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PaTTAN Autism Initiative

The Role of Fluency in programming



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.

<https://answergarden.ch/504652>

What do you think of when you hear the word Fluency...



Introduction

- <https://youtu.be/zL2O5idRETo>



Definitions

- From Wikipedia: Fluency is a [speech language pathology](#) term that means the smoothness or flow with which sounds, syllables, words and phrases are joined together when speaking quickly.

Basic understanding of fluency

- In the sense of proficiency, "fluency" encompasses a number of related but separable skills:
- Reading: the ability to **easily** read and understand texts written in the language;^[2]
- Writing: the ability to **formulate** written texts in the language;
- Speaking: the **ability to produce** speech in the language and **be understood** by its speakers.
- Listening Comprehension: the ability to **follow and understand** speech in the language;
- Reading comprehension: the level of understanding of text/messages.

Key points

- Fluency is accuracy and rate.
- Fluency builds comprehension



Fluency is ...
the ability to read text accurately and quickly.

Fluency is important because ...
it frees students to understand what they read.

Fluency practice ...
is essential for students to bridge the gap between word recognition and comprehension.

Reading Fluency can be developed by ...
having students engage in repeated oral reading and modeled fluent reading.

– The Partnership for Reading

Don't Panic

Time		Name					
Addition Timed Practice (0-2)							
1	0	2	0	1	0	2	0
+2	+0	+7	+2	+7	+5	+4	+7
0	1	2	1	1	2	1	1
+8	+0	+6	+1	+5	+1	+8	+9
2	2	0	2	0	2	1	2
+0	+2	+6	+3	+9	+5	+3	+8
1	0	2	1	2	2	1	2
+4	+1	+7	+6	+9	+2	+5	+3
1	2	0	2	1	0	1	1
+7	+4	+3	+9	+4	+4	+9	+3

Math

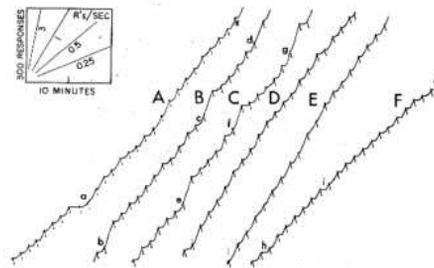
- Procedural **fluency** is the ability to apply procedures **accurately, efficiently, and flexibly**; to transfer procedures to different problems and contexts; **to build or modify** procedures from other procedures; and to recognize when one strategy or procedure is more appropriate **to apply** than another.

Legacy from
Skinner and
Ogden
Lindsley

**In the beginning...
there was Fluency**

B.F. Skinner and Fluency

- Involves the rate of responding.
- Skinner considered rate of response and the cumulative response recorder to be his major contributions (Skinner 1976)
- “Rate is a universal datum”



Odgen Lindsley

- “I saw the opportunity for putting all behavior of all organisms on a frequency spectrum, as previously had been done with light, sound and electricity. In our laboratory research on psychotics, I had recorded the frequencies of human plunger pulling, pacing, talking, looking and listening (Lindsley, 1956,, 1960, 1962). Once we had all behaviors plotted on a frequency spectrum, I was convinced major behavioral discoveries would soon follow”

Lindsley continued.

- Frequency is actually a dimension of behavior, when you change the frequency, you have changed the behavior.”
- “Frequency should not be considered a mere measure of behavior, it is a dimension of behavior.”
- “Laboratory research has shown human behavior frequencies to be 10-100 times more sensitive to changes in procedures than percent correct (Lindsley, 1962)”

Behavioral Fluency

- Behavioral Fluency is the combination of accuracy plus speed of responding that enables competent individuals to function efficiently and effectively in their natural environments. (Binder, 1996)

Other terms equated with fluency:

automatic

(Haughton, 1972a)

second nature performance

(Binder, 1990)

doing the right thing without hesitation

(Binder, 1988b)

Stability or predictability of performance

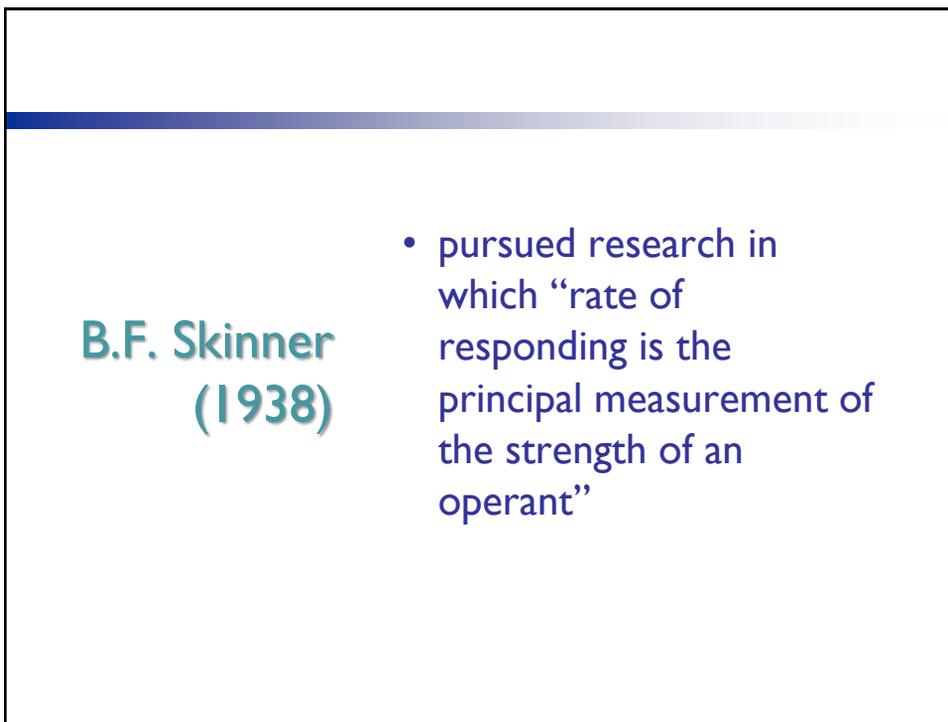
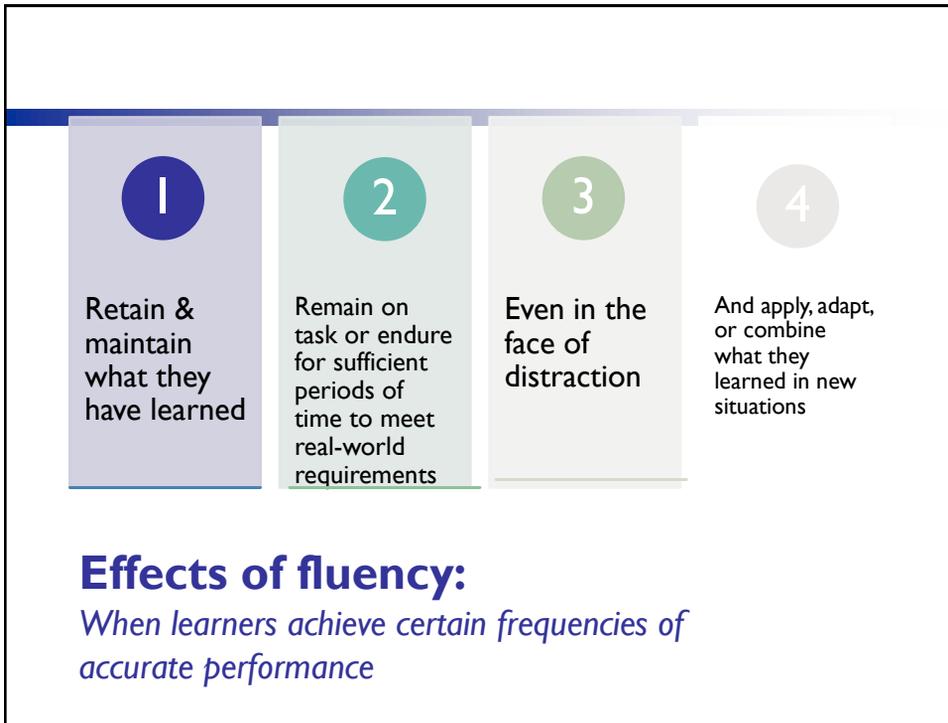
(Barrett 1977a)

immediately accessible

(Gagne, 1970, 1974)

Performed with perfect confidence

(Gagne & Briggs, 1974)



Fluency represents a new paradigm

- In the analysis of complex behavior and the design of instruction

Accuracy is not sufficient

Haughton observed that the mere presence or accuracy of a response class in the repertoire of a learner is not sufficient to ensure progress through a curriculum sequence that depends on that response class as a prerequisite or component.

Just because someone can do something doesn't mean it is a mastered skill.

Component/Composite

- Principle of minimum component behavior frequencies.
- Set the stage for significant improvements in efficiency of instructional programming.
- Increase the frequency of composite skills by increasing the frequency of the component skills.
- Increase complex behaviors by increasing the rate of responding/ strength of the component skills.

Haughton analogy

- Like atoms requiring a certain valence or energy to combine
- behavioral elements require a certain frequency to form compound response classes.

Atomic Repertoires (Palmer)

- A set of fine-grained units of behavior, each under control of a distinctive stimulus, that can be evoked in any permutation by the arrangement of corresponding stimuli

Building complex human behaviors

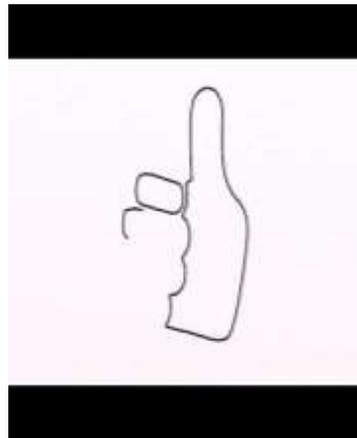
- Building blocks of complex behavior – arise from other response classes that have been shaped bit by bit.
- By appropriate arrangement of these discriminative stimuli, an indefinite number of permutations of atomic units can be evoked.
- Behavioral atom: “a string of atomic responses can be specified by a small set of instruction, and once the responses have occurred in the correct sequence, they may hang together as a unit under control of prevailing contingencies.”

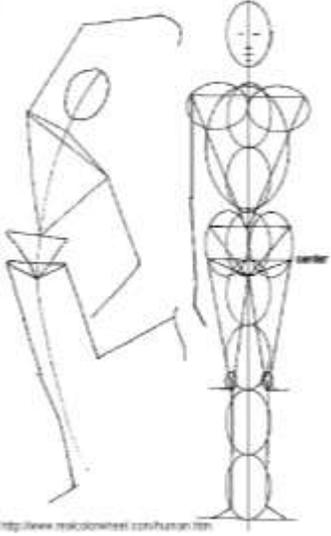
Examples of atomic repertoires



Example

- Follow this instruction (read it silently first)
- Put your right thumb on the back of your neck and say “fall de rall dee dum” after I clap my hands.





<http://www.makobonheki.com/human.htm>

Example 2

- Follow this direction (read silently first):
- Do Seiunchin Kata (Shorin-ryu). The Bunkai is up to you. Maintain Shiko-dachi. Start when I get to ryoku.

Complex behaviors formed by atomic repertoires

- Echoic behavior:
 - Speaker as a listener
 - Parity
 - Grammar
 - Shapes language
- Imitation
 - Used in novel situations
 - Observational learning.
- Tacting behavior:
 - Recall strategy
 - Joint control
 - Responding as a listener
 - Observational learning
 - Rule governed behavior

We must teach the basics
not only accurately but fluently.

**IF We want our learners to
perform complex skills...**

**Vargas
(1977)**

- Teaching is not only producing new behavior, it is also changing the likelihood that a student will respond in a certain way. Since we cannot see a likelihood, we look instead at how frequently a student does something. We see how fast he can add. The student who does problems correctly at a higher rate is said to know addition facts better than one who does them at a lower rate. (p. 62).

Fluency as a teaching tool

- “What many educators assumed to be ‘learning disabilities’ or ‘learning problems’ seemed to wane when students were allowed and encouraged to practice key components of complex behavior to the point at which they could perform each component at relatively high frequencies.”

Gilbert (1978)

- Educational programs will be more effective in the long run if they produce a more focused, but truly mastered, repertoires rather than a broad but fragile repertoire.

Tiemann and Markle (1990)

1

Analyze and sequence curriculum to encourage generativity

2

The emergence of new behavior based on the principle of contingency adduction.

**Johnson &
Layng
(1992, 1994)**

- When the basics are fluent, later learning becomes easier rather than more difficult.

Basic
Math
fact

$$2+2=?$$

More complex
math problem

$$\begin{array}{r} 253 \\ + 314 \\ + 322 \\ \hline \\ \hline \end{array}$$

Component-Composite

Examples from Research involve fluency with:

- Reading
- writing
- computational math
- Fine and gross motor control (Big 6+6)
- Physical, occupational and language therapist.
- Self care and vocational skills. (practicing components in isolation prior to combining them into chains).

Issues with fluency

Drill and practice

- Lack of reinforcement
- Working too much under aversive control

Prolonged practiced when the frequencies are low

- Skills are not ready for fluency building.
- There is no goal, aim or insufficient goals/aims.

Setting Aims

- Are a specific and precise objective of an overall goal

Haughton, 1972

- Educational aims should be personalized to fit each student.

Considerations for fluency aims

- Accuracy – rate of correctness/incorrectness during run-throughs.
- Speed - responses per minute.
- Duration – endurance, attention span, and resistance to distractions during the timing.
- Stability – the ability to engage in the skill easily in the face of distractions
- Retention and maintenance of skills and knowledge.

REAPS

- Retention
- Endurance
- Application
- Performance
- Standards
- We should set aims that are empirically determined levels of performance ensure retention and application of skills.
- Achieving high performance frequencies increase the likelihood that students would maintain attention to task over extended durations of performance in the face of distraction.

Fluency within Intensive teaching

- Use card sort to keep instruction at a fast pace.
- Consider any answer that takes longer than 2-3 seconds an error.
- Keeps responses fluent.
- Keeps problem behaviors and distractions at a minimum.
- Avoids errors on basic skills.

Faster responding results in less problem behavior and/or off task behavior.

PACE OF INSTRUCTION

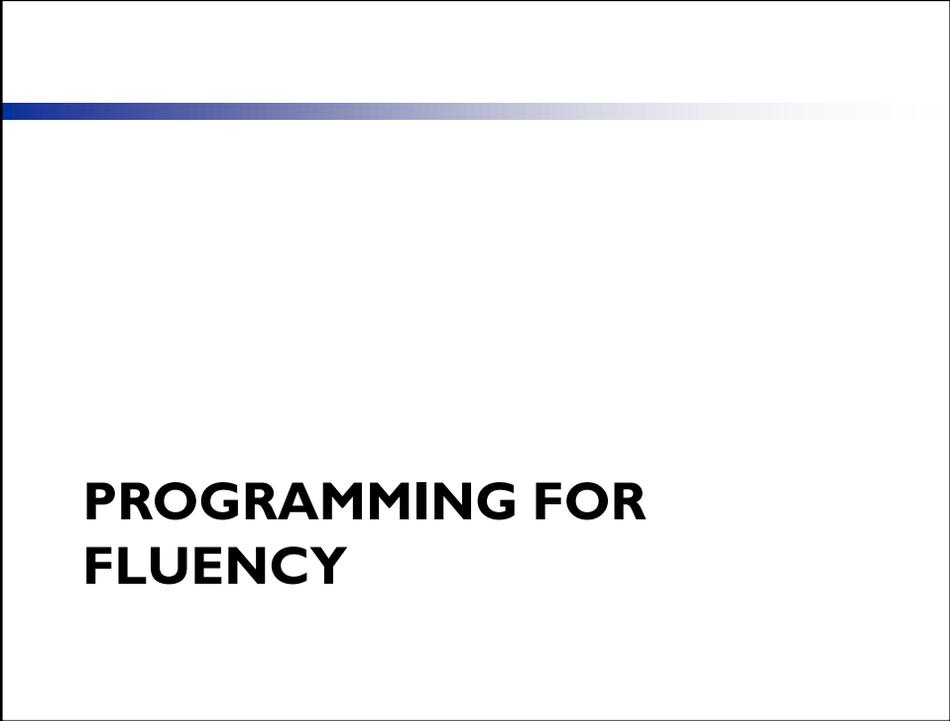
In a teaching session:

- *you can tell fluency by how much time between the direction or S^d and the response.*

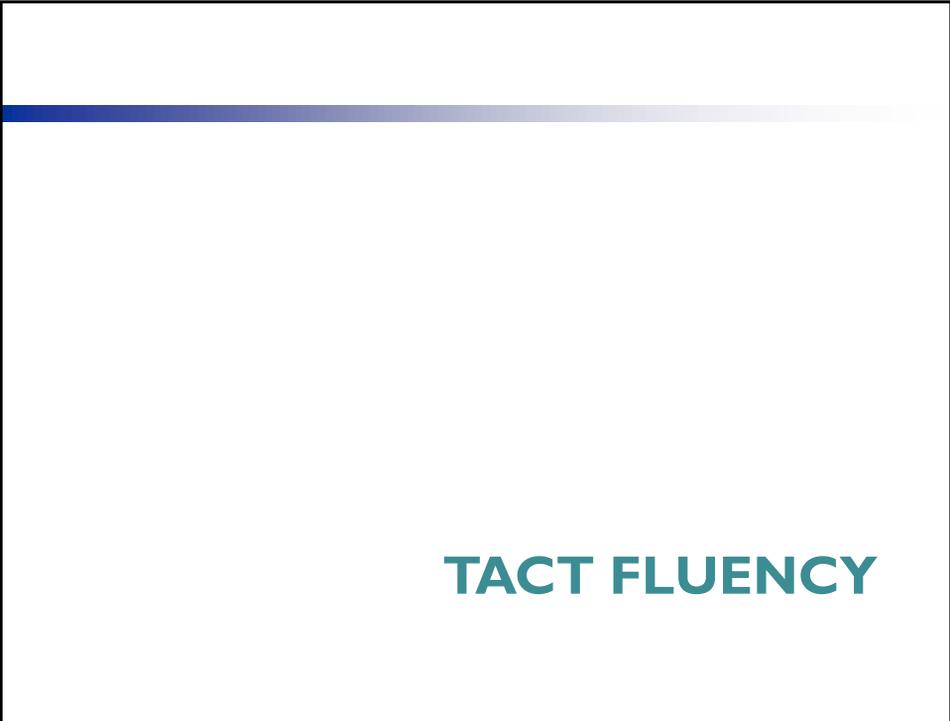
When more practice is needed:

When someone says: he can do that but

- He is distracted
- He is not retaining skills
- He can do it but not all the time
- Slow to respond in intensive teaching for a certain skill.



**PROGRAMMING FOR
FLUENCY**



TACT FLUENCY

When to consider TACT fluency

- When slow at responding with tacts during Intensive teaching
- Slow at responding with tacts in Natural environment
- If student has difficulty such as distractions, memorization issues, generalization issues, prompt dependency/spontaneous behavior problems.

MORE considerations for tact fluency

- Should probe/teach tact fluency before more complex programs: Intraverbals.
- Should probe/teach tact fluency before joint control programs.
- If student has problems with more advanced programs (retention, acquisition, generalization) go back.

Prerequisites for tact programs

- articulation of the picture/tact is clear.
- student should not make frequent errors on tacts.
- tact skills must be acquired!
- student has at least 50 tacts
- Must have instructional control!

Tact fluency video

General guidelines

- Probe baseline performance:
 - Look for the fastest time.
 - Does the student need to stand or sit?
 - Also check to see what is fastest: if you point or if the student points.
 - What field size? Start with the most successful. (never less than 4) I usually start with 6.
 - Start with a 10 second sprint.
- Don't say "what is it?" For every picture.
- Make sure responding is easy and student is successful...
- Run a minimum of three trials a day. Best to do so at least twice a day.
- Pick the best performance to graph.

Key: differential reinforcement

- Set up tact fluency for the student: if they can tact a lot of pictures/items and it is understandable but they are not doing it at a fluent pace.
- Differential reinforcement is important! (give the best reinforcer after the best response).
- Make it fun! Like a game!

Did instructor determine a reinforcer that Student wanted at the moment?

Did instructor provide reinforcement for appropriate behaviors and appropriate responding?

Did instructor provide differential (better) reinforcement for specific behaviors targets for increase and for more independent responses? (the best score during fluency)

•Notes on ways to differentially reinforce:

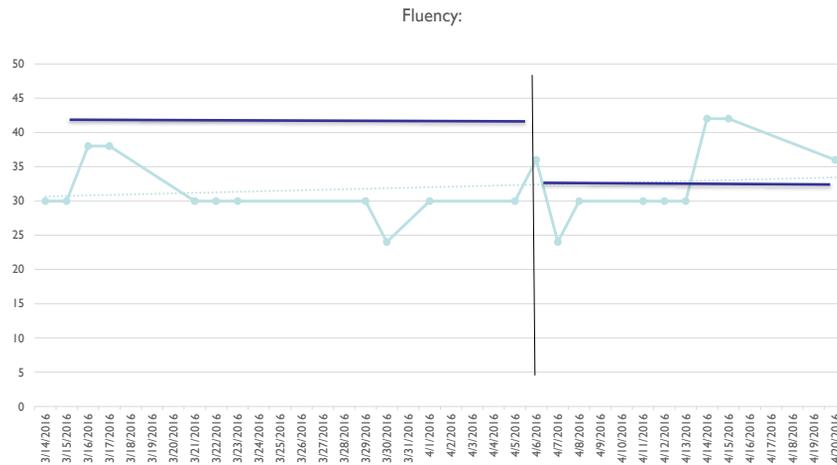
- More quantity of the reinforcer
- Better quality
- Larger magnitude
- More time in contact with reinforcer

If Student engages in undesired behaviors or behaviors targeted for reduction, did instructor withhold reinforcement?

Data collection

- No matter how many times you practice you only convert the best score for the day and graph the best one.
- Conversion to response per minute.
- Example: 9 responses in 10 seconds converts to 9×6 to get the responses per minute.
Conversion for a 15 second timing: responses $\times 4$, 20 second timing: responses $\times 3$, 30 second timing: responses $\times 2$.

Sample graph



Common errors

- Using the same pictures every time you run tact fluency
- Or rotating through 3 sets of pictures.
- Use any of the pictures in the card sort that are known. Don't separate out for fluency only.

Common errors

- Run a probe before doing the fluency session:
 - if the student errors on a tact, take that picture out of the array.
 - If the student has poor articulation for a tact, take it out of the array.
- If student points to a picture but says the one before or after... this is a procedural error that should be corrected.

Aim decisions

- Decisions to make when an aim is hit.
 - Do I increase the aim?
 - Do I increase the field size?
 - Do I build endurance and increase the timing sprint?
 - 10 seconds – 15 seconds – 20 seconds – 30 seconds – 1 minute?

When to end program

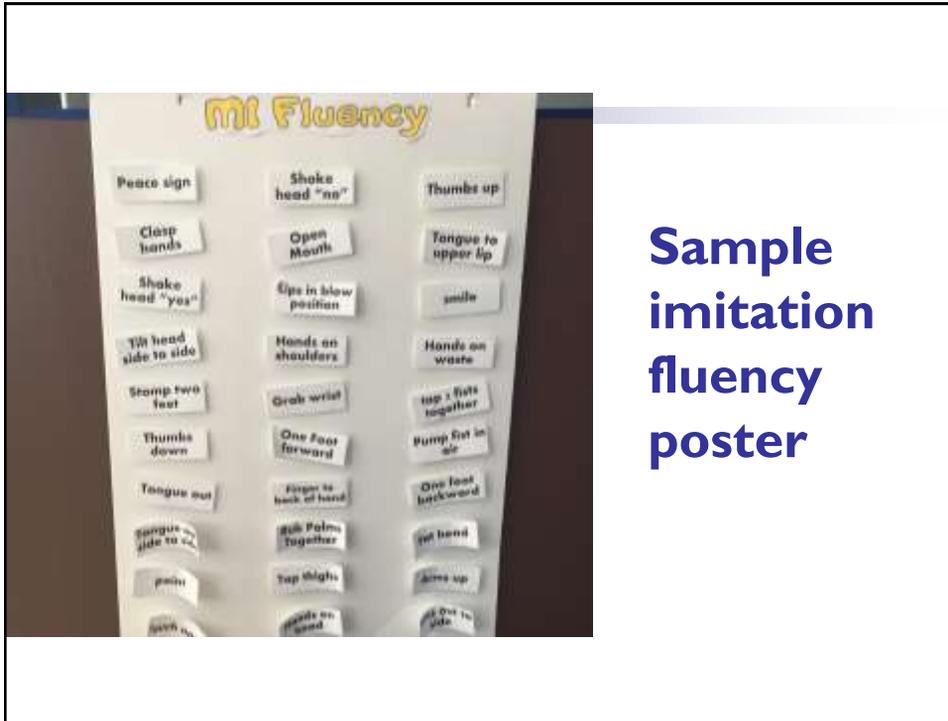
- When do we end a fluency program:
 - When an aim is hit for 3 consecutive days.
 - When the student can perform the skill with endurance (at least 30 seconds).
 - When complex skills or composite skills are acquired easily.
 - Go to maintenance.

IMITATION FLUENCY

When to consider Imitation fluency program

- Student should have at least 20-30 imitations acquired before looking at an imitation fluency program.
- If student has difficulty such as distractions, memorization issues, generalization issues, prompt dependency/spontaneous behavior problems.
- To build “generalized imitation”: imitate any novel movement.
- To teach multiple step imitation (2-3 sequenced)

Imitation probe video



Sample imitation fluency poster

Imitation fluency probe general directions

- Start with a 10 second sprint. With imitation you don't have to say "do this" every time, you can warm up and make it a game.
- Tell him "I want you to go as fast as you can, get ready."
- Start the timer when he gives his first response instead of when you give your first imitation.
- Be careful that you don't go in the same order of imitation every time.

Imitation fluency video

Key: differential reinforcement

- Set up imitation fluency for the student. (if they are all imitating pretty much anything (not 2-3 step imitations).
- Differential reinforcement is important! (give the best reinforcer after the best response today the student got better and better).
- Example: I gave a small amount of reinforcement for the 5 responses, gave even more when he beat that number and got 8 then he got the most reinforcement for 9.

Reminders about reinforcement for fluency programs

- Use a promise reinforcer: have the best reinforcer out that the student loves! Say "If you go really fast you will get the _____. (even if he doesn't "understand")."
- Use differential reinforcement: If the student gets the aim or a really high score: deliver that item. If the student gets lower than the aim, say "good job, let's try to get --- (8) or let's try to go even faster." And don't give a reinforcer maybe a high five or social praise.
- Evaluate the previous performances to determine the best times for delivery of reinforcement.

Common errors

moving faster than
the student

Don't deliver the S^d
before the student
even imitates the
last action.

Only go as fast as
the student.

Common errors

Using imitations that require taking eyes off the instructor

“Do this”
touch feet

Imitation fluency video

Setting aim

- Imitation fluency aim is 48-72 range.
- If the student hits the aim for 3 days, then increase the timing not the aim. 10 second timing goes to a 15 second timing, then 20 and ends with a 30 second timing. (after the 3 consecutive days of hitting the aim increase to the next time). Keep the aim the same. For the aim, anything 48 responses per minute and higher is sufficient.

When to end program.

- **End program when the student hits the aim for 3 consecutive days with a 3 second timing.**

Sample graph



- Dots: behavior increasing
- X: errors decreasing.

Data collection

- No matter how many times you practice you only convert the best score for the day and graph the best one.
- Conversion to response per minute.
- Example: 9 responses in 10 seconds converts to 9×6 to get the responses per minute.
Conversion for a 15 second timing: responses $\times 4$, 20 second timing: responses $\times 3$, 30 second timing: responses $\times 2$.

articulation through improving sign video

IMITATION:

ECHOIC FLUENCY

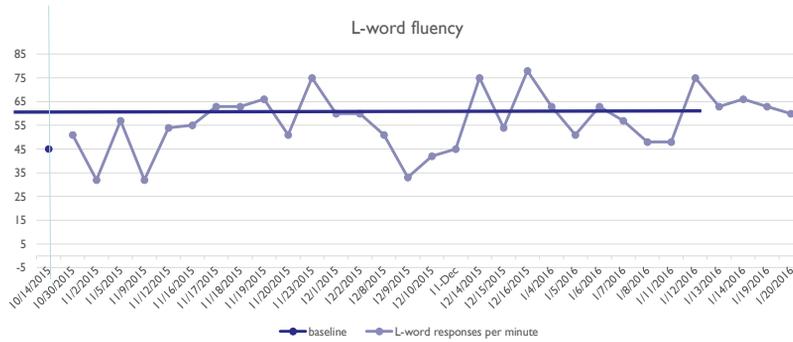
When to consider echoic fluency

- Articulation issues: In speech if the student can emit the sound some of the time but not all of the time.
- As a prerequisite for joint control programming.
 - If student has difficulty such as distractions, memorization issues, generalization issues, prompt dependency/spontaneous behavior problems.
 - Disclaimer: *you must have instructional control with echoics.*

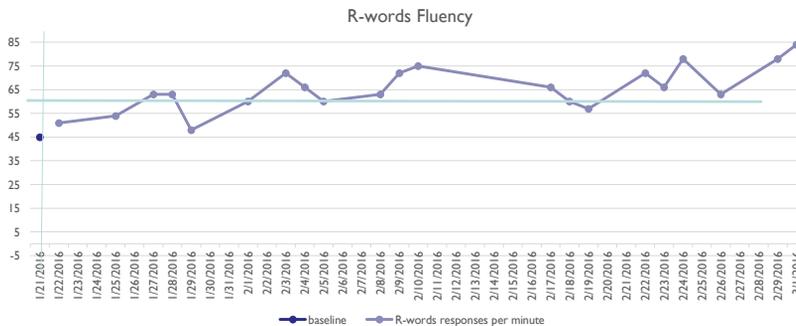
Data example.

- First teach echoic skill in Intensive teaching.
- When have a variety of echoics acquired in IT (50+ per sound).
- **L-Sounds:** baseline 64 L-words tested as echoics. Emitted less than 80% of the time in conversation.
- **R-sounds:** baseline 22 R-words as echoics. 39 R-words taught in Intensive teaching. A total of 61 R-words tested or taught. Emitted less than 80% of the time in conversation.

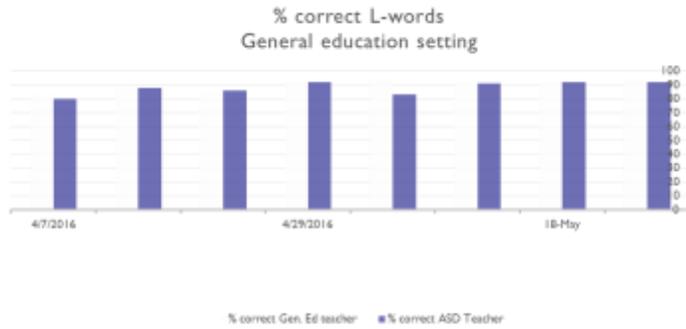
L-word fluency data.



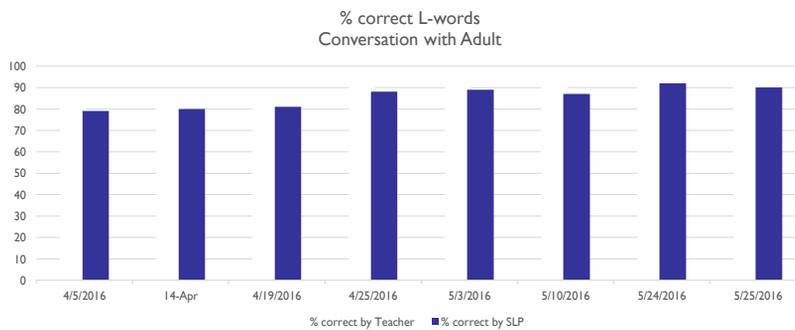
R-word Fluency data.



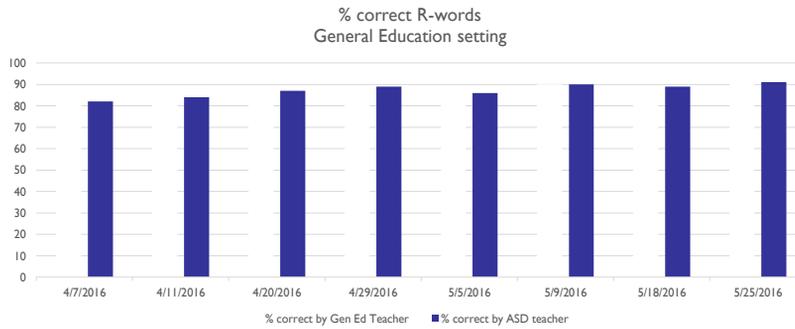
NET data: L-word (in Gen. Ed)



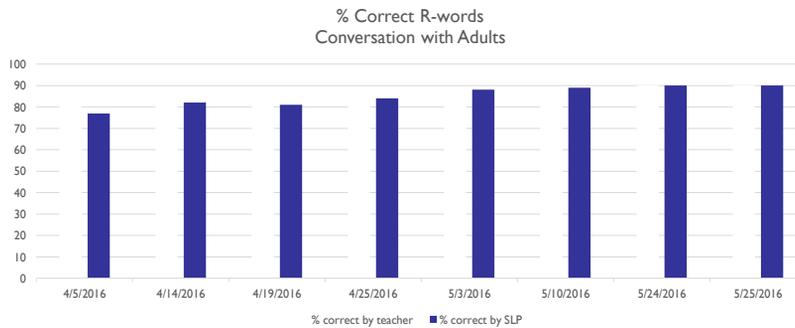
Conversation with an adult: L-words



NET data in Gen. Ed: R-words



Conversation with Adult: R-words



Results

- The student emitted sounds before fluency program in NET conversation less than 80% of the time. His articulation improved after the echoic fluency programs. He was able to emit the sounds more than 80% of the time in NET conversation after fluency instruction.

Results

- Fluency programming increased the rate of responding for the student and his articulation improved in conversation with L-words and R-words.
- The articulation improved at a faster rate in the second program.

LISTENER RESPONDING FLUENCY

Listener Responding

- usually teach tacts and check for this skill as an LR.
- Best to check this skill in Natural environment.
- Only time I have run this as a fluency program is when a student is exceptionally slow to respond it Intensive teaching and articulation is poor so we can't practice tact fluency.
- Or if a student is easily distracted

Carl Binder,
2000.

- Teachers have found that when students achieve fluency in important prerequisite skills and knowledge they do not forget. Instead, more advanced work becomes easier rather than harder and **learning becomes fun** rather than tedious.

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Commonwealth of Pennsylvania

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