

Vocal Training Basics

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Pennsylvania Training and Technical Assistance Network

PaTTAN's Mission

The mission of the Pennsylvania Training and Technical Assistance Network (PaTTAN) is to support the efforts and initiatives of the Bureau of Special Education, and to build the capacity of local educational agencies to serve students who receive special education services.

PDE's Commitment to Least Restrictive Environment (LRE)

Our goal for each child is to ensure Individualized Education Program (IEP) teams begin with the general education setting with the use of Supplementary Aids and Services before considering a more restrictive environment.

Who are you?



Agenda

- Overview of ABA and verbal behavior
- Overview of vocalizations/vocal behavior
- Assessment of vocal behavior
- Assessment analysis
- Treatment selection and procedures
 - Importance of mand training
 - Vocal programs by student profile

Why are we talking about this?

- Many learners with autism do not develop vocal imitation in response to others' sounds and words (Esch, Carr & Michael, 2008).
- Many learners with autism do not acquire speech as their primary form of communication.

The Value of Vocal Behavior

Why focus on vocal training?

- Humans are evolved to speak
- Vocal apparatus is always with us (portability)
- Speech is the most common mode of communication in the general population
- For adept speakers, it is a very quick and effortless response (efficiency)

Vocal Training Challenges

- Where to start?
- What assessments to use?
- How to determine appropriate program?
- How to select targets?



Overview

ABA AND VERBAL BEHAVIOR

What is ABA?

- **Applied Behavior Analysis (ABA)** is a science and a discipline devoted to understanding and improving human behavior.
- Purpose: to improve socially-significant behavior
(examples: language, academic, social, daily living, self care, recreation, and leisure)

ABA and Vocal Training

- Applied Behavior Analysis (ABA) is the most evidenced-based conceptual framework for autism interventions (National Autism Center Standards Project, 2015)
- Procedures derived from ABA have been successful in vocal training.

ABCs of ABA

Consider all teaching interactions in relation to behavioral events:

- **A = Antecedent** (What happens before behavior)
- **B = Behavior** (What person does...must be able to observe it and measure it)
- **C = Consequence** (What happens after behavior)

ABCs: examples

Antecedent	Behavior	Consequence
Something interesting happens	Look in that direction	See the Event
Need to go out and seeing a door knob	Turning the knob	Door opens
Driving and the traffic light turns red	Depress brake pedal	Car stops

Language as Behavior

- Behavior is *anything* a person does that is:
 - Observable (can sense it)
 - Measurable (can count or time it)
- Communication is observable and measurable
- ABCs of ABA can be applied to communication

What is Verbal Behavior?

- **Verbal behavior** is the analysis of language according to ABCs.
- Premise:
 - Language is controlled by antecedents and consequences
 - Consequences are delivered by/through other people (social!)

Why Verbal Behavior Analysis?

- Learners with autism present differences in language skills and communicative competency.
- We can't change something a learner "has."
- We can alter the environment to change how likely it is that learners will respond to and use language effectively.
- A behavior analysis of language allows alterations in the environment to promote effective language instruction.

Verbal Behavior Example

Antecedent	Verbal Behavior	Consequence
Want water →	<ul style="list-style-type: none"> • Say “water” • Sign “water” • Write “water” • Type “water” • Exchange a picture of water • Point to “water” 	Another person delivers water

Non-Verbal Behavior Example

Antecedent	Behavior	Consequence
Want water →	Open refrigerator →	Get water

Functions of Communication

ABCs of language tell us *why we say what we say*

- To ask for what we want
- To label things
- To answer questions
- To repeat things we hear

"COOKIE"



Verbal Functions (Verbal Operants)

	Antecedent	Behavior	Consequence
Mand (asking)	Motivation (wants cookie)	Verbal behavior (says "cookie")	Direct reinforcement (listener gives cookie)
Tact (labeling)	Sensory Stimulus (sees or smells cookie)	Verbal behavior (says "cookie")	Non-specific, social reinforcement (“It IS a cookie”)
Intraverbal (answering)	Verbal Stimulus (someone says "What can you eat?")	Verbal behavior (says "cookie")	Non-specific, social reinforcement (“Yes! You CAN eat a cookie.”)
Echoic (repeating)	Verbal Stimulus (someone says "cookie")	Vocal-verbal behavior: repeats all or parts of the antecedent (says "cookie")	Non-specific, social reinforcement (“Cookie! You said cookie!”)
Listener Responding* (following directions)	Verbal Stimulus (someone says "give me a cookie") In this case, a cookie must be present	*Non-verbal behavior (says "cookie")	Non-specific reinforcement (Listener smiles and says "Thank you!")

Verbal Behavior and Vocal Behavior

Why are we talking about this?

Analysis of verbal behavior is a *critical variable* in vocal training. We don't just teach speech; we teach speech within a functional context.

Vocal versus Verbal

WHAT IS VOCAL BEHAVIOR?

What is Vocal Behavior?

“...the production of auditory stimuli resulting from the movements of the muscles of the vocal apparatus, e.g., the sounds one makes.” (Carbone, 2012)

- Non-vocal learners may use of other forms of verbal behavior such as signing, writing, typing, picture exchange, and/or speech-generating augmentative devices.

Form and Function

		Function	
		Verbal	Non-Verbal
Form	Vocal	*Vocal Verbal* Saying "water"	*Vocal Non-Verbal* Coughing
	Non-Vocal	*Non-Vocal Verbal* Signing "water," exchanging a picture of water, etc.	*Non-Vocal Non-Verbal* Crossing legs

Do Not Give Up on Speech!

- In teaching learners with autism, we may need to teach non-vocal forms of verbal behavior at first, such as sign language, if vocal behavior is not effective.
- Non-vocal forms should almost always be viewed as a temporary “fix” for a vocal communication deficit.
- If a learner has few spontaneous vocalizations, does not attempt to echo on request, and/or has poor speech intelligibility, the learner requires a **vocal training**

Steps in Vocal Training

1. Assess

2. Analyze

3. Select Treatment

Vocal Training

ASSESSMENT

I. Assess



Assessment

Vocal training assessment should answer the following questions:

Is there echoic stimulus control?*

Is the learner making speech sounds?

- How often?
- What sounds?

Is the learner talking?

- 1-word level?
- Combining words?
- Intelligibility?

*Does the learner attempt say something immediately after the instructor says something?

Kinds of Speech Assessments

- ★ Vocalization baseline (Esch, 2015)
- ★ Early Echoic Skills Assessment (Esch, 2008)
- Intelligibility assessment of tact and mands
- Speech sample and/or phonemic inventory
- Standardized articulation assessments, such as:
 - Goldman-Fristoe Test of Articulation 3 (Goldman & Fristoe, 2015)
 - Arizona-4 Articulation Proficiency Scale

Vocalization Baseline

- Record all speech vocalizations in one or more 30-minute “free operant” (play) settings.
- Take a vocalization baseline when learners:
 - ...vocalize/babble infrequently
 - and/or
 - ...have limited sounds in their repertoire
 - and/or
 - ...do not yet have vocal-verbal behavior

Vocalization Baseline

30 min free operant vocal play interval recording for _____ (name)

- Record speech vocalizations that occur during each 30-sec cell
- Mark + for each separate speech vocalization OR transcribe each phonetically

Vocalizations occurred in _____ /50 intervals

Vocalization Baseline = _____ %

Vowels	Frequency	Consonants	Frequency

Barbara E. Esch, Ph.D.
Esch Behavior Consultants, LLC

30 min free operant vocal play interval recording for _____ (name)

- Record speech vocalizations that occur during each 30-sec cell
- Mark + for each separate speech vocalization OR transcribe each phonetically

+ = occurrence

(mimicry/imitation)

se	re	er	ee	oo++	de	ora+	oo+	m+	e
oo+	m+	e	oo++	du++ du+ duhr duhr	oo++	oo+	oo++	oo++	du++ uh+ nuh+
se+	m+	e	oo+	du+	oo++ yuh+	oo++ squid	e	e	du+ muh+ kup++

30/50

Vocalizations occurred in _____ /50 intervals

Vocalization Baseline = 60.0 %

Vowels	Frequency	Consonants	Frequency

Barbara E. Esch, Ph.D.
Esch Behavior Consultants, LLC

9/12/16

30 min free operant vocal play interval recording for [redacted] (name)

- Record speech vocalizations that occur during each 30-sec out
- Mark + for each separate speech vocalization OR transcribe each phonetically

eWER++ wuhwee	eWEE+++ EE wee wee	WEE+	EE eWEE+++ EE+	eWEE+ EE wee wee	TO eWEE++ EE wee wee	wee+ wee wee++ eeah++	eWEE	wee wee+ eWEE++	EE eWEE+++ EE
weeh EE eWEE+	eWEE+++ wee wee++	eWEE wee+ eWEE+ wee wee++ wee+	eWEE++	eWEE++	wee+++	EE+ wee+	wee eWEE+		wee++++ wee wee++

19/20 = 95%

Vocalizations occurred in 19 of 20 intervals

Vocalization Baseline = 95%

Vowels	Frequency	Consonants	Frequency

Vocalization Baseline

What can vocalization baseline tell you?

- Does the learner spontaneously vocalize frequently?
 - Are vocalizations automatically reinforcing?
- Is the learner getting a lot of practice throughout the day?
 - How often does the learner spontaneously vocalize?
- What “raw materials” do we have to work with?
 - Is the learner vocalizing a variety of sound and syllable combinations?

Early Echoic Skills Assessment (EESA)

5 groups of words

1-3 syllables

p, b, m, n, h, w, k, g,
t, f, s, ng, vowels

word stress and
intonation

Early Echoic Skills Assessment (EESA)
Barbara E. Esch, Ph.D., BCBA, ECC-218

Scoring Directions: (1) For each item, circle the best response of up to 3 trials.
(2) Record number and correct number of groups (1 point).
(3) Aggregate response for number of words (1 point).
(4) Aggregate response for number of words (1 point).
(5) Aggregate response for number of words (1 point).

Group 1: 1-3 syllables

one	two	three	four	five	six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty
one	two	three	four	five	six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty

Group 2: 1-3 syllables

one	two	three	four	five	six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty
one	two	three	four	five	six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty

Group 3: 1-3 syllables

one	two	three	four	five	six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty
one	two	three	four	five	six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty

Group 4: 1-3 syllables

one	two	three	four	five	six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty
one	two	three	four	five	six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty

Group 5: 1-3 syllables

one	two	three	four	five	six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty
one	two	three	four	five	six	seven	eight	nine	ten
eleven	twelve	thirteen	fourteen	fifteen	sixteen	seventeen	eighteen	nineteen	twenty

Early Echoic Skills Assessment (EESA)

Administer EESA* to:

Any learner who readily approaches you and stays with you to access reinforcement.

Do not place repeated echoic demands if you are not paired with reinforcement!

*See VB-MAPP for administration instructions

Early Echoic Skills Assessment (EESA)

What can the EESA tell you?

- Does the learner consistently follow instructions to vocally imitate?
 - Is there formal echoic stimulus control?
- Can the learner correctly imitate early syllable structures, moving from simple to complex?
 - Only reflects articulation development up to 30 months of age!
- Can the child imitate speech prosody?

Intelligibility Assessment

Assess intelligibility of tacts and mands when:

...student readily approaches and stays with instructor

and

...there is formal echoic stimulus control

and

...student has some varied “raw material”

(~Group 1 and at least some of Group 2 on EESA, but not above a total score of 90)

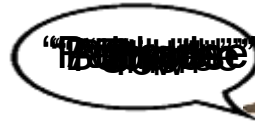
Intelligibility Assessment

- Present various tact and/or mand opportunities.
- Compile 3 different lists of items:

Known Items	Future Targets (mand/tact)	Echoic Shaping Targets
Response is correct and intelligible.	Response is incorrect or unintelligible, but correct and intelligible given echoic prompt.	Response remains unintelligible, even with an echoic prompt.

Intelligibility Assessment Activity

(3 year old student)



Known

Future

Echoic Shaping

Intelligibility Assessment

What can an intelligibility assessment tell you?

- How intelligible is the learner to familiar and unfamiliar listeners?
 - Percent intelligibility
- What types of errors is the learner making in functional communication?
- What are some ***functional speech targets***?

What assessment(s) would you consider?

<https://youtu.be/ydsPlo5bMrE>



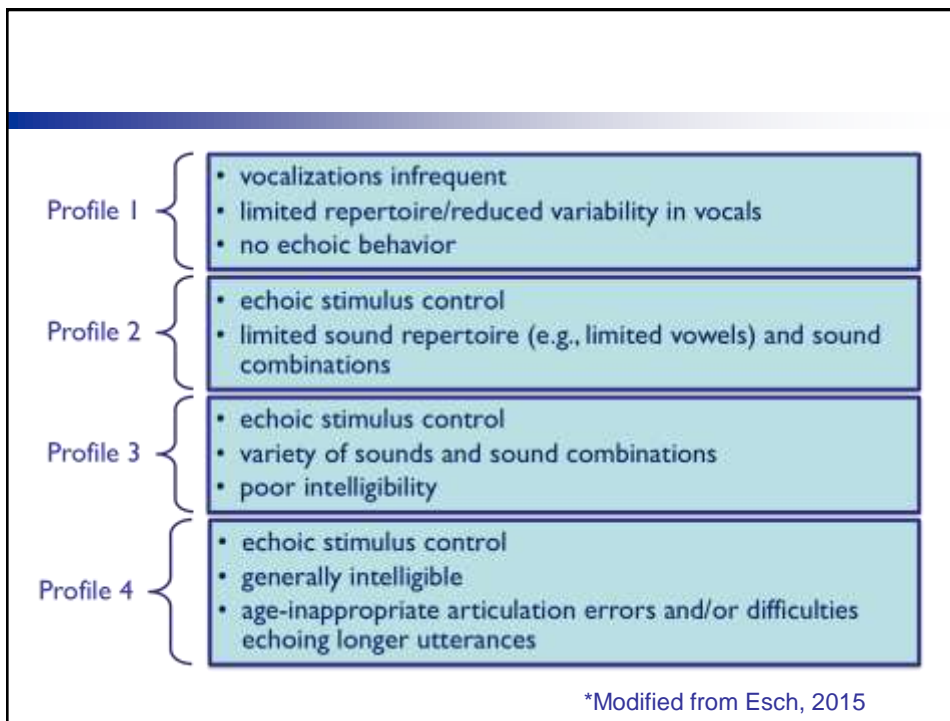
Vocal Training

2. Analyze

ASSESSMENT ANALYSIS

Assessment Analysis

Into which profile does the learner fit best?



Vocal Training

3. Select Treatment

TREATMENT SELECTION: IMPORTANCE OF MAND TRAINING

Vocal Training: Importance of Mand Training

- For all learners, mand training provides an opportunity for vocal training.
- Intensive mand training takes advantage of the effects of strong, direct reinforcement.
- Mand training involves the pairing of spoken words with delivery of reinforcement.

The Mand and Autism

- The mand requires:
 - Social approach and initiation
 - Interactions with other people as having value
 - Flexible and specific verbal responses (communication)
- These skills directly compete with the core deficits of Autism Spectrum Disorders

Motivation and the Mand

	Antecedent	Behavior	Consequence
Mand	Motivation (wants cookie)	Verbal behavior (says "cookie")	Direct reinforcement (gets cookie)

- What does it mean to “want something?”
 - We can consider “wanting something” as being related to events experienced by the learner (the result of events in the environment)

Mands – Improve Social Communication

- Mands can help develop other types of social communication.
 - Increases the value of speaking
 - Transfer of skills from manding (requesting) to echoics (imitating words) and tacting (labeling)

Mand Training: Identify the Response Form

- Assess student's skills
 - Echoic skills
 - Imitation skills
 - Match to sample skills
- Vocal
- Sign language
- Writing
- Picture exchange
- Speech generated device
 - Selection-based or typing



Mand Training: Initial Items to Use

- Are usually strongly motivating
- Can be delivered quickly
- Are consumable or allow only a brief period of contact
- Can be teacher controlled
- The sign or word used to mand for the item is not too hard to produce



Mand Training: Basic Procedures

- Check for motivation for an item/activity (capture/contrive motivation)
- If motivated, deliver wanted activities and items freely at first
- Model the word for the item each and every time to deliver (say it as you deliver!)
- Pause and wait for a moment to see if the learner asks for the item (time delay)
- If necessary, prompt the response (vocal or other form)
- When the learner mands, deliver the item

Mand Training: Model the Vocal

- Extremely important to pair delivery of reinforcement with a model of the response form (the vocalization) that the learner will later be expected to emit. Say what you are delivering!
- Saying what is delivered while it is being delivered conditions the sound of the word as a reinforcer.
- The learner will be more likely to vocalize the modeled word during mand training

Video of modeling the vocal



Mand Training Tip

- Begin mand training with one word mands (“cookie”).
- Requiring multiple words initially or too soon can have undesired consequences.

- Expanding length of utterance too soon may cause several problems:
 - Increased response effort can make the child stop talking (lose motivation)
 - Articulation/clarity may be affected
 - Learner may show unusual grammatical structures
 - Interferes with the natural flow of communication

Mand Training: Differential Reinforcement of Vocalizations

- If the learner is using sign, picture exchange, speech generated device, etc., and he/she vocalizes while manding, **differentially reinforce the response.**
 - Provide more/better reinforcement for mands that occur with vocalizations.
- Differential reinforcement of vocalizations when manding will likely lead to increased vocalizations.

Mand Training Video Examples



Vocal Training

3. Select Treatment

TREATMENT SELECTION: PROGRAMS BY PROFILE

Programs by Profile

Profile 1

- vocalizations infrequent
- limited repertoire/reduced variability in vocals
- no echoic behavior

Program goals:

- Increase frequency of spontaneous vocalizations
- Increase variability in vocalizations
- Establish echoic stimulus control

Programs by Profile

Profile 1

- vocalizations infrequent
- limited repertoire/reduced variability in vocals
- no echoic behavior

Treatment Options	Purpose
<ul style="list-style-type: none"> • Reinforce all vocalizations • Differentially reinforce all vocalizations during manding • Stimulus-stimulus pairing (SSP)* 	Increase frequency of spontaneous vocalizations
<ul style="list-style-type: none"> • Vocal variability training (VV)* 	Increase variability in vocalizations
<ul style="list-style-type: none"> • Rapid motor imitation antecedent (RMIA)* 	Establish echoic stimulus control

*Modified from Esch, 2015

Stimulus-Stimulus Pairing (SSP)

Why attempt increase frequency of spontaneous vocalizations?

- Learners need to engage in some form of behavior in order to shape behavior.
- Typically-developing infants provide caregivers with frequent opportunities to shape speech.
- Many learners with autism provide very few opportunities for instructors to shape speech.

Video of typical infant



Video of 20 month old with autism

<https://youtu.be/vIUT6avqoYU>



Vocal Variability (VV)

- Candidate: Learner emits a limited number of different speech sounds
- Based on a **lag schedule** of reinforcement
 - Reinforcement depends solely on the learner's previous response(s) and not on anything the instructor does or says.
 - During a lag 1 schedule, a learner is reinforced if the current vocalization sounds different from his/her previous response. During a lag 2 schedule, a learner is reinforced if the current vocalization sounds different from his/her previous 2 responses.

Vocal Variability (VV) Procedures*

1. Provide a vocal model of the target. Reinforce the first trial in which **any** vocal response occurs within 3 seconds of the model.
2. For subsequent trials, only reinforce vocalizations that are different from the learner's previous response—no matter the target. Vocalizations are considered different if they contain:
 - Completely different sounds (Example: ah vs. bee)
 - Different combinations of sounds (Example: bat vs. tab)
3. Kinds of errors:
 - Response is the same as the previous response: Do not reinforce and move to the next trial.
 - No response within 3 seconds: Repeat vocal model 3-5 times until the learner emits a response. If learner does not respond within 3-5 repetitions, move to the next trial. (Do not reinforce.)

*See handout for additional details

VV video



Rapid Motor Imitation Antecedent (RMIA)

- Candidate: Learner has very strong non-vocal motor imitation repertoire, but does not readily attempt to vocally imitate the instructor when asked.
- Utilizes **behavioral momentum**: Emitting a rapid series of easy responses make a learner more likely to emit a more difficult one.

Rapid Motor Imitation Antecedent (RMIA) Procedures*

1. Check for motivation for a reinforcer. Keep the reinforcer visible, but not accessible by the learner. For each trial, target echoic should be related to the reinforcer presented.
2. Present 3-6 non-vocal motor imitation models.
3. If the student correctly imitates, immediately hold up the reinforcer
and present the target vocal model.
4. Deliver the reinforcer if the student echoes.

After 3-5 consecutive correct trial sequences, try fading the non-vocal motor imitations. In other words, test the learner's echoic abilities.

*See handout for additional details

RMIA video <https://youtu.be/ydsPlo5bMrE>

**... ONCE CHILDREN HAVE IMITATED
THE RAPID SERIES OF MOTOR ACTIVITIES,**

Vocal Training

Profile 2

- echoic stimulus control
- limited sound repertoire (e.g., limited vowels) and sound combinations

Program goals:

- Strengthen echoic responding
- Increase speech sound repertoire and sound combinations

Vocal Training

Profile 2

- echoic stimulus control
- limited sound repertoire (e.g., limited vowels) and sound combinations

Treatment Options	Purpose
<ul style="list-style-type: none"> • Differentially reinforce <i>better</i> vocalizations during manding • RMIA* • Echoic program for simple sounds and sound combinations* 	<ul style="list-style-type: none"> • Strengthen echoic responding • Increase repertoire of sounds and sound combinations

*Modified from Esch, 2015

Profile 2 vocal training video

https://www.youtube.com/watch?v=IVKI_Z9



Vocal Training

Profile 3

- echoic stimulus control
- variety of sounds and sound combinations
- poor intelligibility

Program goal:

- Increase intelligibility of functional communication

Vocal Training

Profile 3

- echoic stimulus control
- variety of sounds and sound combinations
- poor intelligibility

Treatment Options	Purpose
<ul style="list-style-type: none"> • Differentially reinforce <i>better</i> vocalizations during manding and tacting • Echoic program for shaping tacts and mands* 	Increase intelligibility of functional communication

*Modified from Esch, 2015

Profile 3 vocal training video



Vocal Training

Profile 4

- echoic stimulus control
- generally intelligible
- age-inappropriate articulation errors and/or difficulties echoing longer utterances

Program goal:

- Developmentally-appropriate speech
- Developmentally-appropriate use of grammatical structures
- Engage in self-talk to guide complex behaviors

Vocal Training

Profile 4

- echoic stimulus control
- generally intelligible
- age-inappropriate articulation errors and/or difficulties echoing longer utterances

Treatment Options	Purpose
<ul style="list-style-type: none"> • Differentially reinforce <i>better</i> vocalizations during manding and tacting • Echoic program for shaping speech sounds* • Echoic program for multiple-word utterances 	<ul style="list-style-type: none"> • Developmentally-appropriate speech • Developmentally-appropriate use of grammatical structures • Engage in self-talk to guide complex behaviors

*Modified from Esch, 2015

Profile 4 vocal training video



Profile 4 Note:

“Typically developing children have several hundred spoken words across all verbal functions before they are expected to begin fine-tuning their speech (around age 3), and they have several thousand spoken words before they are expected to acquire adult articulation (around age 8-9). Often, it will be more beneficial for the teacher to shape speech to an intelligible level, rather than an age-appropriate level, if it means that the student will be able to acquire spoken communication faster.”

(PaTTAN, n.d.)

Vocal Training Consideration: Frequency of Practice

- Esch (2015) explains that in order to resemble typical acquisition practice, arrange opportunities for speech practice as follows:
 - Many opportunities (100+)
 - Brief sessions (2-3 minutes)
 - Throughout the day
- “We teachers and parents have to decide: Where is speech acquisition in the ranking of skill and instructional priorities?” (Esch, 2015)

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Tom Wolf, Governor