

NAC 2016

#ptnmath

**The Language of Mathematics: Teaching
Quantitative Verbal Concepts**

*Jared Campbell
Willow Hozella*

Educational Consultants, PaTTAN Harrisburg



Pennsylvania Training and Technical Assistance Network

PaTTAN on twitter

Jared Campbell
@campbell_PaTTAN

PaTTAN
@pattanupdates

#NAC20

#NAC2016



#ptnmath



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.

3

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.

4

Session Outline

Quantitative verbal concepts begin with the ability to tact quantities and extends across exemplars. This session will introduce participants to fundamental verbal concepts in mathematics such as quantity, “more”, “less”, and “equal”. Participants will be able utilize a skills sequence to teach these concepts.

Objectives

- Participants will extend their understanding of teaching students to Tact items to build students’ conceptual knowledge
- Participants will be able determine apply quantitative concepts across mathematical domains
- Participants will be able to identify multiple exemplars for mathematical concepts

Session Outline

1. ABA Stuff
2. **Concept of Number**
3. **Two-way Quantitative Verbal Concepts**
4. **One-way Quantitative Verbal Concepts**

PaTTAN on twitter

Jared Campbell
@campbell_PaTTAN

#NAC20

#NAC2016



#ptnmath



ABA
Background



Pennsylvania Training and Technical Assistance Network

Pop Quiz!

Math is a
Language.

Teaching each symbol or Teaching the collection

Each Symbol

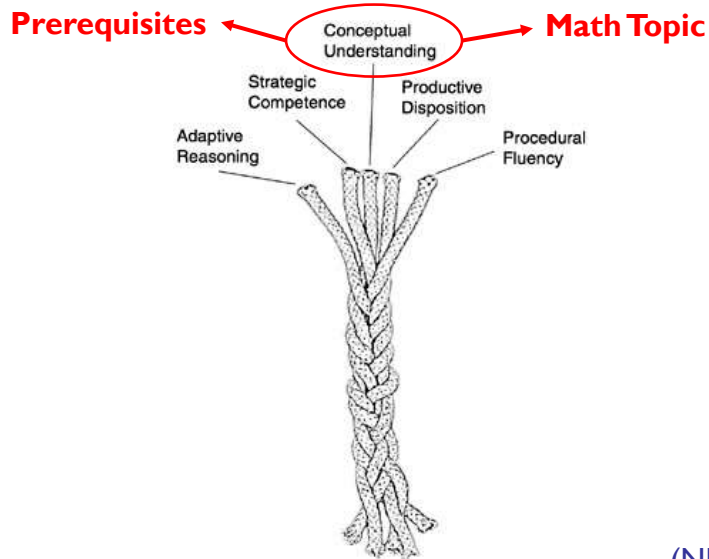
- Name – Meaning – Quantity
- Ability to Subitize

Collection

- Counting
- Magnitude
- Applications

Across Exemplars

5 Strands of Mathematical Proficiency



What is **conceptual understanding**?

Extended Tacts

- Generalization must occur
 - Can apply to novel items without explicit teaching
 - Across...
 1. People
 2. Places
 3. Materials
 4. Instructions
 5. Time
- Feature/Function/Class
 - Tacting critical features may facilitate concept acquisition
- The tact is involved in the process of joint control which assists students in effective verbal recall and effective listener responding

What is **conceptual understanding**?

Atomic Repertoires

- New combination of skills applied to new behaviors
- Most of our spoken language is a result of ARs

What are the prerequisite skills needed for the atomic repertoires for the math content?

- Imitation
- Echoic
- Tacts
- Textual Behavior (reading texts/symbols)
- Transcriptive Behavior (copying text/symbols)
- Etc...

We must identify the skills and outline in a matrix!

13

Textual Behavior...

It is important for students to be able to “read” mathematics.

However, textual behavior is only relevant when students understand the meaning of the words.

OR

Interpreting math symbols is only relevant when they understand their meaning.

14

Quantitative Verbal Concepts

“Language used to describe something that is connected to a value (numerical/spatial)”

“two-way”

more/less
full/empty
wide narrow
most/least

“one-way”

minimum
greater than
volume
area
equality

15

From this point on...

I am going to simplify the ABA Vocabulary so we can focus on the math.

You can still make connection/improvements if you have that level of background.

Early Quantitative Concepts:

The Concept of Number

“What does three really mean?
What is three-ness”



-MM

Pennsylvania Training and Technical Assistance Network

What does “3” really mean?

3 three “three” ● ● ● ● ● ●

“1 ... 2 ... 3!”

“one more than 2”

“one less than 4”

“is between... ”

“is more than... ”

“is the same as... ”

“is less than... ”

3 units




What is Number Sense?

“a child’s fluidity and flexibility with numbers, the sense of what numbers mean, and an ability to perform mental mathematics and to look at the world and make comparisons”

(Gersten & Chard, 1999)

“Concept Matrix”

		<u>Student (behavior)</u>				
		Find digit	Write digit	Write text	Say number	Make pattern
<u>Teacher (antecedent)</u>	Say number	LR	Trans.	Trans.	Echoic	LR
	Show digit	MtS	Trans.	Trans.	IV	MtS
	Show text	MtS	Trans.	Trans.	Text	
	Show pattern	MtS	Trans.	Trans.	Tact	MtS

Teaching each symbol or Teaching the collection

Each Symbol

- Name – Meaning – Quantity
- Ability to Subitize

Collection

- Counting
- Magnitude
- Applications

Across Exemplars

Subitize

The ability to see a quantity and know how many, without “counting.”

Perceptual

and

Conceptual

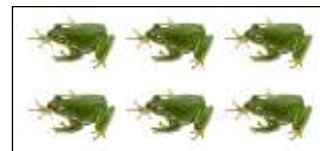
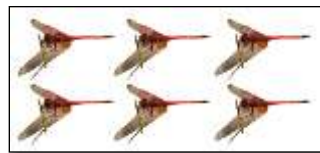
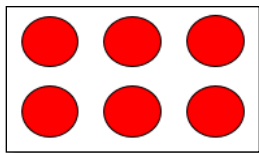
Subitization

Research indicated that dice patterns and rectangular arrays are the easiest for students to learn.

Don't go crazy!

Clements, D. H. (1999). Subitizing: What is it? Why teach it?. *Teaching children mathematics*, 5(7), 400.

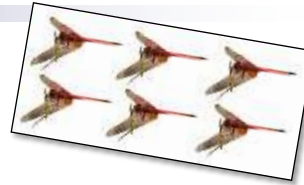
Subitization



Subitization – Tacting a Feature

Verbal Conditional Discrimination must be established.

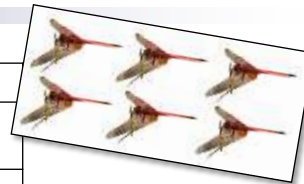
- What is it?
- What part is it?
- How many?



This is complex verbal behavior.

Subitization – Tacting a Feature

Trial	Teacher	Learner
Tact Prompt for Part	Presents item “How many? Six.”	“Six”
Tact Transfer	“How many?”	“Six”
Distractor(s)	?	?
Tact Trial Item	Presents item “What are these?”	“Red-veined Dropwing Dragonflies”
Tact Part Check	Presents item “How many?”	“Six”



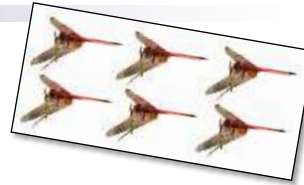
Error Correction – Run a contrast correction as part of the distract trial sequence

Subitization – Data Collection

Skills Tracking Sheet

Skill _____

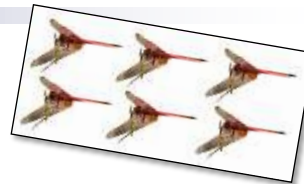
	Target	Date Introduced	Date Mastered
1	One: bus		
2	car		
3	red-velvet strawberry		
4	plane		
5	frog		
6	airplane		
7	Two: bus		
8	car		
9	red-velvet strawberry		
10	plane		
11	frog		
12	airplane		
13	Three: bus		
14	car		
15	red-velvet strawberry		
16	plane		
17	frog		
18	airplane		
19	Four: bus		
20	car		



Subitization – Tacting a Feature

Generalization & discrimination should be present for the items in the set.

The concept of quantity has been developed when the individual can subitize (tact) novel items in a set without explicit training.



What is Number Sense?

“a child’s fluidity and flexibility with numbers, the sense of what numbers mean, and an ability to perform mental mathematics and to look at the world and make comparisons”

(Gersten & Chard, 1999)

Teaching each symbol or Teaching the collection

Each Symbol

- Name – Meaning – Quantity
- Ability to Subitize

Collection

- Counting
- Magnitude
- Applications

Across Exemplars

Stages of Early Arithmetic Learning (SEAL)

Stage 0: Emergent Counting - Cannot count visible items. Either does not know the number words or cannot coordinate the number words with items (one-to-one correspondence).

Stage 1: Perceptual Counting- Can count perceived items but not those in screened collections. This may involve seeing, hearing, or feeling items.

Stage 2: Figurative Counting- Can count the items in a screened collection but counting typically includes what adults might regard as redundant activity. For example, when presented with two screened collections, told how many in each collection and asked how many in all, the child will count from “one” instead of counting on.

Stage 3: Initial Number Sequence- Uses counting-on rather than counting from “one” to solve addition tasks.

Wright, R., Martland, J., Stafford, A., & Stanger, G. (2006). *Teaching Number: Advancing Children's Skills and Strategies*. London: Sage.

Quantitative
Verbal Concepts



Pennsylvania Training and Technical Assistance Network

Quantitative Verbal Concepts (QVC)

“Language used to describe something that is connected to a value (numerical/spatial)”

“two-way”

more/less
full/empty
wide/narrow
most/least
long/short

Lead to...

“one-way”

minimum
greater than
volume
area
equality

33

Two-way QVCs

“Language used to describe something that is connected to a value (numerical/spatial)”

more/less
full/empty
wide/narrow
most/least
long/short

Two-way QVC – Tacting Adjectives

Trial	Teacher	Learner
Tact Trial with echoic prompt	Presents dice patterns of 5 and 2, identical except for attribute. "Let's talk about more and less." Point to 5. "This one is... more."	"More"
Tact Transfer	"This one is..."	"More"
Tact Trial with echoic prompt	Point to 2. "This one is... less."	"Less"
Tact Transfer	"This one is..."	"Less"
Distractor(s)	?	?
Tact Check	Point to 2. "This one is..."	"Less"
Distractor(s)	? (include "How many?")	?
Tact Check	Point to 5. "This one is..."	"More"
Continue with tact checks. Vary tact checks with distractors as shown above. End with the below tact check.		
Tact Check	"What are these?"	"Planes"

Two-way QVC – Data Collection

	Date introduced	Date Mastered
Target: more/less		
Identical Sets:		
Single Digits		
Dice Patterns		
Ten Frames		
2 Novel Identical		
Planes		
Trucks		
Mixed Mastered pairs		
Known with one novel		
NET		
Intraverbal Opposites:		

One-way QVCs

“Language used to describe something that is connected to a value (numerical/spatial)”

minimum
greater than
volume
area
equality

Contact Information

www.pattan.net

Educational Consultants

Jared Campbell jcampbell@pattan.net

Willow Hozella whozella@pattan.net



Commonwealth of Pennsylvania

Tom Wolf, Governor



PaTTAN