If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

This handout is for reference only. It may not include content identical to the PowerPoint. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.
How to Grow a Young Child’s Music Brain

Carol Flexer, PhD, CCC-A; LSLS Cert. AVT
Distinguished Professor Emeritus, Audiology
Northeast Ohio AuD Consortium (NOAC), and
The University of Akron
www.carolflexer.com

Competing Interests

- I have no competing interests to report.
Learning Objectives

At the end of this course, participants will be able to:

- Summarize research about the positive impact of music on the developing brain.
- Describe general music developmental milestones and specific milestones for the development of rhythm and pitch.
- Explain how music and rhythm activities can be used by parents and professionals to support the development of listening, language, literacy and theory of mind for infants and young children.

Thinking about Music?
All babies are innately musical. At birth, and even before, babies possess many skills needed to process music.

- The fetus is first responsive to sound (narrow band of frequencies 300Hz) around 20 -25 weeks gestational age (Chelli & Chanoufi, 2008)
- Around 33 weeks – the fetus shows relatively consistent heart rate and movement changes in response to music stimulus (Kisilevsky et al, 2004)
- Memory for auditory sequences develops early & studied in the womb: Mothers voice, Frequent Music (DeCasper et al, 1994; Krueger et al 2004; DeCasper, Fifer, Moon, 2011)
- Newborns are able to detect the beat in drum patterns while asleep – changing brain wave responses are measured when the pattern changes on the beat. (Winkler et al, 2009)

Why Music Matters

- Before babies understand and use words…

- They focus on their caregiver’s musical, ‘sing-song’ voice and emotion.

- Babies understand through the musical qualities of the voice – not words.
What is the Big Picture?

- Begin at the beginning

- Connect the dots between hearing, brain plasticity, listening, talking, literacy and music development

The Ear is the “Doorway” to the Brain for Sound Spoken Language/Information – Talking – Reading – Music

- “Hearing” occurs in the brain!
- The sense organs are portals to the brain for environmental information.
Well – What is Hearing?

- Hearing can be defined as “brain perception of auditory information.”
- Hearing is a first-order event for the development of language -- spoken communication, literacy skills, music and social-emotional connections.
- Anytime the word “hearing” is used, think “auditory brain development” using 1 billion neurons with a quadrillion synaptic connections!
- Acoustic accessibility of intelligible spoken language is essential for brain growth.
- There are no “earlids” – the brain is available for auditory information 24/7.
- Signal-to-Noise Ratio (SNR) is the key to hearing intelligible auditory information – speech must be 10 times louder than background sounds.

What is Language?

- Language is an organized system of communication used to share information.
- It consists of sounds, words and grammar used to express inner thoughts and emotions.
- Language includes facial expressions, gestures, and body movements.
It’s All About The Brain

- Hearing is not about the ears; it’s about the brain.
- The meaning of sound/auditory information occurs in the brain, not in the ear.

What about the Musical Brain?
The Brain LOVES Music!

- By music, we mean adult-directed singing with the child throughout the day – active not passive.
- Music is a whole brain work-out!
- The brain loves music – the words stimulate the left hemisphere and rhythm stimulates the right hemisphere, and the corpus callosum is "exercised" by cross-over – called interhemispheric transfer.
- Music enhances “paralinguistics.”
- Discuss rhythm and literacy research.

What do we know about the Brain and Music?

- Corpus callosum: Connects both sides of the brain
- Motor Cortex: Involved in movement while dancing or playing an instrument
- Prefrontal Cortex: Controls behaviour, expression and decision making
- Nucleus accumbens and amygdala: Involved with emotional reactions to music
- Sensory Cortex: Controls tactile feedback while playing instruments or dancing
- Auditory Cortex: Listens to sounds perceived and analyses tones
- Hippocampus: Involved in music memories, experiences and context
- Cerebellum: Involved in movement while dancing or playing an instrument, as well as emotional reactions
Forming Important Brain Connections
(Tervaniemi et al)

- Therefore, only through music stimulation can you activate multiple areas in the brain simultaneously – a very important process for auditory and language development.

Music Continues to Develop the Brains of Babies

- Improve processing of both music and speech sounds by moving in synchrony to the rhythm of music, which is repetitive and creates opportunities for learning (Washington Institute for Learning and Brain sciences, 2016)
- Learn through sensory stimulation by moving together to the music (Mustard, 2008)
- Explore vibration, rhythm, pitch, timbre, dynamics and tempo in music to practice hearing sound and support the development of communication & cognitive abilities (Patel, 2003)
- Learn pre-verbal communication skills that lay the foundation for verbal communication
Music & Movement

- Infants who were bounced to a musical rhythm in synchrony... exhibited more altruistic behavior towards the experimenter than the infants who were bounced out of synchrony to the music.

Musical activities assist with early language development and emotional well being...

- Structural changes occur in the brain as a result of musical experiences (Shaw & McEachern, 2001)
- Musical experiences boost implicit learning of both musical & linguistic structures (Francios, C., Schon, D., 2011)
- By the end of the first year after birth, infants are becoming specialized for the rhythmic and tonal structure of music they hear
- Brain responses to pitch go through rapid development after birth and become adult-like at the age of 3 years
Consistent use of Musical Activities in families can help:

- Sharpen early listening skills
- Improve auditory discrimination and attention in 2–3-year old children
- Develop neural pathways in the brain for language and reading
- Support social interactions
- Encourage emotional well-being & expression

But, what do we actually know about musical development?
### Early Music Milestones

<table>
<thead>
<tr>
<th>AGE - MUSIC MILESTONE - MUSIC ACTIVITY</th>
</tr>
</thead>
</table>
| **0 – 3 MONTHS:** Alerts and calms to music; prefers infant directed singing; coos/cries  
ACTIVITY: Sing lullabies; gently rock and pat to music |
| **3 – 6 MONTHS:** Musical babbling; repetitive movements in response to music; turns to the source of music; prefers higher pitched voices  
ACTIVITY: Imitate baby’s babbling; provide shakers, bells, and simple rhythm toys; bounce gently to music |
| **6 – 9 MONTHS:** Occasionally matches pitch; larger repetitive movements; recognizes familiar melodies; uses descending vocalizations  
ACTIVITY: Imitate spontaneous songs; play pitch matching games using “la-la” or “loo-loo”; easy finger play songs; nursery rhymes with movement |
| **9 – 12 MONTHS:** “Sings” spontaneously; recognizes and attempts to sing along with familiar songs. Chanting style  
ACTIVITY: Provide songs for different activities (like wake-up/bath time/bedtime, etc.); a variety of recorded music; drums and xylophones |

Developed for http.FirstYears.com
Early Music Milestones

**AGE - MUSIC MILESTONE - MUSIC ACTIVITY**

**4 – 5 YEARS:**
Larger purposeful movements; imaginative songs and stories; beginning to recognize familiar melodies without lyrics; matches beat to others.

**5 – 6 YEARS:**
Maintains steady beat while moving to music; sings melody with pitch accuracy; plays melodies on simple instruments; can remember songs in head; begins to read and write rhythmic notation.

**6 – 7 YEARS:**
Develops tonal centers; starts to sing harmony and rounds’ vocal range and focused around 5 – 6 notes; expands rhythmic and melodic written notation.

**7 – 9 YEARS:**
Vocal range expands; uses more complex meters and harmonies; demonstrates music preferences.

---

The Brain continues to Develop

- Pitch discrimination skills increase in acuity as children get older. (Hargreaves & Lamont, 2017)

- 5 year olds: able to distinguish and identify upward and downward shifts of up to 0.3 semitones correctly. This is also the limit of adult levels of discrimination. (Stalinski et al, 2008)

**Why Encourage Music in Education?**

- 8 – 10 year olds with 12 months of music training were found to have larger MMN (mismatched negativity) responses (electrical activity in the brain) for speech sounds – suggesting that training affects the auditory pathway. (Chobert, et al., 2014)
Active and Interactive participation in musical activities is paramount!

- Kirschner & Tomasello (2016): Younger children - improved outcomes - learning scaffolded by interactions with others

A study by Stanford researchers (Gaab et al, 2005) found that musical training improves how the brain processes the spoken word. Specifically, the research found that musical instruction and experience helps the brain improve its ability to distinguish between rapidly changing sounds: auditory processing.

“adaptive auditory system”

- This auditory processing is critical to developing phonemic awareness and to learning to read successfully.
What can we encourage parents to do?

Let's start with Rhythm – the heartbeat of music and life!
Consider… Musical Milestones in relation to Rhythm

- 2 – 6 months: Movement response to music
- 6 – 12 months: Occasional Beat matching – fragmented
- 18 – 24 months: Basic Beat - less fragmented/steady rhythm in response to stimulus
- 2 – 3 years: Basic Beat established: Flexible rhymical response to meters & imitation
- 3 – 4 years: Using rhythm instruments to accompany their songs
- 5 – 6 years: Fully established – complex subdivision, auditory memory of rhythmic sequences – can match beat to others

Why is beat so important?
Beat Synchronization in pre-schoolers

- Children who can synchronize to a beat are better at reading – related reading skills
- Phonological awareness
- Short term auditory working memory
- Rapid naming
- Synchronizers have a more precise neural envelope
- Encoding of speech sounds
Clap to the basic beat. What does the music tell you to do?

Find the beat. Clap on Beat 1. Tap your knees on beat 3.
Maintaining a basic beat.
Clap for 3 beats.
Silence for 3 beats.

Longer Term Implications: Kraus (2015)

Kraus was the first to provide biological evidence linking the ability to keep a beat, to the neural encoding of speech sounds, which has significant implications for reading.

The study shows that accurate beat-keeping involves synchronization between the parts of the brain responsible for hearing and movement.

- Kraus focused on the auditory component of the beat, whereas previous research highlighted the motor component of the beat.
- 124 students, fitted with electrodes measuring the consistency of the brain response to a repeated syllable, had to tap to a metronome. The brainwave test showed the more accurate the adolescents were at tapping, the more consistent their brain response was to the speech syllable.
Singing in the Family – So Important!

- Experience and familiarity with different tonal voices
- Learning everyday routines and language through simple repetitive songs: wash, wash, wash your hands
- Opportunities for frequent repetition/developing vocabulary through simple traditional nursery songs
- Repetition – wired into developing listening brains

What to look for in selecting songs

- Simple rhythmic, rhyming and alliteration songs
- Traditional rhymes
- Action songs
- Nursery rhymes
- Songs that develop language through their natural repetition of rhythmic words, rhyming sentence structures and repetitive simple musical structures; all significant for the parallel development of musical milestones.
Why is pitch important?

Pitch influences:

- Vocal emotions: understanding and expression
- Listening in noise
- Characterization
- Singing
Consider… Musical Milestones: Pitch

- **6 – 9 MONTHS**: Occasionally matches pitch; uses descending vocalizations

- **18– 24 MONTHS**: Able to imitate songs; lyrics more accurate than pitch; chanting style with steady rhythm

- **2 – 3 YEARS**: Sings in different keys and meters; matches some pitches. Chant-like quality still present

---

Emotions are conveyed through pitch

- 4 and 5 year-olds are able to express happiness and sadness in their invented songs (Adachi & Trehub, 2000).

- Recognition and expression of intended emotion in songs has been shown to emerge particularly between the ages of 4 and 7 years (Gabrielsson & Ornkloo, 2002).
Singing impacts babies from birth

- Small key/note changes in “Twinkle Twinkle” can be detected by neonates and 4 month-old infants, familiarized with the melody in the last trimester of pregnancy: brain event-related potentials (Partanen et al 2013)

Let's give it a try. Listen and complete the last word and note of this phrase.
Musical Memory and Auditory Closure –
Develop through repetition, musical meaning and time.

And again…
In summary

- Musical experiences are valuable for all children, including children with hearing loss
  - Music serves to “jumpstart” other auditory, cognitive, and social-emotional skills (Robbins, 2015)
  - Musicians have been shown to be “better listeners” than non-musicians (Kraus, 2014)
  - It’s all about engaging the child in “real” music and “real/authentic” communication! (Barton & Robbins, 2016)
  - Music can be integrated into home life, therapy & education

Resources
BabyBeats

- Search for ‘Advanced Bionics’ in the iTunes® or the Google Play™ store.

- Look for the BabyBeats app and download.

TunesUps Music Program

- [http://amymcconkeyrobbins.com/tuneups.html](http://amymcconkeyrobbins.com/tuneups.html)
Hear & Listen! Talk & Sing!

- Hear & Listen! Talk & Sing!: Songs for Young Children Who Are Hearing-Impaired and Others Who Need Help Learning to Talk
- By Warren Estabrooks

Kindermusik

- https://www.kindermusik.com/
Gymboree Classes


Hearing First

- https://hearingfirst.org/

- This website offers many ideas for the advancement of pre-literacy and music skills. Their suggestions are helpful and appropriate for all children, not only for children with hearing loss.
Thank You For Listening

Carol Flexer
www.carolflexer.com

General References

- TOPEL – Test of Preschool Early Literacy (norm-referenced ages 3-6 years)