

# Visual Abnormalities in Interaural Asymmetry

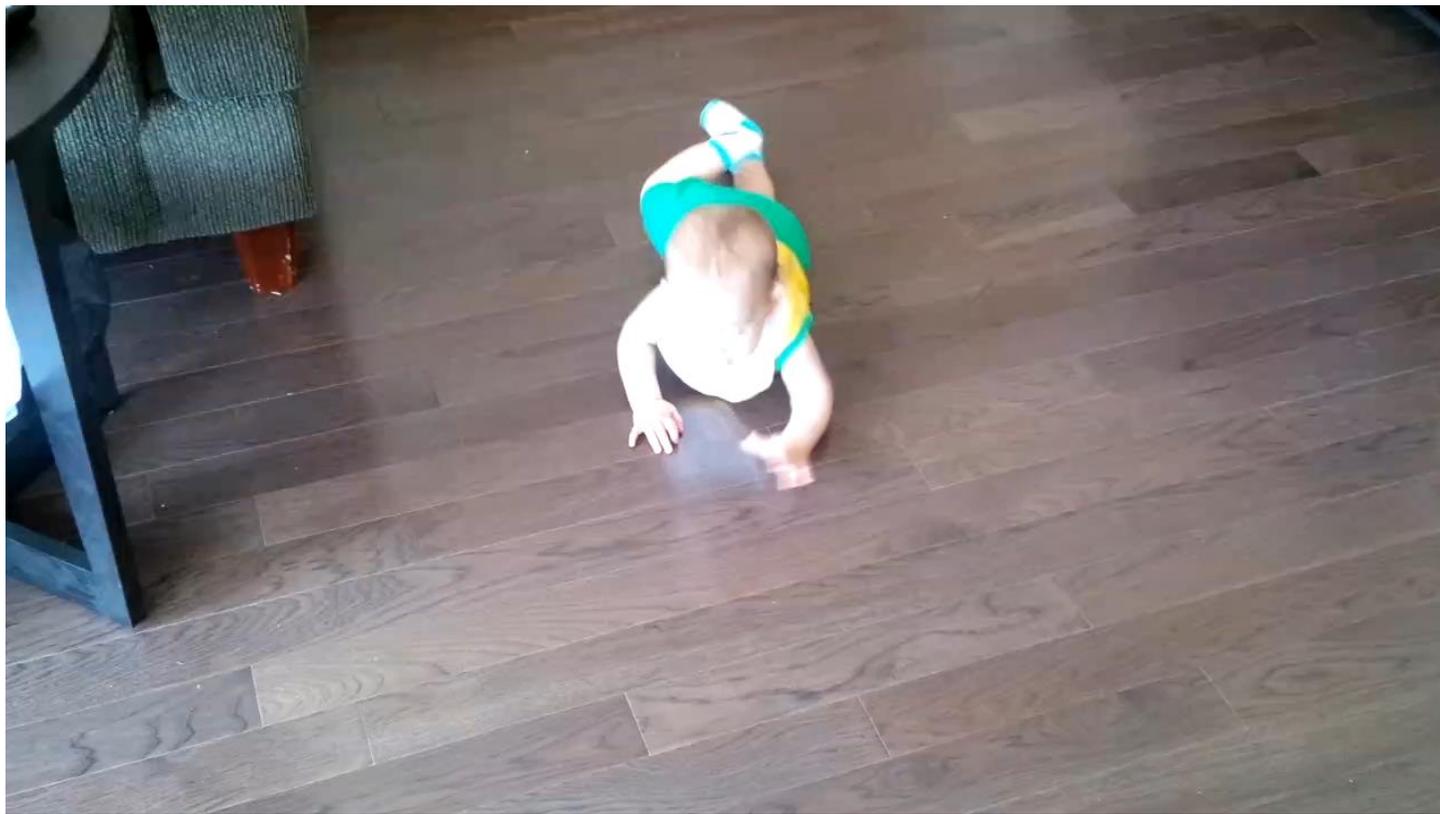
Virginia Donati, OD

# Case 1: WS, 6 Months Old, First Exam

## ▶ History:

- ▶ Born 36/52, no complications. Rapid labour and delivery (38 minutes start to finish).
- ▶ Failed newborn hearing test at bedside in the right ear, failed again at 2 weeks, “soft pass” at 12 weeks, “full pass” at 16 weeks old.
  - ▶ “Born too quickly”, “didn’t get the ‘juices’ squeezed out of his right ear enough”
- ▶ Right-sided motor delay and “neglect” reported
- ▶ Strong aversion to OS cover, minimal aversion to OD cover, even with repeated trials.
- ▶ OKN, Hirschberg normal OD and OS, UTA Lea Paddles (more interested in reaching for paddles)
- ▶ Mohindra: OD +2.50-2.00x180, OS+1.00-1.00x010
- ▶ Then there’s this crawl...

# “The Crawl”



# Case 2: HH, 5 Years Old, Second Opinion

## ▶ History:

- ▶ Born FT, no complications
- ▶ Typical crawl, all milestones on time.
- ▶ Previous eye exam 1 month ago. Was told should patch one eye at a time for 2 hours each and was given glasses which HH won't wear (didn't bring to the appt).
- ▶ HH was seen once previously at our office at age 2 by another OD
  - ▶ “Uncooperative”, but OU VA testing 20/30 with Allen pic.
  - ▶ Static Ret: OD +2.00-1.00x180, OS +2.25-1.00x030

# Case 2: HH, 5 Years Old, Second Opinion

- ▶ My exam:
  - ▶ UVA OD 20/50, OS 20/40
  - ▶ Cover Test: n/s ortho @D, n/s 6XP @N
  - ▶ Stereo: OD Suppression
  - ▶ W4D: OD Suppression
  - ▶ Static Ret: OD +2.25-0.50x180 20/30, OS +3.75-0.25x020 20/20
  - ▶ Ant Seg, Post Seg, Colour Vision, Pupils normal
- ▶ Apparent OD Amblyopia without typical amblyogenic factors!
  - ▶ Doesn't pass the "Sniff Test", refer to GP for medical consult.
  - ▶ Mom advised not to patch or wear specs if he's not comfortable in them.
  - ▶ Return to me when cleared by GP.

# Case 2: HH, 5 Years Old, Second Opinion

- ▶ Returned 5 mo later:
  - ▶ No neuro concerns
  - ▶ GP referred to ENT due to fluid present in right ear w/o infection: failed hearing test.
    - ▶ Chronic right tonsil enlargement had encroached into the right middle ear.
    - ▶ Tonsils removed 6 weeks ago
  - ▶ Diagnosis: Right Amblyaudia
    - ▶ He is 2 weeks into auditory rehabilitation therapy

# Amblyaudia

- ▶ Amblyaudia develops when there is a unilateral decrease in auditory Afferent Signal Quality (ASQ) early in development.
  - ▶ Early “critical period” length is debated.
- ▶ Dichotic Listening Tests are used to assess an individual’s binaural integration.
  - ▶ Patients are asked to identify two different sounds presented simultaneously to the two ears.
- ▶ Most patients will have a slight right-ear advantage (REA) which is typical with left hemispheric dominance for linguistic input, but some may have a slight LEA.
- ▶ Amblyaudia is diagnosed when there is a significant difference between the preferred and non-preferred ears.
- ▶ It is the most common binaural integration defect (47% of all auditory processing disorders).
- ▶ Responds to treatment with Auditory Rehabilitation for Interaural Asymmetry (ARIA).

Moncrieff et al  
Whitton and Polley

# Hierarchical Levels of Auditory Processing

## ▶ Level 1

- ▶ Auditory Acuity, the lowest or earliest level of processing, represents how sharply a person hears, and is a product of the integrity of the peripheral hearing mechanism.

## ▶ Level 2

- ▶ Auditory Perception, the mid-level processing of information received auditorily, involves attending, selecting, comparing and operating on acoustic information.

## ▶ Level 3

- ▶ Auditory Conceptualization, the higher order interpretation and comprehension of auditory information, is concerned with relating auditory information to a conceptual framework using imagery, and making inductions and deductions based on auditory information.

- ▶ These three levels can conceptually be compared directly to visual processing.

# Amblyaudia vs Amblyopia

- ▶ Research points to a pathological decrease in ASQ as being an amblyogenic factor in Amblyaudia.
  - ▶ Otitis Media with Effusion early in development
  - ▶ Repeated or chronic bouts of OM
- ▶ Visual deprivations are well-known amblyogenic factors
  - ▶ Cataract, ptosis, etc
  - ▶ “Signal Quality” = Light
- ▶ Auditory deprivations can impede on Level 1 (auditory signal acquisition) just as visual deprivations can impede on the Level 1 equivalent for visual processing.

# Is Amblyaudia Patho-binocular?

Two Questions:

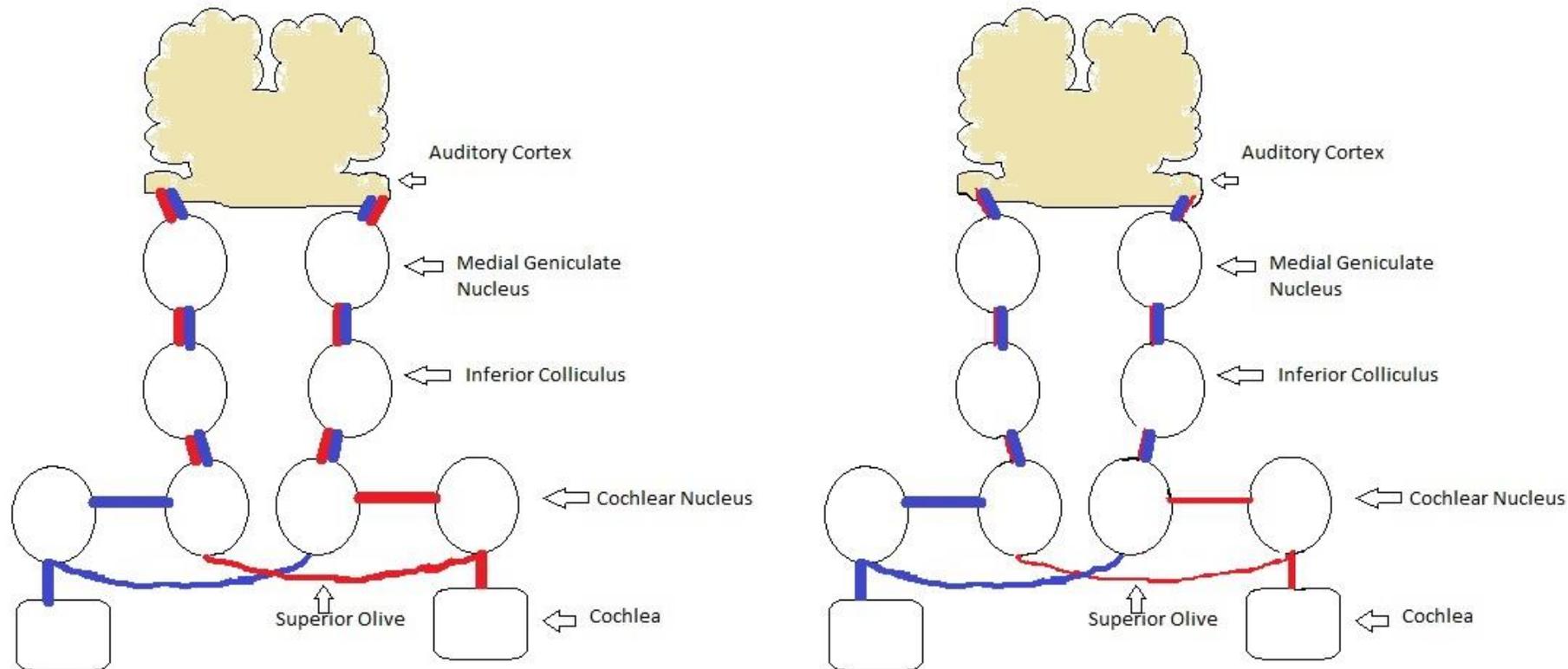
1. How could Amblyaudia cause binocular dysfunction?
2. Are there any studies linking Interaural Asymmetry to Intraocular Asymmetry / Patho-binocularities / Visual Perceptual Abnormalities?

# 1. How Could Interaural Asymmetries (Including Amblyaudia) Cause Patho-Binocularities?

## Afferent Auditory Pathway

Normal

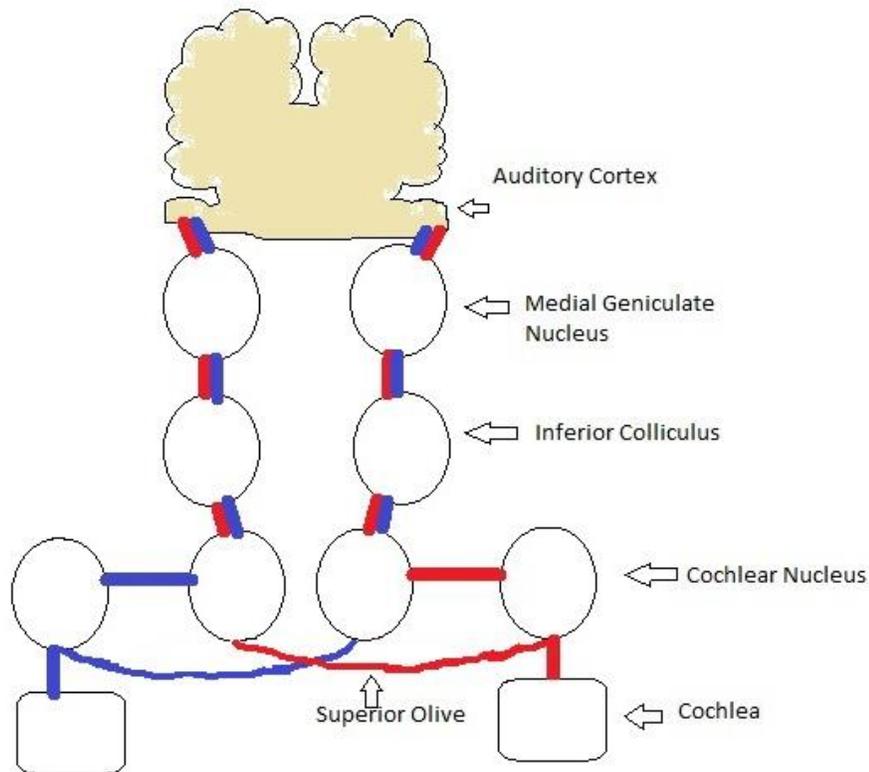
In Amblyaudia



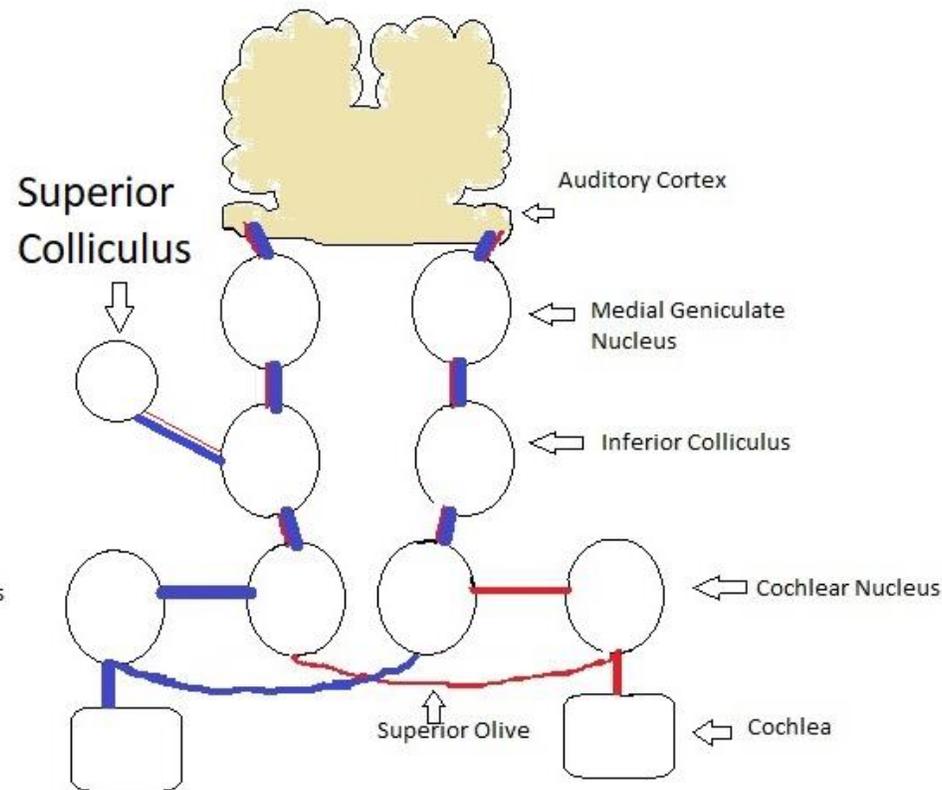
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## Afferent Auditory Pathway

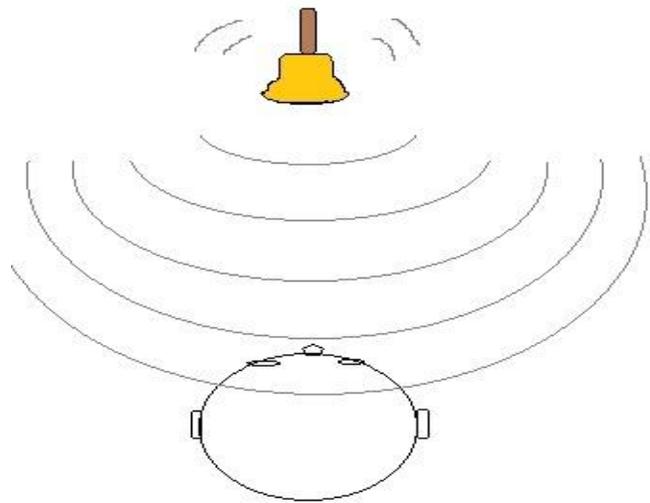
Normal



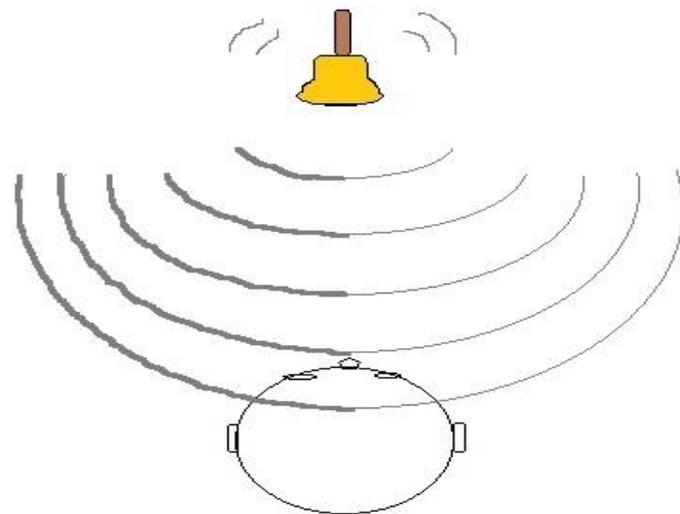
In Amblyaudia



# Effect of Intra-aural Asymmetry

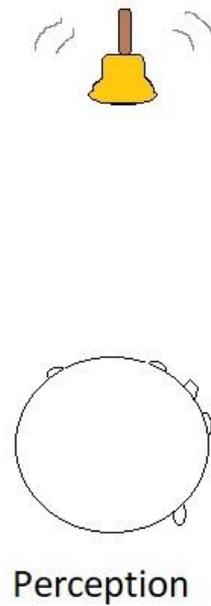
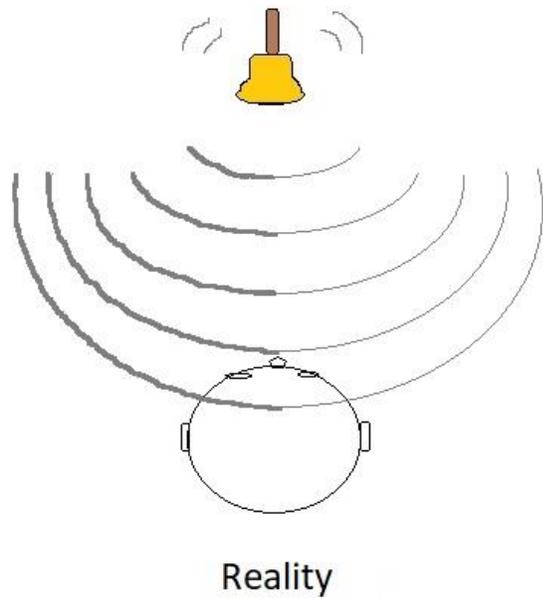


Normal



Amblyaudia

# Effect of Intra-aural Asymmetry



# Summary: How could Amblyaudia Cause Patho-Binocularities?

1. Less efficient communication within the tectum on the amblyaudic side may lead to an asymmetry in performance of oculo-motor abilities between the two eyes.
2. A reduced ability to localize sound on the amblyaudic side may cause a mismatch between visual and auditory space maps and lead to distortions in the patient's ability to be aware of his position in space (anti-gravity) and his ability to visually localize (centering).

## 2) Are there any Studies Linking Interaural Asymmetry to Path-Binocularities?

- ▶ YES...
- ▶ ...and not really

# Dichotic listening deficits in children with dyslexia

- ▶ Performed dichotic listening tests on dyslexic and control groups of right-handed 11 year old children.
- ▶ Results:
  - ▶ “More dyslexic than control children demonstrated significant reductions in dichotic listening performance, **but no uniform pattern of deficit emerged.**”

Moncrieff DW, Black JR. Dichotic listening deficits in children with dyslexia. *Dyslexia*. 2008 Feb; 14(1): 54-75

# Interaural Asymmetries Revealed by Dichotic Listening Tests in Normal and Dyslexic Children

- ▶ Tested dyslexic and control children with three different dichotic listening tests: Dichotic Digits test, Competing Words test, Dichotic Consonant-Vowel test.
- ▶ Large variation in performance. Only the Competing Words test produced a consistent REA across all children tested.
  - ▶ “Using a criterion of poorer than 76% correct for the left ear, the Competing Words subtest of SCAN identified 7 out of the 10 dyslexic children as abnormal, with no false alarms in the control group”

Moncrieff DW, Musiek FE. Interaural asymmetries revealed by dichotic listening tests in normal and dyslexic children. J Am Acad Audiol. 2002 Sep; 13(8): 428-37.

# “Dyslexia” Criterion

- ▶ Normal IQ
  - ▶ Impaired word recognition on Wechsler Individual Achievement Test (WIAT).
  - ▶ Impaired performance on the Decoding Skills Test (DST).
  - ▶ Parent and school history
- 
- ▶ NO VISION EXAMS!

# Further Investigation Needed

- ▶ Nothing more than dyslexia investigated thus far.
  - ▶ What about other patho-binocularities?
  - ▶ Potential co-morbidity for learning-related vision problems?

# Follow-Up - Back to Case 2 (HH)

- ▶ Parents did not want to proceed with VT until after they had completed the ARIA.
- ▶ HH returned after 6 months to proceed with VT. New vision exam performed:
  - ▶ UVA OD 20/20-2, OS 20/30-, OU 20/20
  - ▶ Stereoacuity: 200"
  - ▶ Worth-4-Dot: Left suppression @D, rapid alternation between left suppression and diplopia @N
  - ▶ Static: +1.50-0.75x180 20/20 OD, +2.50-0.50x180 20/30+ OS
- ▶ LEFT amblyopia!
- ▶ HH is still currently in VT.

# Thoughts...?

▶ Thank you!