Cognition and hearing: Should this be part of my clinical practice?

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Support for our research from National Institutes of Health R01 DC006014, R01 DC012289, R33 DC011174

This course is presented in partnership with continued.
Outline

What is cognition?
Research findings on hearing and cognition
Cognition in the clinic: where are we now?
Overview of cognitive screening instruments
Including cognition in treatment and counseling
Cognition

The mental action or process of acquiring knowledge and understanding through thought, experience, and the senses.

Includes, but is not limited to:

- Attention
- Memory
- Reasoning
- Problem solving and decision making
- Language comprehension and production

Normal cognitive changes with age

The rate at which new information is learned can be slower

Daily occupational and social functioning is not impaired

Long-term memory changes with age, while short-term memory shows less decline

Most aspects of language ability remain strong, although word-finding ability declines with age

www.apa.org
Cognitive abilities that change with age

- Processing speed
- Attention
- Working memory
- Executive functions
- Memory
- Language
- Visuospatial abilities

www.apa.org
Processing speed

Speed of processing simple information

Can be measured using digit-symbol substitution reaction time task. Participant presses key to indicate whether probe pair matched code table. Scored as response time.

Example from Motes et al., 2011
Cognitive abilities that change with age

- Processing speed
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Attention

- **Sustained attention:** the ability to focus and concentrate on specific stimuli and tasks
- Remains strong in older adults

(Carriere et al., 2010; McAvinue et al., 2012)
Attention

- **Selective attention**: the ability to focus on specific stimuli and ignore the others
- **Divided attention**: the ability to focus on multiple tasks simultaneously
- **Decline with aging process**

Cognitive abilities that change with age

- Processing speed
- Attention
- **Working memory**
- Executive functions
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(Salthouse et al., 1995; Carlson et al., 1995)
When do you need working memory?

Information processing
- make a semantic judgment about a sentence
- arrange the words/numbers according to category or order

Information storage
- recall words from the sentence, or unrelated words
- recall words/numbers from the list

Working memory tests: two examples

Reading span test

Verbal memory test

Cognitive abilities that change with age

- Processing speed
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- Working memory
- **Executive functions**
- Memory
- Language
- Visuospatial abilities

Executive functions: driving as an example

- **Inhibition**: resistance to inference from irrelevant stimuli or tasks
- **Coordinative ability**: coordinating distinct tasks
- **Task shifting**: switching between tasks
- **Memory updating**: monitoring and storage of new information
Measuring Executive Functions

Trail-making test

Stroop test

Cognitive abilities that change with age

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www.apa.org
## Memory and aging

<table>
<thead>
<tr>
<th>Declines with age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed free recall: spontaneous retrieval of information from memory without a cue&lt;sup&gt;24,25&lt;/sup&gt;</td>
</tr>
<tr>
<td>Example:</td>
</tr>
<tr>
<td>Recalling a list of items to purchase at the grocery store without a cue</td>
</tr>
<tr>
<td>Source memory: knowing the source of the learned information</td>
</tr>
<tr>
<td>Example:</td>
</tr>
<tr>
<td>Remembering if you learned a fact because you saw it on television, read it in the newspaper, or heard it from a friend</td>
</tr>
<tr>
<td>Prospective memory: remembering to perform intended actions in the future&lt;sup&gt;26&lt;/sup&gt;</td>
</tr>
<tr>
<td>Example:</td>
</tr>
<tr>
<td>Remembering to take medicine before going to bed</td>
</tr>
</tbody>
</table>

## Fluid cognitive abilities that change with age

- Processing speed
- Attention
- Working memory
- Executive functions
- Memory
- Language
- Visuospatial abilities
Language abilities

- **Vocabulary**: improves over time
- **Visual confrontation naming**:
  - Naming a common object
  - Stable until age 70
- **Verbal fluency**:
  - Generating words for a certain category
  - Decline with aging
- **Comprehension**:
  - Word and sentence recognition
  - Slower and more errors

(Harada et al., 2013; DeDe and Flax, 2016)

Measures of language abilities

- **Processing speed**
- **Executive functions**
- **Working memory**

- Error in parsing complex sentences
- Slower comprehension
- Declined inhibition in verbal fluency

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Cognitive abilities that change with age

- Processing speed
- Attention
- Working memory
- Executive functions
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- Visuospatial abilities

Visuospatial abilities

- Visuospatial perception remains intact
- Spatial memory is preserved, except for complex tasks
- Mental imagery (i.e., image generation and rotation) is negatively impacted by the aging process
- Navigation (and map/place learning) abilities decline

(Klencklen et al., 2012)
In the context of speech comprehension...

Processing speed—real-time processor
Working memory—information integrator
Executive functions—task manager
Disorders that affect cognition

- Alzheimer's Disease (60-80% of dementia)
- Vascular (post-infarct) (30% of dementia)
- Other dementias (dementia with Lewy bodies, mixed dementia)
- Parkinson’s disease
- Huntington’s disease
- History of traumatic brain injury

What is dementia?

- Evidence of significant cognitive decline from a previous level of performance in one or more cognitive domains
- The cognitive deficits interfere with independence in everyday activities (i.e., at a minimum, requiring assistance with complex instrumental activities of daily living such as paying bills or managing medications).
- Not due to delirium or another mental disorder (e.g., depression)
Symptoms to watch for

➢ Trouble recalling recent events or recognizing people and places.
➢ Trouble finding the right words in conversation.
➢ Problems planning and carrying out tasks, such as balancing a checkbook, following a written instruction, or writing a letter.
➢ Trouble using judgment, such as knowing what to do in an emergency.
➢ Trouble controlling moods or behaviors. Depression is common, and agitation or aggression may occur.
➢ Not keeping up personal care such as grooming or bathing.

Mild Cognitive Impairment

▪ Evidence of modest cognitive decline from a previous level of performance in one or more cognitive domains
▪ The cognitive deficits do not interfere with capacity for independence in everyday activities (i.e., complex instrumental activities of daily living are preserved, but greater effort, compensatory strategies, or accommodation may be required).
▪ Not due to delirium or another mental disorder
▪ Also called: mild cognitive disorder, cognitive impairment no dementia, and mild cognitive dysfunction
“Dementia is the greatest global challenge for health and social care in the 21st century.”

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Outline

What is cognition?

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Original Investigation

Hearing Loss and Cognitive Decline in Older Adults

1984 older adults (age 70-79 years) who were enrolled in the “Health ABC study” over a 6-year period

All participants completed a hearing test and neurocognitive assessments. At the beginning of the study, no participant had cognitive impairment.

Lin et al., 2013, JAMA
Hearing loss -- 30-40% acceleration in rate of cognitive decline.

Verbal task (Modified MMSE)  Nonverbal Task (Digit Symbol Substitution)

Reduced cognitive performance associated with a 25 dB loss was equivalent to an age difference of 7 years.

Compared with older adults with normal hearing, individuals were 1.89 times as likely to develop dementia if they had mild loss, 3 times as likely with moderate loss, and 5 times as likely with severe loss.

For individuals > 60 yrs, more than 1/3 of the risk of dementia was associated with hearing loss.
Possible reasons for hearing loss-cognition connection

#1. Changes in cognition and hearing loss might share common neural pathology

Possible reasons for hearing loss-cognition connection

#2. Social isolation/loneliness

People with hearing loss may withdraw more from communication and social involvement.

Loneliness has been associated with cognitive decline and dementia.
Possible reasons for hearing loss-cognition connection

3. Cognitive Load
When listening is more difficult (due to noise, hearing loss), more cognitive resources are devoted to hearing so that there are fewer resources for things like working memory.

HL n=51; NH n=75
78% mild HL
18% moderate
4% severe
**Blue/green**

Areas in right temporal lobe there individuals with hearing loss had more gray matter decrease than those with normal hearing.


Adults with mild-to-moderate hearing loss showed:
- increased amplitude and decreased latency of visual evoked potential components
- cortical re-organization: increased activation of auditory temporal areas elicited by visual stimulation
- poorer speech perception scores in noise
Summary of findings

Greater hearing loss is associated with lower scores for:
- mental status
- memory
- executive function

Greater hearing loss is associated with increased risk of dementia

Why?
- Hearing loss and progressive cognitive impairment caused by a common neuropathological process
- Hearing loss causes dementia by: exhausting cognitive reserve; increasing social isolation; environmental de-afferentation; or a combination thereof

Can treating hearing loss slow cognitive decline?
Indirect evidence that hearing aids can moderate cognitive decline

Personnes Agées QUID study
3670 adults followed over a 25-year period
Self-reported hearing loss associated with poorer & more rapidly declining cognitive ability
Adults who wore hearing aids had similar cognitive decline to those who reported no hearing loss

Amieva et al. 2015 (Journal of the American Geriatrics Society, 63:10, p. 2099-2104)

Is hearing aid use associated with better cognitive ability?
If yes, is the association because hearing aid wearers have more social engagement?
Dawes et al. 2015 analyzed data from 164,770 adults aged 40-69 years
Hearing aid use was associated with better cognition, regardless of social engagement

Model 3

This course is presented in partnership with continued.
Hearing loss is the largest modifiable risk factor for dementia

(Livingston, G. et al., 2017).

Reduce dementia risk by controlling hearing loss, hypertension, obesity

Reduce dementia risk by controlling depression, activity, smoking, diabetes

Aging and Cognitive Health Evaluation in Elders (ACHIEVE) study

Can hearing rehabilitative interventions reduce the rate of cognitive decline in older adults?

700 adults aged 70-84 years followed for three years

Randomly assigned to receive hearing aids + appropriate counseling; or a non-hearing (healthy aging) intervention.

http://www.achievestudy.org/
SENSE-Cog project

Aims to understand the links between hearing and cognitive ability (as well as vision and emotion) to improve early detection and diagnosis.

Aims to determine the effectiveness of interventions.

January 2016 – December 2020

https://www.sense-cog.eu/

Outline

What is cognition?
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Cognition in the clinic: where are we now?
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Including cognition in treatment and counseling
Patients are concerned about cognition

**Perceptions of Age and Brain in Relation to Hearing Help-Seeking and Rehabilitation**
Jill E. Preminger and Ariane Laplante-Lévesque

*Objectives:* This study used a qualitative approach to explore the perspectives of adults with hearing impairment on hearing help-seeking and rehabilitation. Two superordinate themes, Age and Brain, emerged from prior analyses and are investigated in the present article.

50% of patients interviewed about communication volunteered concerns about communication and cognition

Will screening make a difference?

Lancet Commission on Dementia: “Many people present to services with mild cognitive impairment, a risk state for dementia, ... and this state provides an opportunity for more targeted interventions. “

AAA: Guidelines for the Audiologic Management of Adult Hearing Impairment includes cognitive tests in needs assessment

ASHA: Consider including a cognitive screening as part of assessment. Results of cognitive testing can inform and support counseling.
To screen or not to screen?

“In this paper we advocate for universal cognitive screening of patients 70 years of age and older with hearing loss and/or listening difficulties—even in the absence of obvious signs or symptoms of cognitive impairment.” (Beck, Weinstein & Harvey, Hearing Review, Feb. 2016)

“For patients who have normal cognition and similar audiograms, cognitive measures...could provide new insights into why some listeners experience more difficulties than others...[and] guide recommendations about rehabilitation options.” (Pichora-Fuller, interviewed for Starkey Technologies newsletter, 2016)

To screen or not to screen?

“Audiologists should be trained to recognize an abnormality in older clients’ cognitive status.” (Shen et al., American Journal of Audiology, 2016)

“It is necessary for audiologists to alter their case-history taking, enhance their patient observation, and implement dementia screening tools in order to detect cognitive decline in the patients they serve.” (Remensnyder, Audiology Today, 2012)
Anderson et al. (2017). Survey of current practice...in hearing aids for adults. JAAA.

<table>
<thead>
<tr>
<th>Test/Procedure</th>
<th>0%</th>
<th>20%</th>
<th>40%</th>
<th>60%</th>
<th>80%</th>
<th>100%</th>
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<tbody>
<tr>
<td>Pure Tone Audiogram (Air and Bone Conduction)</td>
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<td>Speech Audiometry (SRT, word recognition e.g., NU-6, W-22)</td>
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<td>100%</td>
<td>3%</td>
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<td>Probe-Microphone Measures</td>
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<td></td>
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<td>68%</td>
<td>20%</td>
<td>3%</td>
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<td>Patient Questionnaires</td>
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<td></td>
<td>49%</td>
<td>36%</td>
<td>6%</td>
<td>4%</td>
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<tr>
<td>Loudness Measurements</td>
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<td>40%</td>
<td>41%</td>
<td>20%</td>
<td>3%</td>
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<td>Additional speech test: unaided in noise</td>
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<td>40%</td>
<td>40%</td>
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<td>Additional speech test: unaided in quiet</td>
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<td>47%</td>
<td>31%</td>
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<td>Additional speech test: aided in quiet</td>
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<td>32%</td>
<td>40%</td>
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<td></td>
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<tr>
<td>Additional speech test: aided in noise</td>
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<td>29%</td>
<td>37%</td>
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<tr>
<td>Speech Intelligibility Index (SII) or other indices</td>
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<td>26%</td>
<td>27%</td>
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<tr>
<td>Cognitive assessments/screenings</td>
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<td>4%</td>
<td>21%</td>
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<tr>
<td>Acceptable Noise Level (ANL) test</td>
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<td>4%</td>
<td>15%</td>
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<td>TEN test for Dead Regions</td>
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<td>1%</td>
<td>9%</td>
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</tbody>
</table>

**25% of survey respondents report using cognitive assessments or screenings**
Outline

What is cognition?
Research findings on hearing and cognition
Cognition in the clinic: where are we now?

Overview of cognitive screening instruments
Including cognition in treatment and counseling

Screening for mild cognitive impairment
Montreal Cognitive Assessment (MoCA)
Saint Louis University Mental Status Examination (SLUMS)
Mini-Cog (or clock drawing test)
Mini-Mental State Examination (MMSE) [lower sensitivity & there may be a copyright issue/fee]
MoCA

Montreal Cognitive Assessment (MoCA)

Orientation, short-term memory, executive function, language abilities, attention, visuospatial ability

Multiple forms for retesting

Available for visually impaired patients and in many different languages

Training and registration at www.mocatest.org

Distribution of MoCA scores for our hearing-impaired patients

Simple Scatter of MoCA total by Age

Developer’s recommended pass/fail cutoff

Pass/fail for better specificity*

*Shen et al. 2016; Lee et al. 2008; Luis et al. 2009
This course is presented in partnership with continued.
Mini-Cog

Instructions for Administration & Scoring

Step 1: Three Word Registration
Look in the eyes of the person and say, "Please listen carefully, I am going to say three words that I want you to repeat back to me now and try to remember. The words are (word1), (word2), (word3)." The words are listed on the left side of the page. The person in brackets is the person to say the words to. Please say them for me now." If the person is unable to repeat the words after three attempts, move on to Step 2 (Clock Drawing).

The following are general rules for the use of non-cognitive tests in multiple sclerosis. For repeated administrations, use of an alternative word list is recommended.

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<td>Figure</td>
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<td>Phone</td>
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</tbody>
</table>

Step 2: Clock Drawing
Say, "Now, I want you to draw a clock for me. First, put in all the numbers when they go. When the clock is completed, say 'Now, set the hands to (hour and minute)."

Step 3: Three Word Recall
Ask the person to recall the three words you stated in Step 1. Say, "What were the three words I asked you to remember?" Record the word list version number and the person's answer below

Word List Version: _____ Person's answer: _____

References
MMSE

Mini-mental state exam (MMSE)

Lower sensitivity and specificity than MOCA or SLUMS

Copyright in contention

Test sensitivity and specificity

<table>
<thead>
<tr>
<th></th>
<th>Average Time to Administer</th>
<th>MCI sensitivity</th>
<th>Dementia sensitivity</th>
<th>MCI specificity</th>
<th>Dementia specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>MoCA</td>
<td>10 minutes</td>
<td>83-90% (depending on cutoff score)</td>
<td>100%</td>
<td>82-88% (depending on cutoff score)</td>
<td>87%</td>
</tr>
<tr>
<td>MMSE</td>
<td>10 minutes</td>
<td>66%</td>
<td>79%</td>
<td>73%</td>
<td>88-100%</td>
</tr>
<tr>
<td>Mini-Cog</td>
<td>3 minutes</td>
<td>Slightly more sensitive than the MMSE</td>
<td>76%</td>
<td>89%</td>
<td></td>
</tr>
<tr>
<td>SLUMS</td>
<td>7 minutes</td>
<td>74%</td>
<td>93%</td>
<td>65%</td>
<td>96%</td>
</tr>
</tbody>
</table>

This course is presented in partnership with continued.
### Resource list (handout)

<table>
<thead>
<tr>
<th>Test</th>
<th>Domains assessed</th>
<th>Available at</th>
<th>Clinical use without permission?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>St. Louis University Mental Status Exam (SLUMS)</strong></td>
<td></td>
<td><a href="https://www.slu.edu/medicine/geriatric-medicine/aging-successfully/assessment-tools/mental-status-exam.php.">https://www.slu.edu/medicine/geriatric-medicine/aging-successfully/assessment-tools/mental-status-exam.php.</a></td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Mini-Cog</strong></td>
<td></td>
<td><a href="https://mini-cog.com/">https://mini-cog.com/</a>.</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Reading Span Test</strong></td>
<td>Working memory</td>
<td>English-language version and instructions for administration and scoring are available from Thomas Lunner, <a href="mailto:tlu@oticon.dk">tlu@oticon.dk</a></td>
<td>Contact Dr. Lunner</td>
</tr>
</tbody>
</table>

### A caution when testing hearing-impaired patients

Hearing loss is associated with lower test scores ([Dupuis, et al. 2013](#)).

Be careful when using these tests:

- Audibility/visibility
- Testing environment
- Remember you are screening, not diagnosing
Alternatives to formal screening

Individual test components: clock drawing (1 minute); trail making (1 minute); serial 7’s or w-o-r-l-d backward (1 minute); animal naming (1 minute)

The patient’s self-reflection, concerns, and behavior

Your observations and concerns

Outline

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Including cognition in treatment and counseling
To screen or not to screen?

“The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for cognitive impairment.” (US Preventative Services Task Force, 2014)

Clinical decision factors

Appointment structure and time available
Clinician and/or staff knowledge/expertise/training
Billing and coding
Extent of buy-in from administration or colleagues
Care pathway / support for referrals
Over- (or under-) referrals
What’s best for our patients?
Talking to patients about screening results

Assess what the patient already knows. For example, “Have you had any concerns about your memory?” (and if yes: “Have you discussed this with your physician?”)

Provide simple, accurate information using appropriately cautious language. A non-passing score only indicates the need for further referral.

Be empathic. The fear of dementia is powerful, especially for older adults. Some individuals may worry about being screened or about the need for referral and testing.

Slow down. Give the patient enough time to react and express his or her views.

Referral and the care pathway

Provide clear next steps (such as having the patient discuss the issue with her or his primary care physician).

With the patient’s agreement (HIPAA!) send a report to the physician. Include the cognitive screening results and recommendation for follow-up. Be specific regarding the measure used and the score obtained. If you are reporting behavioral changes, use your direct observations or the client or family member’s language for describing the problem.

An objective tool is nice to have, but general concerns should also be communicated to the physician. A brief letter with a clear descriptive report is sufficient.
Referral and the care pathway

Geriatricians are trained and positioned to receive such referrals. Referral to the primary care physician is a good option especially when there is no geriatric care pathway available.

Encourage patient (or family) self-advocacy. Emphasize the importance of opening a conversation with the physician regarding the concerns.

When appropriate, consider referral to speech-language pathology for evaluation of cognitive-communication changes

http://www.healthinaging.org/find-a-geriatrics-healthcare-professional
Referral and the care pathway

A facility social worker may be able to facilitate follow up when the patient has poor insight, has accompanying mental health issues, or is reluctant to involve a physician.

In cases where direct referral is not possible (i.e., patient refusal), express your concerns directly to the patient with written documentation (but recognize that follow-up may fail, compared to direct referral).

Slow down

Individuals with cognitive impairment need more time to process and organize responses.

Reduce rate of information presentation
Reduce volume of information
Allow for more/longer appointments
Deliberately introduce new topics
Listen actively

www.flickr.com/photos/kewl.8393213472
Provide information before appointment

- Allows more time to process/respond
- Allows individual to engage help from support partners
- Encourage individuals/families to bring in questions
- Individuals can process better if not under time constraints of appointment limitations
- Don’t expect decisions within the same appointment

Thank you!  

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