MARCH 2025

NEUROAUDIOLOGY NEWSELTTER

Editor: Alyssa Davidson, AuD, PhD
Co-Editor: Amy Bradbury, AuD
Founder: Frank Musiek, PhD

New Study Challenges Traditional Views on “Normal” Hearing

A recent publication in Hearing Research, "Not-so-normal hearing: Temporary hearing changes lead to chronic difficulties for listeners with 'normal' audiometric thresholds," explores the relationship between hearing difficulties, noise exposure, and temporary threshold shifts in a large sample of Service Members.

The study out of Walter Reed National Military Medical Center, conducted by Douglas Brungart, Gregory Ellis, Alyssa Davidson, Hector Galloza, Benjamin Sheffield, and Jaclyn Schurman, analyzed data from 10,492 individuals. Findings revealed that hearing difficulties systematically increase even within the conventionally defined “normal” range of pure-tone thresholds. Additionally, noise exposure history—especially reports of noticeable changes in hearing after noise exposure—was linked to greater long-term difficulties, highlighting potential individual differences in susceptibility to noise-induced damage.

These results challenge fundamental assumptions of current hearing conservation programs and suggest that standard audiometric thresholds may not fully capture the impact of noise on long-term auditory function. The study underscores the need for new approaches to assess and mitigate hearing difficulties, even among those with clinically normal hearing. Read the full article here:
https://www.sciencedirect.com/science/article/pii/S0378595525000024

Brungart, D. S., Ellis, G. M., Davidson, A., Galloza, H., Sheffield, B., & Schurman, J. (2025). Not-so-normal hearing: Temporary hearing changes lead to chronic difficulties for listeners with” normal” audiometric thresholds. Hearing Research, 458.

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Short communication

Not-so-normal hearing: Temporary hearing changes lead to chronic difficulties for listeners with "normal" audiometric thresholds

Douglas S. Brungart [a,*], Gregory M. Ellis [a], Alyssa Davidson [a], Hector Galloza [b], Benjamin Sheffield [a], Jaclyn Schurman [c]
[a] Walter Reed National Military Medical Center, 4494 N Palmer Road, Bethesda, MD, 20889, USA
[b] Dos Gari Solutions, LLC, 25 Los Cipreses, Aguada, 00602, Puerto Rico
[c] National Institute on Deafness and Other Communications Disorders, 6001 Executive Boulevard, Rockville, MD, 20852, USA

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ABSTRACT

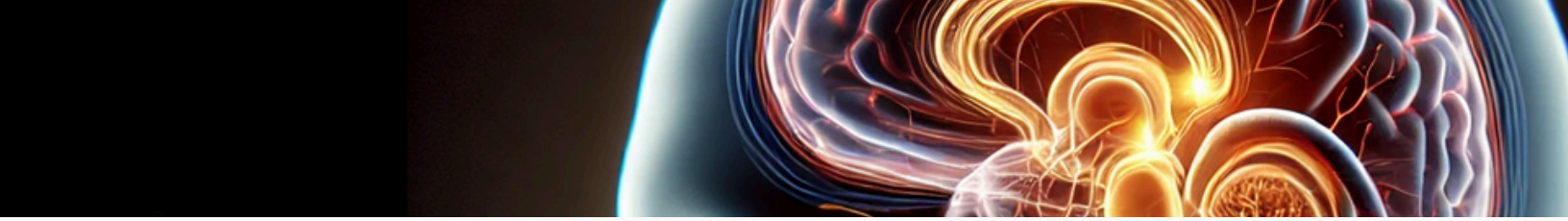
Hearing loss has historically been mainly associated with elevated pure-tone thresholds. However, in recent years, there has been increased interest in addressing the hearing difficulties reported by individuals with normal hearing thresholds. In this study, we measured hearing thresholds, noise history, temporary threshold shift history, and hearing difficulty for a sample of 10,492 Service Members. Our data reveal that overall hearing difficulties increase systematically as a function of hearing threshold within the range that is conventionally considered to be "normal" hearing. Noise exposure history is associated with increasing hearing difficulty at all thresholds, particularly individuals with a history of noticeable changes in their hearing after noise exposure. These results challenge some fundamental assumptions of current hearing conservation programs and suggest that variations in post-noise hearing symptoms may reflect differences in individual susceptibility to permanent damage from noise exposure.

Audiology Trivia

1.**The length of the adult, human auditory nerve is about how long?**
a) 10–12mm, b)22–25mm, c) 32–35mm, d) 40–42mm

2.When listening to a single pure-tone and the individual hears multiple tones and/or “roughness” of the tone, what is this called?
a) misophonia, b) diplacusis, c) hypoacusis, d) dysphonia

3.**Gap detection is consdiered to be primarily what kind of auditory process?**
a) discrimination, b) lateralization, c) temporal, d) sequencing



Upcoming Mini-Symposium

2ND ANNUAL "QUEST FOR THE BEST IN CAPD/NEUROAUDIOLOGY"

On April 26, 2025, this mini-symposium will present topics on Practical Management Approaches for CAPD. The final page of this newsletter is the official announcement with schedule and how to register.

Program Directors: Frank Musiek and Jennifer Shinn
Sponsors: University of Kentucky and Hearing Health and Technology Matters Pathways
Faculty:
--Teri Bellis, PhD--University of South Dakota (Ret.)
--Vivian Illiadou, MD, PhD--Medical School of Aristotle University of Thessaloniki, Greece (Professor)
--Frank Musiek, PhD--University of Arizona (Ret.)
--Jennifer Shinn, PhD--University of Kentucky
--Gail Whitelaw, PhD--Ohio State University

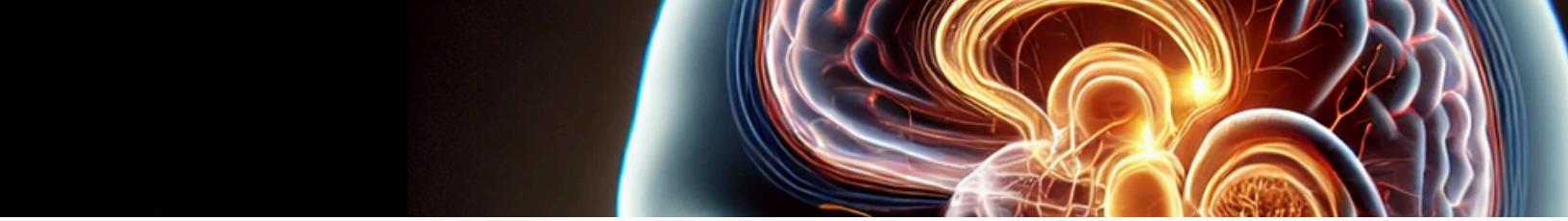
This 2nd annual virtual program will provide expert practical yet scientific based management approaches for those with CAPD. Each of the outstanding speakers bring a wealth of practical experience as well research acumen to their presentations. Featured in addition to expert presentations will be an interactive panel which will address challenging management cases in CAPD. Circle the date on your calendar so you don't miss this timely and informative program.

Thoughts on Audiology Curricula

Katie McLaren, an AuD student at the University of Arizona, attended the mini symposium last year (2024) and had some interesting insights into ways we are (and are not) educated about CAPD.

Having attended the "Pathways: Quest for the Best in CAPD/NeuroAudiology" symposium in April 2024, I gained a lot of insight, not only from the presentations given, but also into the general understanding exhibited by my fellow attendees. Practicing audiologists expressed a common concern: despite understanding core concepts of auditory processing, they still faced challenges in identifying and managing CAPD and were unsure of where to obtain further knowledge.

While these audiologists may not have completed their programs of study at a time where an abundance of this information was accessible, today's students also struggle acquiring "niche" clinical knowledge. There is large variability in the required curricula between each audiology program, with many lacking comprehensive coursework on clinical aspects of CAPD, sound tolerance conditions, tinnitus, and ototoxicity, to name a few. Graduate students rely on their programs to guide them through bridging these gaps, because of the considerable investment that they've made into their education. This variability in curricula across programs emphasizes the need for more comprehensive training and increased access to supplemental resources, such as workshops and conferences, which are frequently out of reach for students who have otherwise dedicated significant time and funds to their studies.



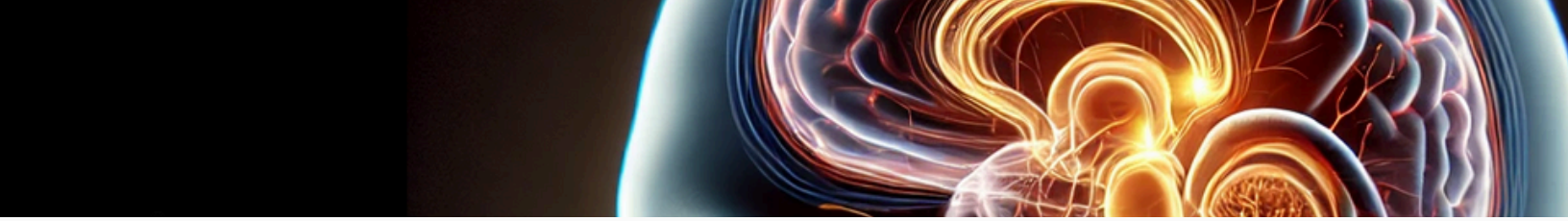
NeruoAudiology/CAPD Corner

TOPIC: COMMENTARY ON THE THEORETICAL MODELS OF APD
AUTHOR: JULIANNE CERUTI, AUD, PHD

Auditory processing disorder (APD) is a somewhat controversial topic within Audiology. APD affects auditory learning and communication as the brain's ability to accurately process and interpret auditory information is impaired despite a normal audiogram. This commonly leads to reported difficulties in understanding speech in degraded environments (i.e., noise, reverberation), following instructions, identifying differences and similarities between sounds, and retaining auditory information. One main contributing factor to the controversy is the lack of uniformity in candidacy and diagnostic criteria. There are no agreed-upon candidacy criteria related to language and cognitive ability in the field. Deficits in these areas often co-occur with listening challenges due to deficits in higher-order systems that receive and process information from the auditory system. When listening challenges and cognitive or language deficits co-occur, this can lead to challenges in determining modality specificity.

Many tests commonly used in Audiology to assess auditory processing require language knowledge and rely on cognitive skills, such as working memory, attention/executive functioning, and processing speed. These confounds can complicate the interpretation of test results intended to measure auditory deficits- and lead to misdiagnosis (DeBonis, 2017). The diagnosis of an auditory processing disorder should be considered in cases of sensory deficits in the central auditory nervous system and not hearing challenges resulting from higher-order deficits. Auditory processing deficits may be identified and targeted for management or treatment, but a diagnosis should be withheld in those conditions.

Testing for auditory processing disorders or deficits can be conceptualized into two main frameworks: the Buffalo Model and a deficit-specific model. Both models have in common the requirement for normal hearing sensitivity as determined by a diagnostic hearing assessment, including acoustic immittance, or compensation of hearing loss (as appropriate). Auditory processing and listening deficits often co-occur with other disorders, especially in the pediatric population, but do these co-occurring deficits preclude a diagnosis of auditory processing disorder? As outlined in the American Academy of Audiology clinical practice guidelines, completing a multidisciplinary evaluation before the auditory processing evaluation is imperative to understanding the individual's cognitive and language resources. It is also important to consider confounding variables affecting the accurate interpretation of the test results, as the normative values for the tests are based on individuals with normal language and cognitive function. One such variable is age, especially regarding children and candidacy criteria. Most agree that reliable testing cannot be completed until age seven due to variability in the central auditory nervous system's maturation, causing significant variability and maturity in understanding what is being asked for each test. A comprehensive multidisciplinary evaluation is crucial to understand each individual’s resources to ensure an accurate diagnosis with appropriate management. It is important to consider that deficits observed on the auditory processing test battery may not be true auditory deficits in the case of co-occurring language and cognitive deficits. Efforts should be made to get modality-specific data, either through electrophysiology or comparison to test conditions without distortions in the auditory signal (i.e., speech in quiet versus speech in noise), to determine the contribution of the auditory system to impaired test performance.



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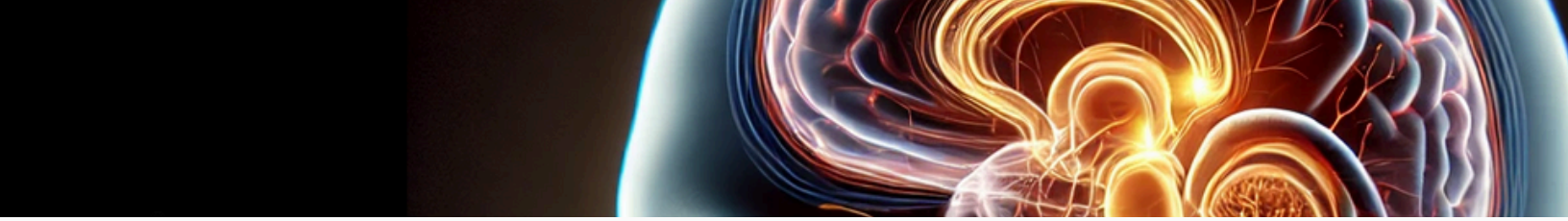
AUTHOR: JULIANNE CERUTI, AUD, PHD

The American Academy of Audiology (AAA) and American Speech and Hearing Association (ASHA) define auditory processing disorder as “difficulties in the perceptual processing of auditory information in the central nervous system and the neurobiological activity that underlies that processing and gives rise to the electrophysiologic auditory potentials) (AAA, 2010). The deficit-specific or neurobiological model of APD is a framework that identifies and categorizes patterns of weaknesses within an individual's auditory processing abilities and relates them to processes within the auditory brain, allowing for targeted interventions that rely on principles of neuroplasticity to improve hearing. These auditory functional deficits are commonly categorized as deficits in auditory closure, temporal processing, dichotic listening, and binaural interaction. Skills can be assessed using different tests within each functional area, so one functional area may likely be evaluated in multiple ways to better understand the type of deficit to determine the best approach for treatment and management.

Dichotic Listening	Binaural Separation
	Binaural Integration
Temporal Processing	Temporal Resolution
	Temporal Ordering and Sequencing
Auditory Closure	Signal to Noise Ratio Loss
	Spectral Degradation
	Temporal Degradation
Binaural Interaction	Localization/Lateralization
	Spatial Release from Masking

Functional areas have overlapping neurophysiology, so patterns across tests can be informative, especially when taken with cognitive and language abilities. An auditory closure deficit refers to difficulty filling in incomplete auditory information, particularly when parts of the signal are distorted or unclear. A dichotic listening deficit is an impaired ability to process and integrate different auditory stimuli presented simultaneously to both ears. A temporal processing deficit is an impaired ability to perceive or process the timing aspects of auditory signals, such as duration, rhythm, or the order of sounds, which can affect speech perception and reading. A binaural interaction deficit is the impaired ability to integrate or use spatial auditory information from both ears, affecting localization, lateralization, and understanding speech in noise. This deficit-specific approach does not prescribe any particular test for a functional skill or require that all function skills be evaluated during an auditory processing assessment.

The test battery should be selected using the audiologists' clinical expertise, the reported symptoms of the individual being tested, and the sensitivity and specificity of the available tests for the functional area. For a comprehensive overview of available tests and evidence-based practice in auditory processing, the Handbook of Central Auditory Processing Disorders (Musiek & Chermak, 2014) volumes and Assessment and Management of Central Auditory Processing Disorders in the Educational Setting (Bellis, 2011) are recommended as a starting point. This model has more flexibility, and the test batteries have been more thoroughly validated for different types of APD – developmental, acquired, and secondary (Alanazi, 2023). This lack of uniformity in diagnostic criteria and lack of gold standards are challenges that need to be addressed through research and clinical practice guidelines as they add to the controversy surrounding APD within and outside the field of audiology.



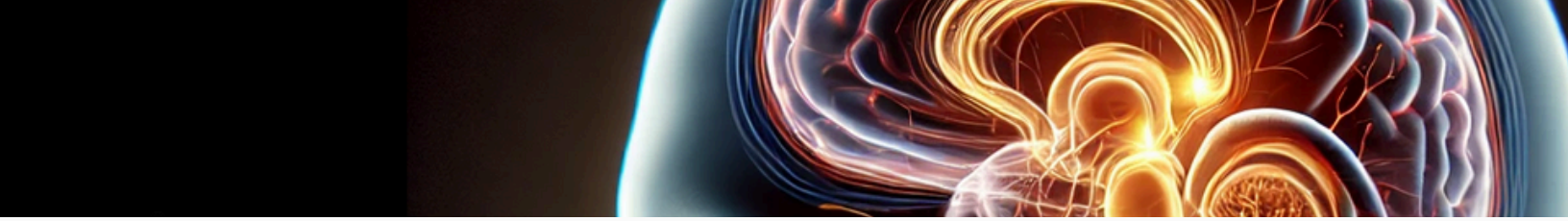
NeruoAudiology/CAPD Corner

TOPIC: COMMENTARY ON THE THEORETICAL MODELS OF APD
AUTHOR: JULIANNE CERUTI, AUD, PHD

The Buffalo Model, developed by Dr. Jack Katz, is one of the most well-known models for APD assessment, making it a common choice among audiologists, especially in educational audiology (Katz, 2007). It defines auditory processing as “what we do with what we hear.” It quantifies deficits in auditory processing based on performance on a 48-question survey, Buffalo Model Questionnaire, and 3-test battery: Staggered Spondaic Words, Phonemic Synthesis Test, and the Speech in Noise Test. The Staggered Spondaic Word (SSW) test assesses dichotic listening by presenting overlapping spondee words to both ears, requiring the listener to identify and recall the words in the correct order accurately. This test is foundational to the four categories of APD identified with the Buffalo model – decoding, tolerance-fading memory, integration, and organization category.

An integration deficit refers to difficulty combining auditory information with other sensory or linguistic inputs, affecting the simultaneous processing of multisensory information. An organization deficit refers to difficulty sequencing and organizing auditory information, often leading to disorganized responses and errors in order or structure. The Phonemic Synthesis Test evaluates auditory processing by requiring the listener to blend individually presented phonemes into whole words. This test has indicators for three of the categories but is primarily indicative of decoding difficulties. A decoding deficit refers to difficulty accurately and efficiently processing auditory information, particularly at the phonemic level, affecting auditory discrimination and word recognition. The Speech-in-Noise evaluates the difference in the listener’s ability to understand single words in quiet versus in competing background noise and is an important indicator for the Tolerance Fading Memory (TFM) category. A Tolerance Fading Memory deficit refers to difficulty understanding speech in noisy environments (i.e., tolerance) and challenges with auditory memory (i.e., fading memory), including accurately recalling and sequencing auditory information. The model focuses on auditory processing and does not fully appreciate the impact of multisensory, cognitive, or linguistic aspects that may impact performance. As a result, other diagnoses may be overlooked and misdiagnosed as APD.

Many of the tests used with the battery have normative values as young as five, which is a deviation from recommendations in current professional practice guidelines. Longitudinal data would be helpful to understand how test performance may be related to educational outcomes in the pediatric population. The Buffalo Model is most appropriate for developmental APD, and its applicability to secondary or acquired APD has not been vetted. As the protocol is standardized, it is short and easy to administer, which is especially useful for the pediatric population. However, it is limited in scope and does not explicitly assess some fundamental auditory skills (e.g., temporal processing). It focuses on deficits that do not fully align with current frameworks from major professional organizations like the AAA and ASHA. Additionally, while popularly used, the test battery lacks robust peer-reviewed evidence compared to other tests.
Overall, more evidence is required to establish best practices and for professional organizations to create a standard of practice for diagnosis and assessment of auditory processing across the lifespan.



For Those Attending the 2025 American Academy of Audiology Conference

Frank E. Musiek, PhD, and Monika Jones, JD, Founder and Executive Director of the Pediatric Epilepsy Surgery Alliance in Los Angeles, California, are teaming up to present at the AAA conference this year.
Title: Central Auditory Processing Evaluation after Pediatric Epilepsy Surgery and the PESA
When: Thursday March 27, 2025; 8:15 AM - 9:15 AM
Where: Room 203-205, Convention Center New Orleans, LA

This presentation will focus on the evalautio nand habilitation of children and adults that have undergone temporal lobectomy/hemispherectomy for control of seizures. This will be achieved within a framework of a growing need of audiological invovlement for this interesting population spearheaded by the Pediatric Epilepsy Surgical Alliance (PESA).

Trivia Answers

1. (B) The average length of an auditory nerve is 22-25mm.
2. (B) Hearing multiple tones when one is present is called diplacusis.
3. (C) Gap detection is primarily a temporal auditory process.

Learning Corner

The learning corner will offer citations of articles that may contribute to one's knowledge base for CAPD/NeuroAudiology.

- Bamiou, D. E., Werring, D., Cox, K., Stevens, J., Musiek, F. E., Brown, M. M., & Luxon, L. M. (2012). Patient-reported auditory functions after stroke of the central auditory pathway. Stroke, 43(5), 1285-1289.
- Bellmann, A., Clarke, S., Adriani, M., Maeder, P., Meuli, R., Fornari, E., ... & Villemure, J. G. (2001). Auditory localisation in patients with right hemispherectomy: performance and fMRI data. NeuroImage, 13(6), 861.
- Harford, E. E., Smith, E. D., Holt, L. L., & Abel, T. J. (2024). Listening with one hemisphere: A review of auditory processing among individuals after hemispheric surgery. Neuropsychologia, 109019.

PATHWAYS: QUEST FOR THE BEST IN CAPD/ NEUROAUDIOLOGY

"Practical Management Approaches to CAPD"

A virtual mini symposium sponsored by Pathways &
the UK Department of Otolaryngology - Head & Neck Surgery.

Course Directors: Frank Musiek, Ph.D. and Jennifer Shinn, Ph.D.

COURSE DESCRIPTION:
This 2nd annual virtual program will provide expert practical and scientifically based management approaches to those with CAPD. Featured in addition to expert presentations by a well noted faculty, will be an interactive and international panel which will address challenging management cases in CAPD. Also represented will be an expanded view of types of auditory processing disorders and related habilitative techniques aimed at both pediatric and adult populations.

PROGRAM OBJECTIVES:
As a result of this activity, participants will be able to:

- Apply key concepts in designing appropriate management programs for adults and children.
- Discuss foundational principles that apply to auditory training.
- Discuss the advantages of applying low gain amplification to those with CAPD.

FACULTY:
Teri Bellis, Ph.D., University of South Dakota (Ret.)
Vivian Illiadou, M.D., Ph.D., Medical School of Aristotle University of Thessaloniki, Greece
Frank Musiek, Ph.D., University of Arizona (Ret.)
Jennifer Shinn, Ph.D., University of Kentucky
Gail Whitelaw, Ph.D., Ohio State University

SCHEDULE: (ALL TIMES ARE EST)

12:00p	Introduction- Drs. Musiek & Shinn
12:05p	Dr. Illiadou, "Auditory Training in APD-Focus on Individual Deficits"
12:45p	Dr. Musiek, "Dichotic Interaural Intensity Difference (DIID) Training: Origin to Application"
1:25p	Dr. Bellis, "Dichotic Listening Training to Improve Hearing in Noise and Related Skills"
2:05p	Break
2:15p	Dr. Whitelaw, "Low Gain Hearing Aids as a Tool in Rehabilitation for APD"
3:00p	Case studies Panel on: Challenging Cases of CAPD
3:55p	Summary & Closing remarks: Drs. Shinn & Musiek

REGISTRATION:
Please list Pathways as your event.
https://bit.ly/UKYENT
Fee: $35.00 Professionals, $10.00 students
CEUs will be available.

Saturday, April 26, 2025

Contact: Jennifer.Shinn@uky.edu