AGENDA
• Rhythm and phonological processing
  – Definitions
  – Descriptions
  – Development
  – Impact on literacy development
  – Intervention strategies

Rhythm
• Rhythm includes:
  – rise time (modulations in amplitude)
  – duration

CONSIDER:
• Say these words with different rise time and duration:
  – Contract
  – Object
  – Research

AMPLITUDE MODULATION
• AM is important for speech development and perception.
• Students with dyslexia are less sensitive to changes in amplitude. (Goswami, 2013)
RHYTHM IN LANGUAGE

- Rhythm - regularities that govern groupings of elements in a language’s phonological structure.
- Rhythm is the manner in which stressed and unstressed syllables succeed each other using pitch, loudness and tempo (the speed of speaking) (Corriveau et al., 2007; Murty et al., 2007; Tuan, 2010)
- Rhythmic language is BOTH segmental and suprasegmental.

RHYTHM IN LANGUAGE

- Segmental level exists at the word level by manipulating syllables and phonemes of words.
  -- Phonological awareness
- Suprasegmental level exists across phrases and sentences and encompass our intonation and timing across multiple words.
  -- Prosody

SUPRASEGMENTAL Feature: Temporal Proximity
Twinkle, twinkle, little star,
How I wonder what you are.
Up above the world so high,
Like a diamond in the sky.
Twinkle, twinkle, little star,
How I wonder what you are!

SEGMENTAL Feature: Syllable Stress (Meter)
Twinkle, twinkle, little star,
How I wonder what you are.
Up above the world so high,
Like a diamond in the sky.
Twinkle, twinkle, little star,
How I wonder what you are!
SUPRASEGMENTAL or PROSODIC Features of Language

- **Stressed-timed rhythm** of language
  - Each breath group has about the same duration
  - Occur in normal pauses within sentences

- **Syllable-timed rhythm** of language
  - Each syllable takes about the same amount of time to say
  - Duh-duh-duh-duh-duh-duh

SYLLABLE-TIMED RHYTHM

- **Duh-duh-DUUUUH-duh**

- **Stressed-timed rhythm** of language
  - Duh-DUUUUH-duh

RHYTHMIC STRUCTURE

- **English** is stress-timed and the segmentation of English is also stress-based.
- **French** is syllable-timed and the segmentation of French is also syllable-based.

What about Spanish?

In English, the amount of time it takes to say something does not depend on the number of syllables.

- Dogs chase cats.
- The dogs chase cats.
- The dogs chase the cats.
- The dogs will chase the cats.
- The dogs will be chasing the cats.

Each sentence has three stressed words.

RHYTHM and PROSODY in the BRAIN

- Rhythm and prosodic processing occurs predominately in the right hemisphere, separate from left hemisphere involvement.
  (Telkemeyer et. al., 2009)
PHONOLOGICAL SENSITIVITY

- Responsiveness to different aspects of speech sounds including rhythm, rhyme and intonation patterns. (Pufpaff, 2009)

- Infants learn to verbalize the sounds they hear following:
  - Prosody – natural rhythms of language
  - Suprasegmental
  - Phonotactic cues – sounds patterns of words
  - Segmental

PHONOLOGICAL SENSITIVITY DEVELOPMENT

- Babies born up to three months premature can recognize different syllables in human speech.
- Similarities were found in the way the brain processes language in the newborns and adults - including specific neurological reactions to changes from the "ba" to "ga" sound and to a male to female voices. (Mahmoudzadeh et al. 2013)

RHYTHM in LANGUAGE

- Sensitivity to speech rhythm and prosody is a contributing factor to children's reading ability. (Holliman et al., 2010)
MEASURING RHYTHMIC ABILITY

• Speech rhythm sensitivity and
• Productive non-speech rhythm
  – Motor entrainment

RHYTHMIC PERCEPTION and ENTRAINMENT

• Ability to coordinate movements in sync with an external rhythm
• These abilities lead to:
  – recognition of prosody,
  – syllable distinction and segmentation, and
  – intonation patterns of various languages i.e. DIFFiculty – diffiCULty

PROSODY and PHONOLOGICAL DEFICIT

• Study looking at syllable stress perception in 13 yr. old students with dyslexia
  – Used a mis-stressed task (i.e. DIFFiculty – diffiCULty)
  – Results indicated significantly less sensitivity to age matched peers with predictors in rise time and duration
• Musical beat perception
  – accounted for 42% of the unique variance in single word reading (Huss, 2011)
  – accounted for 43% of the unique longitudinal variance in reading comprehension
  (Goswami, Huss, et al. 2012)

TEMPORAL SAMPLING THEORY

• Your brain ‘samples’ sensory information at different temporal rates, efficiently taking multiple ‘looks’ at the speech signal using temporal windows of multiple lengths simultaneously (Poepple, 2003).

HOW DOES THIS RELATE?

• Dyslexia involves rise time perception difficulties (neuronal alignment).
• Difficulties in basic auditory processing of rise time, amplitude modulation and beat structure could lead to difficulty processing the sound structures of words and prosodic difficulties.

“Dyslexia – in tune but out of time” (Goswami, 2013)
RHYTHMIC PERCEPTION and ENTRAINMENT

• Interventions targeting rhythmic perception and entrainment skills are linked to improvements in reading skills. (Ment & Vohr, 2008)

RHYTHM and PHONOLOGICAL PROCESSING

• Connection between temporal processing and phonological processing
• Rhythmic training plays an important role in phonological skills development – particularly for children who may not respond to traditional phonics-based training approaches. (Molinari et al., 2003)

PHONOLOGICAL PROCESSING

• Ability to process sound structures of oral language in spoken or written language. (Anthony & Francis, 2005; Wagner et al. 1997)

Three component skills:
• Phonological memory – ability to store sound information in short-term memory
• Phonological awareness – ability to attend to and manipulate sounds and syllables in oral language
• Phonological naming (or access to lexical storage) – ability to retrieve phonologically encoded information from long-term memory

SEQUENCE OF PHONOLOGICAL AWARENESS INSTRUCTION AND INTERVENTION (Schuele & Boudreau, 2008)

PHONOLOGICAL REPRESENTATION

• The storage of phonological information about words in long-term memory. (Maillart et al., 2004; Sutherland & Gillon, 2005)
• Interacts with other phonological abilities to assist language learners to speak correctly, learn to read and spell.
PHONOLOGICAL REPRESENTATION

- Two components:
  - Input representation: auditory characteristics of words
  - Output representation: articulatory gestures
- This combination allows a listener to distinguish one word from another as they are stored in and retrieved from the PR
- Closely tied to semantic representations (McGregor & Schwartz, 1992)

PHONOLOGICAL REPRESENTATION and VOCABULARY

- Learning new words requires both phonological and semantic representations to form and work in unison. (Edwards & Lahey, 1996; Rispens & Baker, 2012; Stackhouse & Wells, 1997)

PHONOLOGICAL REPRESENTATION DEVELOPMENT

- Young children hold words in short-term memory, then through rehearsal and association, store them in long-term memory as a single unit. (Fowler, 1991)
- As children develop language, they must determine word boundaries and begin to identify word forms and referents. (Hester & Hodson, 2004)
- Memory growth and increased exposure to similar sounding words forces children to distinguish between like forms for storage in long-term memory. (Metsala & Walley, 1998; Maillart et al. 2004)
- As stabilization takes place, children learn to hear and consciously recognize similarities and differences in words.
  - This facilitates the development of phonological awareness – including rhyming, alliteration, blending, segmenting, deletion and manipulation. (Fowler, 1991; Gillon, 2005; Hester & Hodson, 2004)

FOUR-PART PROCESSING MODEL FOR WORD RECOGNITION

Context Processor
Phonological Processor
Orthographic Processor
Phonics

Oral Language

(Dahaene, 2009)
CHALLENGES TO PHONOLOGICAL REPRESENTATION DEVELOPMENT

• Children with imprecise phonological representations need more acoustic information. (Anthony et al., 2011)
• Unstable recognition of sounds impedes the sound-to-meaning connections needed for learning to read and write. (Hornickel et al., 2012)

STRATEGIES TO DEVELOP PHONOLOGICAL REPRESENTATION

• Using slight amplification appears to help children with dyslexia improve phonological awareness and reading.
• Whisper Phone

“Brains of kids who wore the device responded more consistently to the very soft and rapidly changing elements of sound that help distinguish one consonant from another, such as cat, bat and pat. That improved stability was linked with reading improvement.”

(Hornickel, et al., 2012)
STRATEGIES TO DEVELOP RHYTHM AND PHONOLOGICAL PROCESSING

- Rhythm is more overt in music than in language.
- Rhythmic and musical interventions can improve phonological awareness skills in children improving literacy learning. (Goswami, 2013)
- Link musical rhythm with beat structure to build rhythmic entrainment.
- The simple act of clapping in time to a slow rhythmic stimulus can improve reading rate/fluency and comprehension in children with speech-language impairments and reading impairments. (Ritter et al., 2013)

SO...

- Phonological sensitivity develops foundations in suprasegmental and segmental aspects of rhythm.
- This leads to phonological representation and enhanced vocabulary, which is connected to phonological processing – memory, naming and awareness.
- ALL are facilitated by rhythm with repetition and rehearsal.
- Include rhythm and music with language and movement.
- Provide enhanced listening for all of it.

References:


