones & Gallo, 2002; Marcopulos, McLain, & Giuliano, 1997; Marcoulous & McLain, 2003). The MMSE has been widely criticized for items that may be biased toward culture and educational level. Ostrosky-Solis, Lopez-Arango, and Ardila (2000) investigated the sensitivity and specificity of the MMSE in a Spanish-speaking population. Participants were divided into three age ranges (16–50, 51–65, and 66–89) and four educational ranges (0, 1–4, 5–9, and >10 years). Results found that neurologically intact illiterate participants obtained mean scores in the severely impaired range ($M = 17.76$), whereas those with 1–4 years of education scored in the moderately impaired range ($M = 20.61$). Authors found a low level of sensitivity and specificity for participants with less than 4 years of schooling. Jones and Gallo (2002) investigated educational and gender differences on the MMSE and found significant group differences. Participants with low education were more likely to display errors on items such as Serial 7's, spelling "WORLD" backwards, repeating a phrase, writing a sentence, naming the season, and the design copy task. A study by Rosselli, Tappen, Williams, and Salvatierra (2006), investigating the relation of education and gender on attention items on the MMSE with Spanish-speaking Hispanic elders found significant educational effects. Additionally, these authors propose that the two items that have been criticized in the past for cultural and educational biases (Serial "7's" and "WORLD") are not equivalent in their difficulty and may test different abilities.

One language that the MMSE has never been translated into is American Sign Language (ASL). Nor, have there been any validity or reliability studies that examine the utility of the MMSE with elderly culturally Deaf populations. ("D" in Deaf Culture reflects a community who uses ASL as their language and has a unique set of values reflective of a subculture within the general population compared with "d" deaf, which typically denotes audiological deafness.)

Much of the research on mental health assessment in the deaf population is dated; however, it provides a foundation for practitioners to begin to understand some of the complexities in working with this population. The literature on neuropsychological assessment with deaf older adults is sparse, and the majority of studies published have focused on children and young adults. However, these studies have provided a glimpse into cognitive domains such as memory for learning, free recall, cued recall, and visual memory. Pollard, Rediess, and DeMatteo (2005) developed and validated the Signed Paired Associates Test (SPAT), which in many ways is analogous to the Associate Learning task on the original Wechsler Memory Scale. Although further studies on the utility of this measure for older adults and the elderly have yet to be established, these authors suggest that SPAT is clinically valid in detecting cognitive impairment in the domain of verbal learning and memory. Cattani, Clibbens, and Perfect (2007) investigated hemispheric preference of visual memory for shapes in deaf signers and non-signers and hearing signers and non-signers. Although this study may not be generalizable to older adults because of the relatively young mean age of participants (between 26.40 and 29.41 for the four groups), results suggested that there are hemispheric differences for signing and non-signing participants. Results suggest that signing individuals regardless of hearing status were more accurate at memorizing shapes and that deaf individuals regardless of signing ability displayed right hemispheric advantage. The authors suggest that memory performance is enhanced for shapes in deaf and hearing signers which is a result of the development of visual skills as a concomitant constructs of sign language. The authors also propose that deafness itself, regardless of signing background, provides a visually based strategy for memory of "difficult-to-describe" items. However, one critique of the study is that the stimuli used in the Shape condition utilized objects that require different modalities of recall, such as having as sign in the vocabulary or fingerspelling, which could potentially be a confound.

Deaf adults represent an underserved minority population who may present with mental illness, cognitive impairment, illiteracy, and economic disadvantage (Duffy, 1999; Feldman, 2005). The deaf community often lacks access to information and therefore deaf individuals may have a limited ability to seek services. To complicate matters, barriers to communication between the practitioner and individual may hinder the assessment process. The use of English vocabulary terms in the medical and mental health setting may be unfamiliar to deaf individuals and contribute to difficulty in accessing services and communication breakdown (Steinberg, Loew, & Sullivan, 1999). Neuropsychological assessment of deaf individuals is different from that of hearing individuals in many ways. The deaf individual's presentation of symptoms is often ambiguous; therefore it can be difficult to give a definitive diagnosis (Elliot, Glass, & Evans, 1987). Most tests are normed for hearing individuals and have strong English linguistic and cultural components. Those who strongly identify with Deaf Culture and whose primary communication is ASL may have difficulty comprehending test instructions and understanding task demands. This may influence test performance and lead to an increase in misdiagnosis with a greater likelihood of false-positive results. Consequently, the individual may present as demonstrating neuropsychological dysfunction, when in fact, results may reflect a misunderstanding of the task (Wisniewski, DeMatteo, Lee, & Orr, 1989). Often, Deaf individuals with neurological dysfunction (presenting with poor language skills, difficulties with hyperactivity and attention, and aggression)

may be misdiagnosed as emotionally disturbed by a hearing clinician unaware of the impact of deafness on social, academic, linguistic, and cognitive development. Clinicians unfamiliar with Deaf Culture may also misinterpret behaviors, mannerisms, and conversation styles unique to Deaf individuals (Dinges & Cherry, 1995). It is imperative that a complete developmental history be obtained to gain an understanding of whether the individual at any time had been diagnosed with a learning disability, which could affect the results of many cognitive and neuropsychological tests. One possible difficulty in assessing deaf individuals is that many with pre-existing learning disabilities have not been diagnosed with these disorders (Morgan & McCay, 1994).

The present study investigated the use of the MMSE with culturally Deaf senior citizens and sought to evaluate how Deaf individuals perform on the MMSE with minimal changes made to the structure of item instructions. Additionally, demographic information was collected in order to evaluate variables that may be correlated with test performance. Finally, exploratory analysis of test items was performed in order to investigate variables related to overall test performance and to provide preliminary data on patterns of performance and score ranges.

Materials and Methods

Participants

All data were collected at the Deaf Seniors of America conference in San Francisco in 2005. This is a national conference for Deaf senior citizens held every 2 years; thus, participants represented geographical locations throughout the USA. Participants consisted of 33 male and 84 female Deaf senior citizens ($M = 117$) aged 55 and over ($M = 69.43$, $SD = 8.55$). Participants had an average of 13.8 years of education ($SD = 2.8$) and nearly half of the participants indicated that they had attended a Deaf Residential school (60.7%). The remainder indicated that they attended an Oral program (22.2%), Public/mainstream school (14.5%), or Deaf Day school (2.6%). Participants consisted primarily of community dwelling individuals (93.2% residing independently in a house or apartment) active in the deaf community, as evidenced by their attendance at a national conference. Participants were congenitally deaf or prelingually deaf and identified ASL as their primary language. Participants reported a severe to profound level of hearing loss; however, most did not know their level of decibel (dB) loss. Factors such as late deafened (as with normal aging or post-lingual), hard of hearing, and those with a previous history head injury and/or diagnosis of depression and/or dementia were excluded from the study. A total of five participants were excluded from the sample for one or more of the above reasons.

Procedure

Institutional Review Board (IRB) approval was obtained from the Gallaudet University and Macon State College. All data were collected by the authors of this study who are proficient in ASL, as defined by the Gallaudet University. Informed consent was presented to individuals in ASL. Participants were asked to volunteer without monetary compensation. Individuals first completed a brief demographic questionnaire, which included state of residence, age, and previous diagnosis of depression, head injury, or dementia. Participants were then presented with the MMSE using sign-based communication.

Mini-Mental Status Exam

A standard form of the MMSE was used. English words were translated into ASL and the exam was presented to participants in this format. English to ASL translation was developed by the authors and cross checked by other professionals with clinical and academic experience in ASL. To better gauge language issues specific to Deaf participants, the following modifications were made. First, on the immediate and delayed word recall, the words “cat,” “tree,” and “house” were substituted for the more common words found on different versions of the MMSE, including “apple,” “table,” and “penny.” This was due to concerns about the lack of a standard ASL equivalent for the word “penny.” The authors chose these three words based on analogous frequency of use compared with standard words as well as for the handshapes that were different enough as not to cause prompting and distinguishable enough to ensure response identification (Emmorey, 2002). Second, on the reading task “Close Your Eyes”, individuals were tapped on the shoulder, rather than told verbally to open their eyes.

Results

Mean score on the MMSE ($M = 25.91$, $SD = 3.49$) indicated that the average performance of this relatively highly educated group was below the acceptable cut off point for “Normal” functioning. Distribution frequencies indicated 6.0% of the sample

obtained scores below 19 (Severe Cognitive Impairment), 27.4% obtained scores between 20 and 25 (Mild Cognitive Impairment), and 66.7% obtained scores between 26 and 30 (Normal Cognitive Function). For a full breakdown of scores by percent, refer to Fig. 1. Response patterns were analyzed and indicated items that appeared particularly problematic including: Orientation (naming the Governor of their home state), Attention and Calculation (Serial 7's), and Language Repetition (No If's And's or But's) (see Table 1 for frequency of responses to all items). On the task "Serial 7's," 83.8% of participant's were unable to correctly recall all five consecutive numbers. In contrast, only 8.5% were unable to correctly identify any of the five letters in spelling the word "World" backward, and 70.9% of participants received full points for this task.

With the immediate recall task, 99.1% of participant's correctly recalled the first item, "cat," 90.6% correctly recalled the second item, "tree," and 99.1% correctly recalled the third item, "house." However, during the delayed task, 86.3% correctly recalled the "cat," 84.6% recalled the "tree," and 88.8% correctly recalled the "house." Items included in the command sequence, spontaneous sentence generation, and the copying tasks also yielded fewer correct responses (refer to Table 1). Analyses were conducted to evaluate relationships among demographic variables and the total score obtained on the MMSE. The results yielded a small but statistically significant correlation between the highest level of education attained ($M = 13.84$, $SD = 2.83$) and MMSE total score ($M = 25.91$, $SD = 3.50$), $r(115) = .23$, $p = .01$. However, a one-way ANOVA with years of education as a grouping variable (i.e., 7–9, 10–12, 13–16, and 17–21 years) did not reveal a significant difference between education and total score, $F(3, 113) = 2.43$, $p = .069$ ns. Participant's age ($M = 69.44$, $SD = 8.55$) was negatively correlated with the overall score, $r(115) = -.33$, $p < .001$, a result which supports previous findings (see Folstein et al., 1975). Age ASL was learned and total score was not significantly correlated ($r(115) = .023$, $p = .803$ ns). Chi-square revealed significant relationships between Type of Educational Placement and Total Score ($\chi^2(3) = 88.64$, $p < .001$) and Total Score and Gender ($\chi^2(15) = 118.62$, $p < .001$).

Discussion

The objective of the current study was to examine the performance of culturally Deaf older adults on the MMSE and evaluate patterns of scores on test items. The results indicate that several factors could potentially affect test performance and artificially lower the overall score, thereby increasing the risk of false-positive results.

English-based test items and instructions often do not translate well into ASL because of grammatical and structural differences between the two languages. This leads to a misunderstanding of the task, making it more difficult for the individual to

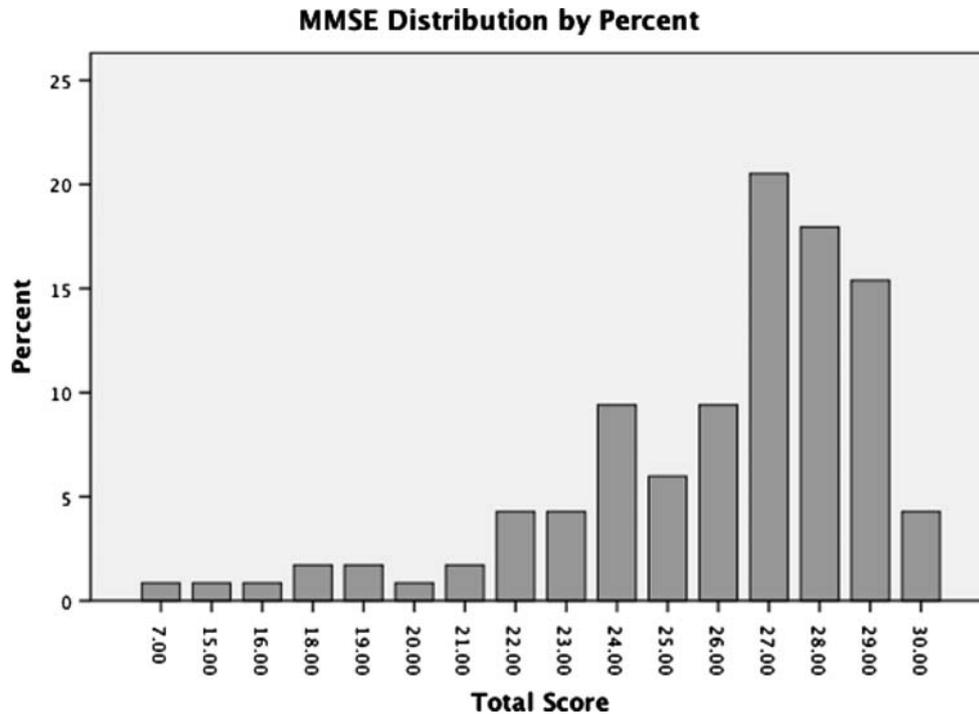


Fig. 1. Distribution of Total MMSE Score by percent.

Table 1. Frequency of responses

Cognitive domain	Test item	% Incorrect	% Correct
Orientation	Year	2.6	97.4
	Season	0	100.00
	Date	27.4	72.6
	Day of week	8.5	91.5
	Month	10.3	89.7
	State	2.6	97.4
	City	3.4	96.6
	Location	6.8	93.2
	President	2.6	97.4
	Governor	23.1	76.9
Registration	Imm. Rcl Cat	0.9	99.1
	Imm. Rcl Tree	9.4	90.6
	Imm. Rcl House	0.9	99.1
Attention/calculation	Serial 7's	83.8	16.2
	World^a	8.5	70.9
Recall	Delay Rcl Cat	13.7	86.3
	Delay Rcl Tree	15.4	84.6
	Delay Rcl House	12.0	88.0
Language	Watch	8.5	91.5
	Pencil	0.9	99.1
	Repetition	78.6	21.4
	Reading	3.4	96.6
	Command: Right	37.6	62.4
	Command: Fold	12.8	87.2
	Command: Lap	11.1	88.9
	Sentence generate	22.2	77.8
Visual-motor	Copy	16.2	83.8

Notes: Items in bold represent task frequencies of less than 85% correct and potentially problematic.

^aThe frequencies presented for “World” represent scores of 0 or 5 and thus do not add up to 100%.

comprehend and respond correctly to the item. For example, the instructions for Serial 7's, in which only 16% of the current sample received full points, and sentence repetition which had a similarly low frequency of participants receiving credit (21%). The English instructions for Serial 7's “I want you to start with 100 and count backwards by 7's” translates in ASL to “Start 100, subtract 7, subtract 7, subtract 7, . . .” with each “subtract 7,” hands move in increments to the right to indicate continuation. This type of gesture is a typical component of ASL structure, which does not have an English equivalent. Although the above is an appropriate translation into ASL, this may change the task demand, therefore tapping a different cognitive domain. Additionally, the use of the visual movement from right to left may encourage participants may utilize a more visuospatial strategy in responding to this task. Previous studies have suggested that specific items, such as “Serial 7's” and “Close Your Eyes,” are problematic for minority cultures and may be biased with respect to education, race, and ethnicity (Jones & Gallo, 2002; Teresi et al., 2001). Serial 7's is heavily influenced by arithmetic skill which is historically a weak area in deaf individuals (Brauer, Braden, Pollard, & Hardy-Braz, 1999; Gaines, Meltzer & Glickman, 2008). However, at this time, it is difficult to discern the nature of the weakness of this particular item.

As ASL and English are two different languages with different language structure, syntax, and grammar, the “write a complete sentence” task may be more difficult for Deaf individuals whose primary language is ASL. Sentences may make sense in ASL but if scored strictly using English grammar, the individual may not receive credit. It is important to note that culturally Deaf children and adults will often, in everyday usage, write sentences in correct ASL format rather than in Standard English, therefore violating English grammatical rules. Although 78% of the current sample produced a scorable sentence, the MMSE assumes that a cognitively intact individual should earn full credit, suggesting that this may be due to language difficulties considering the sample group.

Certain vocabulary does not translate into ASL, therefore affecting the individual's conceptualization and performance. The phrase “No If's And's or But's” is an example of this difficulty in the MMSE. This phrase, while familiar to a more general older adult population is an idiom, and does not translate into ASL and is therefore unfamiliar to most Deaf individuals. Although idioms in ASL do exist, many deaf individuals may or may not be familiar with them due to the variable age at which they entered Deaf culture. This is where having some understanding of the individual's cultural identity may play a role. As the directions for the task would not typically make sense to a Deaf individual, it would therefore be likely that

their response would not be accurate and thus would lower their score. Many Deaf participants included in this study who did well on the majority of other tasks and showed no signs of cognitive impairment, struggled with, and were generally unable to complete this task.

Two correlations between total MMSE scores and individual demographic variables were observed. There was a correlation between total MMSE score and age, indicating that the older the participant, the lower the total MMSE score. There was also a correlation between total MMSE score and education. The higher the individual's education level, the better the total MMSE score. Neither of these two correlations are particularly surprising and supports the findings in previous research studies (Crum, Anthony, Bassett, & Folstein, 1993).

The average age of Deaf individuals in this study was 69.44 years with 13 years of education and a mean score on the MMSE was 25.91, whereas the hearing counterpart in a previous study was 69 years old with college experience and a mean score of 29 (Crum et al., 1993). This demonstrates a clear disparity in test scores between Deaf older adults in this sample and the general older adult hearing population previously studied by Crum and colleagues (1993). Although both groups have similar years of education, scores obtained by Deaf individuals are below the acceptable cut off range for normal cognitive function. Scores obtained by the Deaf population are more consistent to those of the Eighth Grade Education Group from the Crum and colleagues (1993) study. On the basis of the above data, it appears likely that this disparity is due to cultural and linguistic factors. This was the case despite the use of professionals trained in the administration and interpretation of psychological assessment measures in ASL with Deaf individuals. Espino and colleagues (2001) suggested that cultural and/or social factors may adversely have an impact on scores due to differences in familiarity with skill sets assessed on the MMSE.

A major criticism of research norms on the MMSE is that population samples are predominantly Caucasian with relatively high levels of education (≥ 13 years) and living in economically stable areas of the USA (Marcoulos McLain, 2003). This may result in overestimating cognitive impairment in individuals with lower levels of education, lower socioeconomic status, and those from diverse cultural and ethnic backgrounds. Marcoulos McLain (2003) attempted to address the issue of educational and cultural factors by increasing samples of bicultural African Americans. Results indicated that participants, ranging in age from 55 to 74 with 7 to 10 years of education had a mean score of 25.5 ($SD = 2.8$) on the MMSE. Although the sample size was considerably smaller and represented a lower education level than that obtained in the current study, the findings provide further support that there is an effect of culture on performance. Furthermore, it is concerning that the current sample, which had some college experience, demonstrated analogous scores to individuals with lower levels of education when compared with data by Marcoulos and McLain (2003).

Limitations

The primary limitation in this study, which may affect the overall implications of using the MMSE with a culturally Deaf older adult population, is the sample used for this study. The individual population consisted only of those Deaf senior citizens who were able to travel to, participate in, and attend the Deaf Seniors of America conference. As a result, this individual group consisted of a comparatively well-educated and highly functional group of Deaf older adults and may not generalize well to the older deaf population. Additionally, participant recruitment was focused toward those who strongly identify with Deaf culture. Deaf identity is a complex topic and involves several components such as audiological status, linguistic immersion (i.e., English-based sign language vs. ASL, etc.), and educational background. Those individuals with a stronger cultural Deaf identity rather than (purely audiological) deaf, more readily utilize ASL and in theory, would have a higher likelihood of incongruent performance compared with hearing individuals. Thus, these results may not generalize to all audiological deaf individuals. Since educational level positively correlated with the scores on this test, use of such a highly educated sample has implications for the potential misclassification of the general population of deaf individuals who often have lower levels and quality of education. Another potential limitation of the current study was that the authors did not complete an exhaustive review of psychological, medical, and/or neurological conditions that can have an impact on cognitive functioning. Thus, it is possible that the sample may have included those with cognitive impairments; however, this study has also shed light on the difficulty in the accurate assessment of cognitive impairment in this population.

Conclusion

The above results of this study do not suggest that the MMSE is inappropriate for use as a cognitive screening measure with Deaf older adults. However, it does indicate that the most accurate results will be obtained when the MMSE is administered by qualified professionals with a background in the cognitive assessment of Deaf adults and who are proficient in ASL. Even with such individuals, there still exist some cultural and linguistic components of the test that may artificially lower the total MMSE score for the Deaf individual. Total MMSE scores for Deaf older adults must be interpreted with caution, and it must be

recognized that cultural and linguistic factors, rather than cognitive impairment, may be a reason for scores which appear to be below the range of normal functioning. On the basis of the results of this study, there is a clear need for a larger scale study with a more diverse participant population as well as a clinically impaired population. Such a study should investigate the performance of Deaf participants with more typical levels of education as well as a more racially and ethnically diverse population. On the basis of the current data, it appears likely that with lower educational levels (and, presumably, weaker English skills) such individuals would be even more vulnerable to misclassification. Thus, future studies may investigate if modification of the instructions may be beneficial or if a change in the task would produce more accurate data. At that point, it would also be important to evaluate whether item instruction, the task itself, or a combination of the two, problematic. This would also help to build upon the development of separate diagnostic guidelines or test modifications needed to ensure appropriate use of this instrument with Deaf individuals.

Conflict of Interest

None declared.

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