The Dyslexia Foundation
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Executive Skills and Reading

Classroom Strategies that Facilitate Executive Functions

Kelly B. Cartwright, Ph.D.
Professor of Psychology, Neuroscience,
& Teacher Preparation
kelly.cartwright@cnu.edu
@KellyBCartwrig1

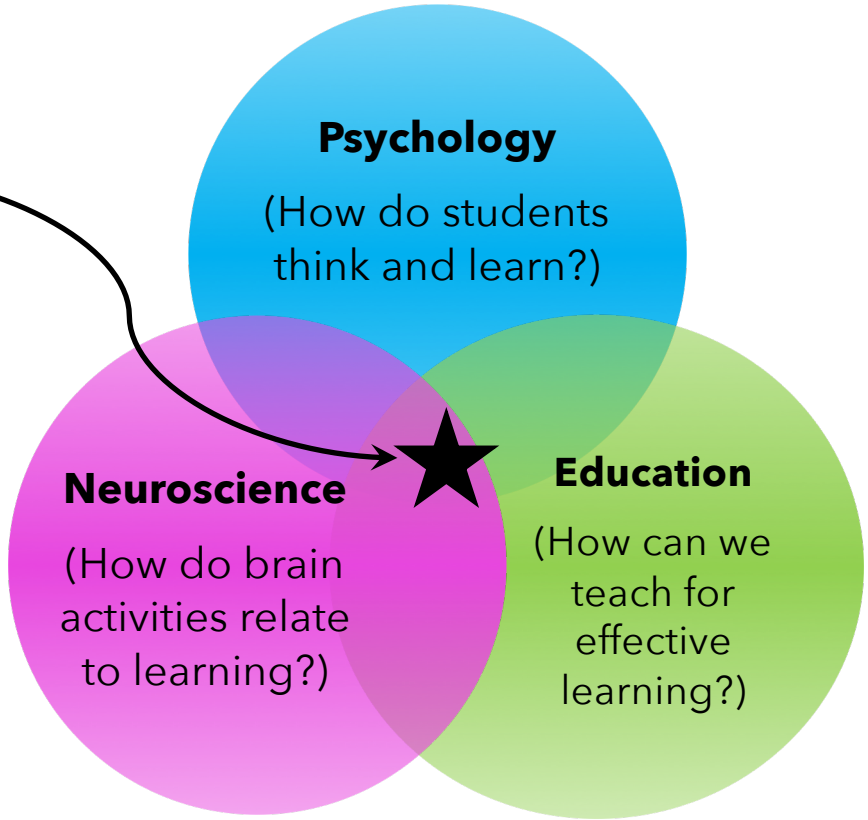
Christopher Newport University

Plan for the afternoon

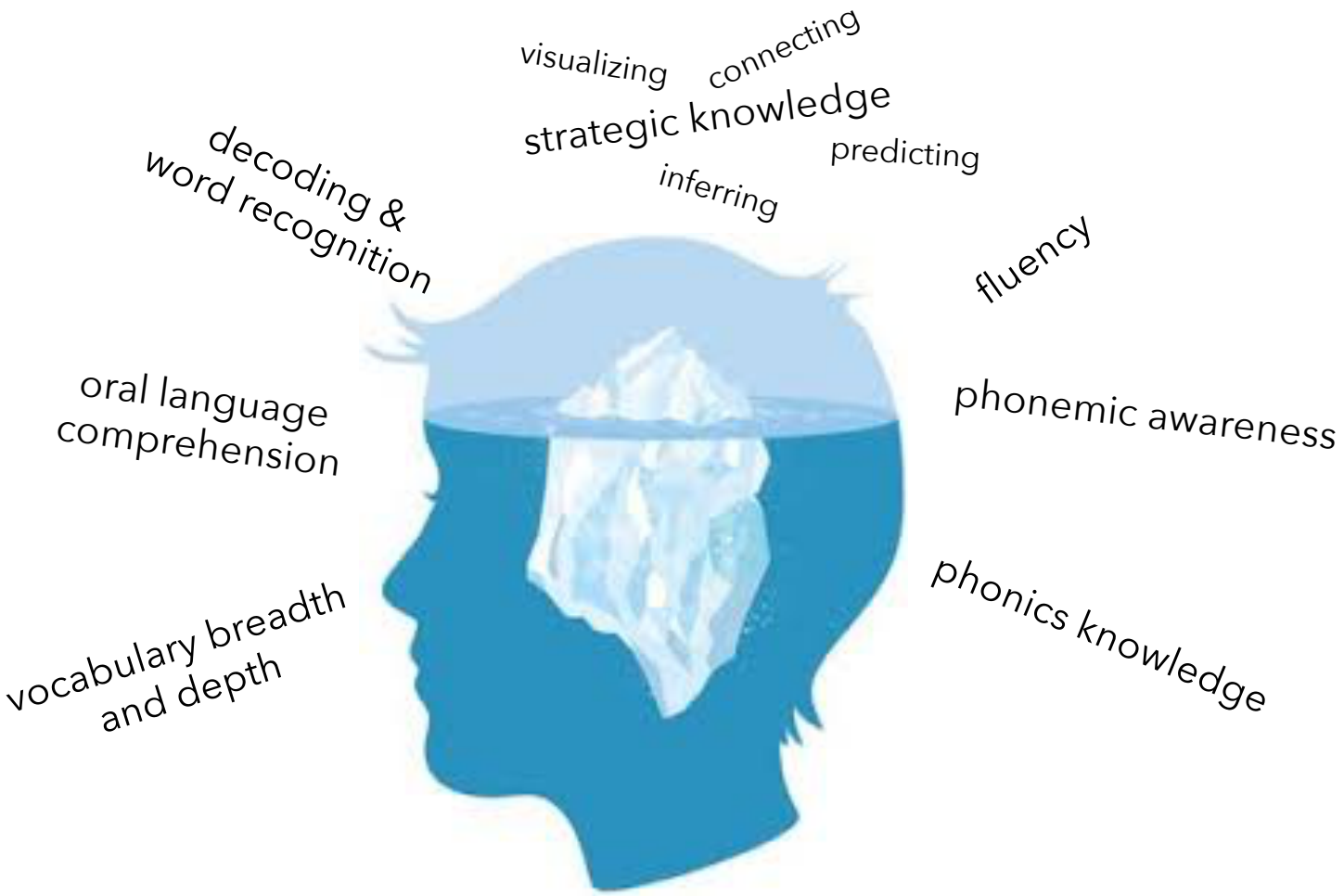
- Background & orientation
- What are executive functions?
- Why are they important?
- How can we teach them to support effective reading?

Working at an intersection…

Today, we are here!



reading is thinking



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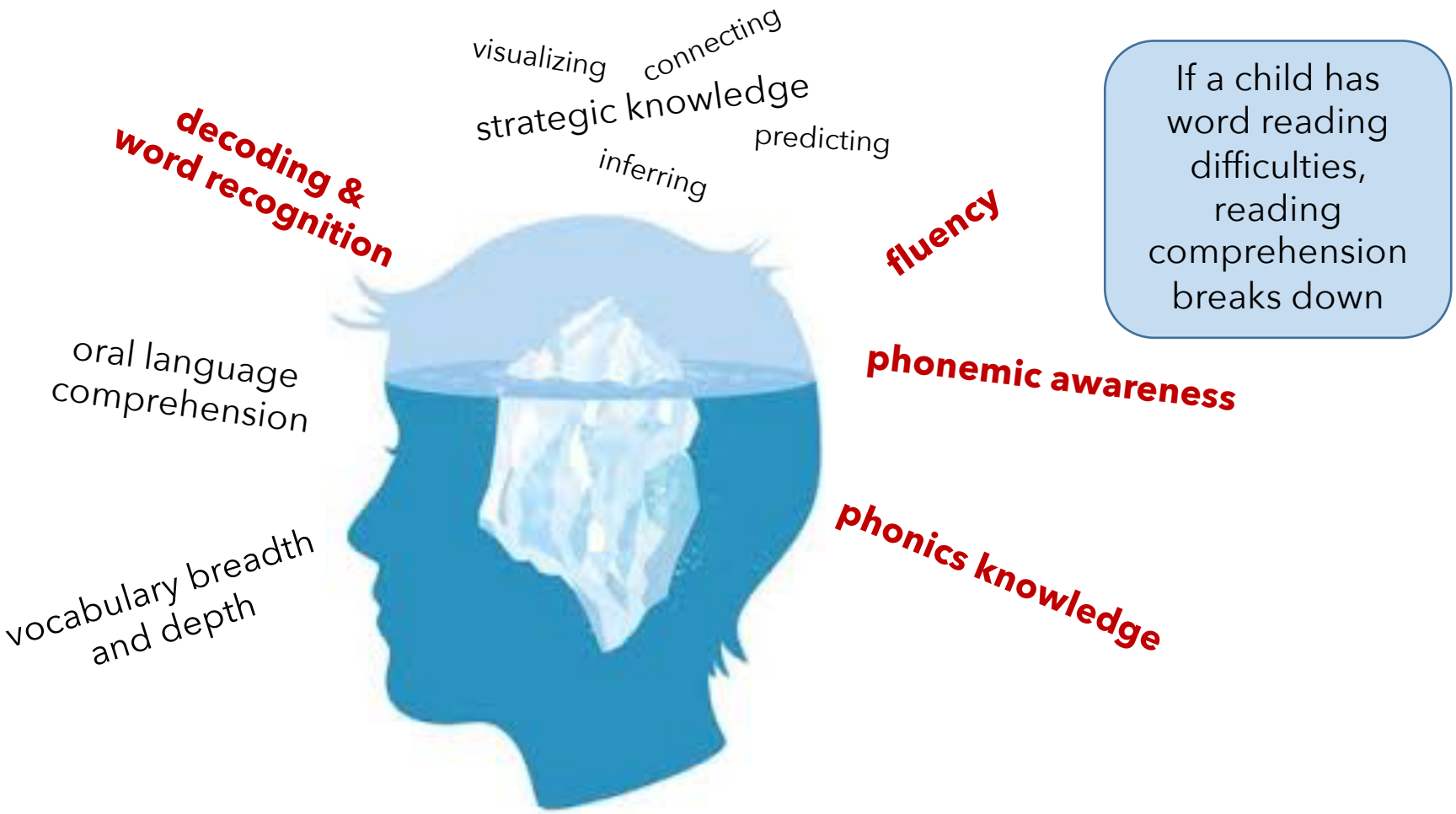
What's the goal?

The only purpose for reading is to comprehend the author's message…

> Yet most of what we know about reading concerns the mechanics of decoding individual words.

(Wagner, Schatschneider, & Phythian-Sence, 2009, xi)



If a child has word reading difficulties, reading comprehension breaks down

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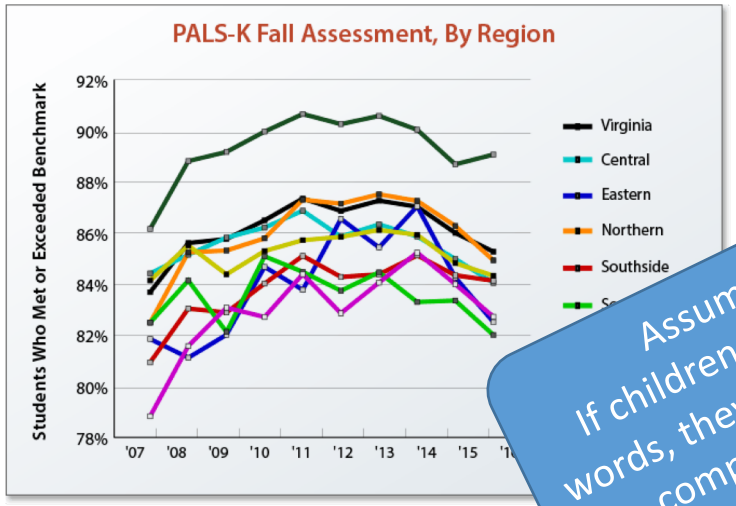
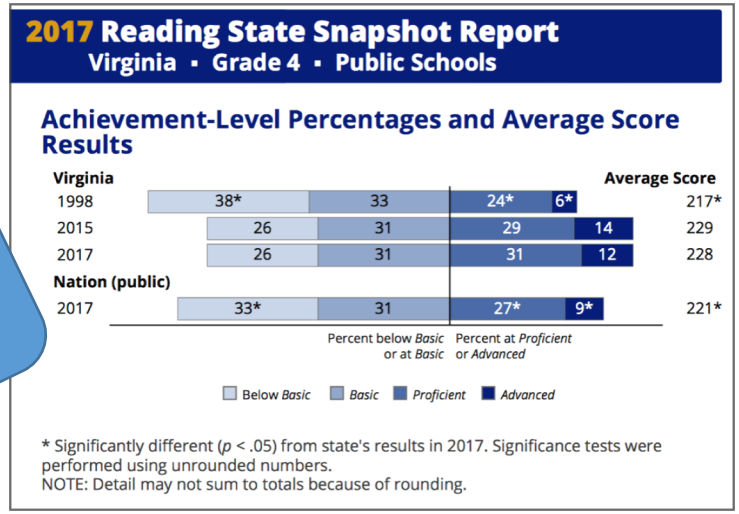
word reading doesn't guarantee reading comprehension

Virginia data as an example



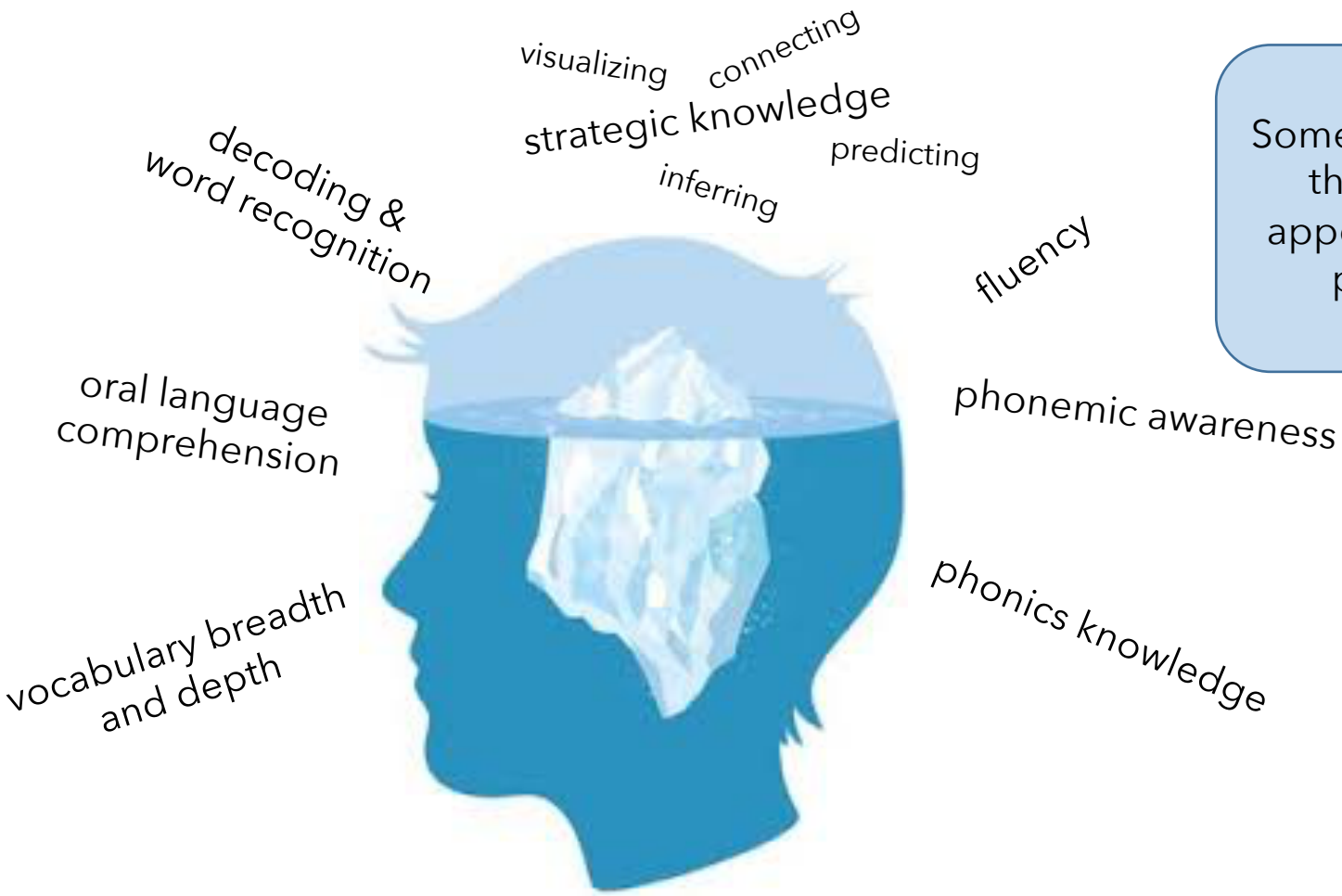
Assumption:
If children can read the words, they WILL be able to comprehend texts.



Virginia Early Intervention Reading Initiative (since 1997) has focused on processes essential to word reading (using the PALS: Phonological Awareness Literacy Screening to identify students who need extra support in grades K-3).

http://vaperforms.virginia.gov/Education_schoolReadiness.cfm

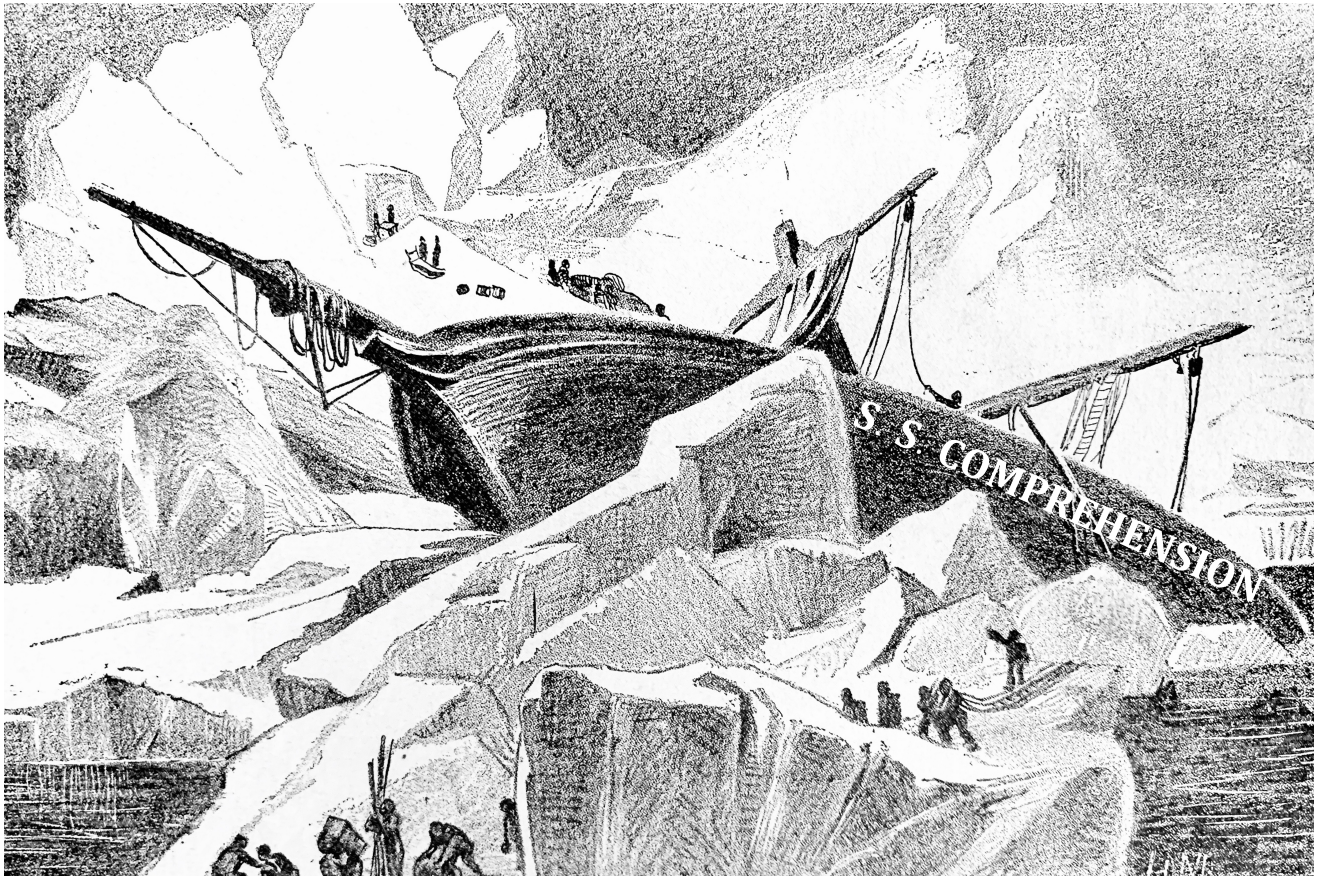
National Assessment of Educational Progress: almost 60% of Virginia 4th graders cannot comprehend text at a proficient level.



Sometimes, all of these skills appear to be in place….

image credit: http://clipart-library.com

BUT, reading comprehension STILL looks like this for some of our students…



"It seems like one of my students has an issue with memory. Even after <u>just</u> reading the text beautifully, it's like he doesn't remember <u>any</u> of it!"
-- Reading Specialist

"You mean I have to know what it **means**, too?!"
-- Intervention Student

meaningless reading*

-- Dolch (1960)

"She's my best reader. She just can't comprehend!"
-- Classroom Teacher (Applegate et al., 2009)

*meaningless reading = specific reading comprehension deficits (**RCD**); "poor comprehenders" or "word callers"

Let's think about these students…

Name	Reading Rate (WCPM)	Word Decoding (Grade Level)	Comprehension (Grade Level)
Benson, Charles	52	2.1	1.3
Carter, Andrew	71	3.5	2.0
Franklin, Megan	73	3.2	3.1
Jones, Sarah	85	4.1	2.4
Lopez, Selma	63	3.1	3.0
Martin, David	91	4.3	4.0

3rd grade students in September; grade-level rate = 71 WCPM

(Hasbrouck & Tindal, 2006)

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executive functions

mental skills we use to manage our thoughts, feelings, & behaviors to achieve goals

IN READING: a critical set of mental skills that enable the management of reading processes toward the end goal of reading comprehension

What are executive functions?

Coming to terms….

- executive skills
- executive functions
- executive functioning skills
- executive control
- executive control processes

What are executive functions*?

mental skills we use to manage our thoughts, feelings, & behaviors to achieve goals

self-regulation

*Umbrella term: includes many skills, core (or basic) & more complex

3 Core (or Basic) Executive Functions*

working memory

- 2 parts: storage & processing
- e.g., remembering directions while carrying them out, holding text meaning in mind while using decoding strategies as you read through a text

cognitive flexibility (shifting, switching)

- switching between ideas or activities; revising goals/plans; shifting
- e.g., transitioning from math to circle time, juggling words' sounds & meaning

inhibition (self control or inhibitory control)

- resisting impulses, controlling behavior, ability to STOP and THINK
- e.g., waiting turn, using words instead of grabbing, ignoring irrelevant word meanings or details, ignoring distractors in the environment while reading;

*underlie more complex executive skills like planning, organization, & monitoring

Why are executive functions important?

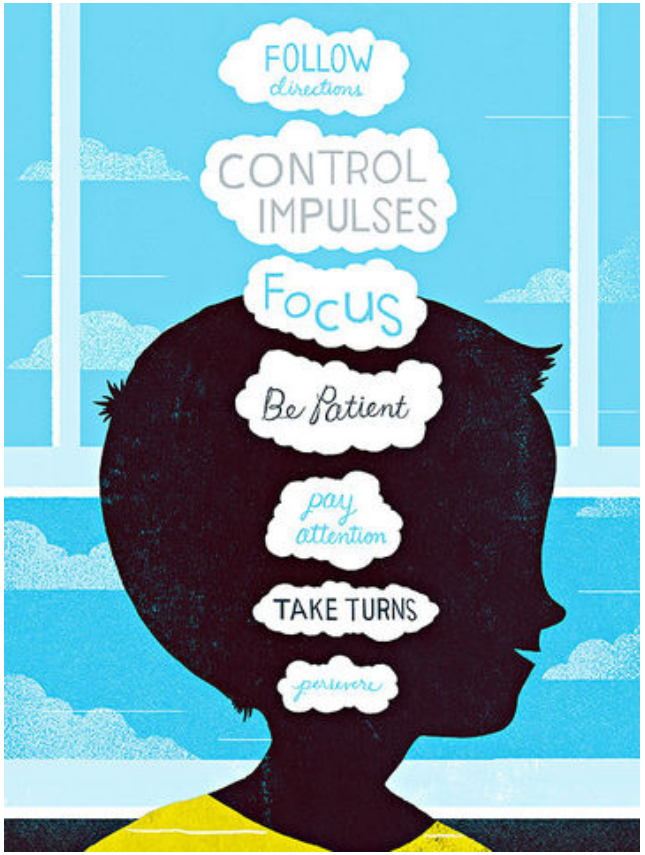


illustration by Christopher Silas Neal for *Parents Magazine*: http://www.parents.com/toddlers-preschoolers/development/executivefunction-skills

- behavior problems and reading difficulties occur together (comorbid) and are both associated with difficulties in executive functioning (Morgan, Farkas, Tufts, & Sperling, 2008)

- children with EF deficits exhibit behavior and reading problems (Pimperton & Nation, 2014)

Preschool executive functions predict…

Growth in emergent literacy, vocabulary, and math across Pre-K (McClelland et al., 2007)

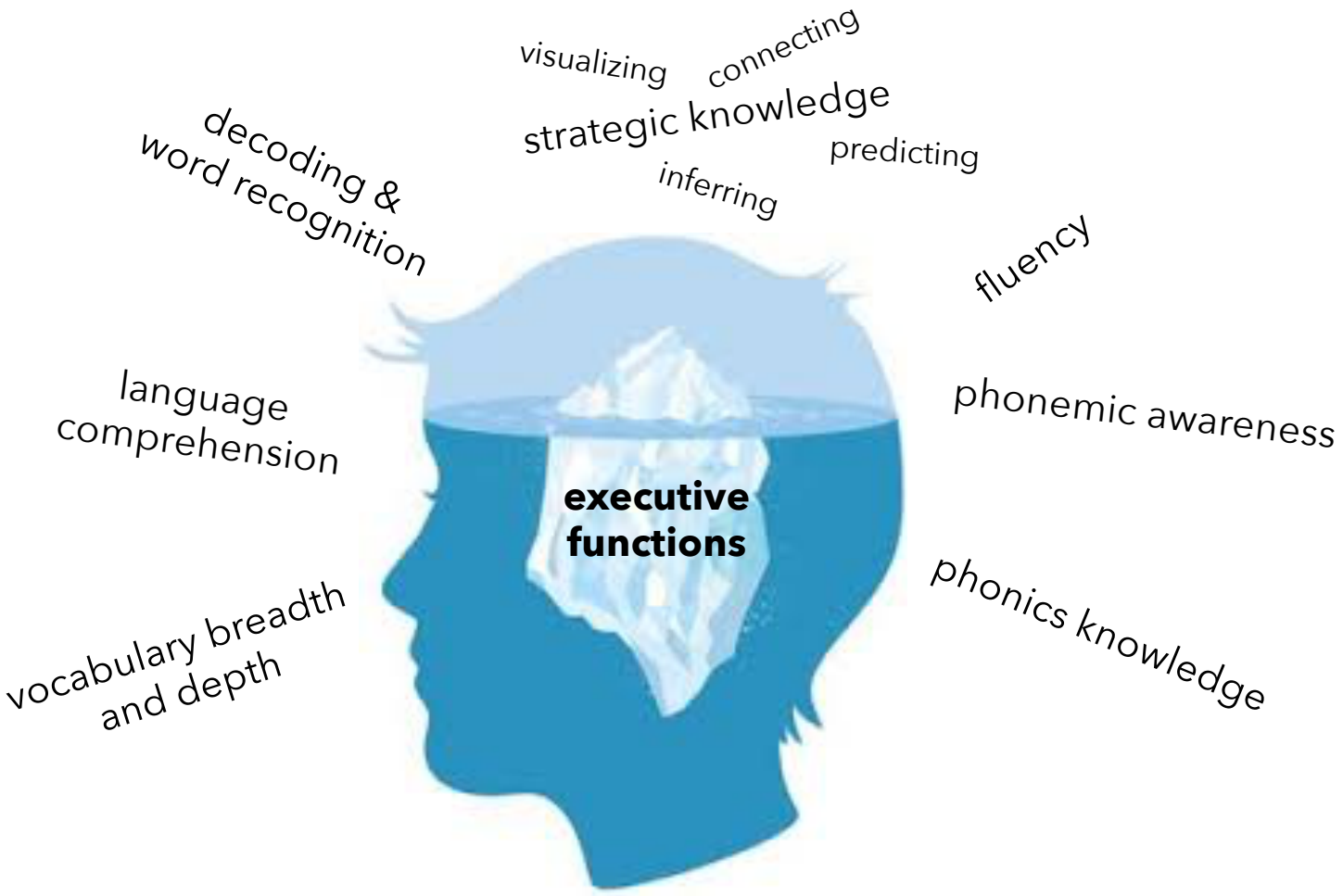
Kindergarten literacy and math skills (Blair & Razza, 2007)

3rd grade reading comprehension (Guajardo & Cartwright, 2016)

Math & reading achievement at age 21 (McClelland et al., 2013)

College completion by age 25 (McClelland et al., 2013)

LIFESPAN ACADEMIC SUCCESS!



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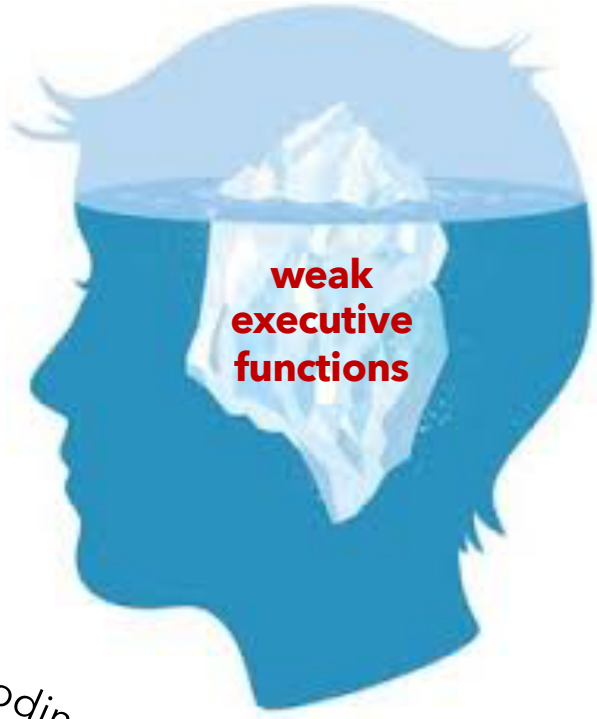


vocabulary breadth and depth

language comprehension

decoding & word recognition

strategic knowledge

predicting

inferring

visualizing

phonics knowledge

connecting

phonemic awareness

fluency

image credit: http://clipart-library.com

Specific executive functions underlie successful reading comprehension…

planning & organization (Cutting, Materek, Cole, Levine, & Mahone, 2009; Locascio, Mahone, Eason, & Cutting, 2010)

working memory (Borella, et al., 2010; Cain, 2006;; Carretti, Cornoldi, De Beni, & Romanó, 2005; De Beni, Palladino, Pazzaglia, & Cornoldi, 1998; Oakhill, Hartt, & Samols, 2005)

cognitive flexibility (Cartwright, Bock et al., 2017; Cartwright, Coppage et al., 2017; Colé et al., 2014; Søndergaard Knudsen et al., 2018)

inhibition (Borella, Carretti, & Pelegrina, 2010; Cain, 2006; Locascio, et al., 2010)

social understanding (Brown, Oram-Cardy, & Johnson, 2013; Cartwright et al., 2017; Guajardo & Cartwright, 2016; **see Zelazo & Carlson, 2012, for a discussion of hot EF skills**)

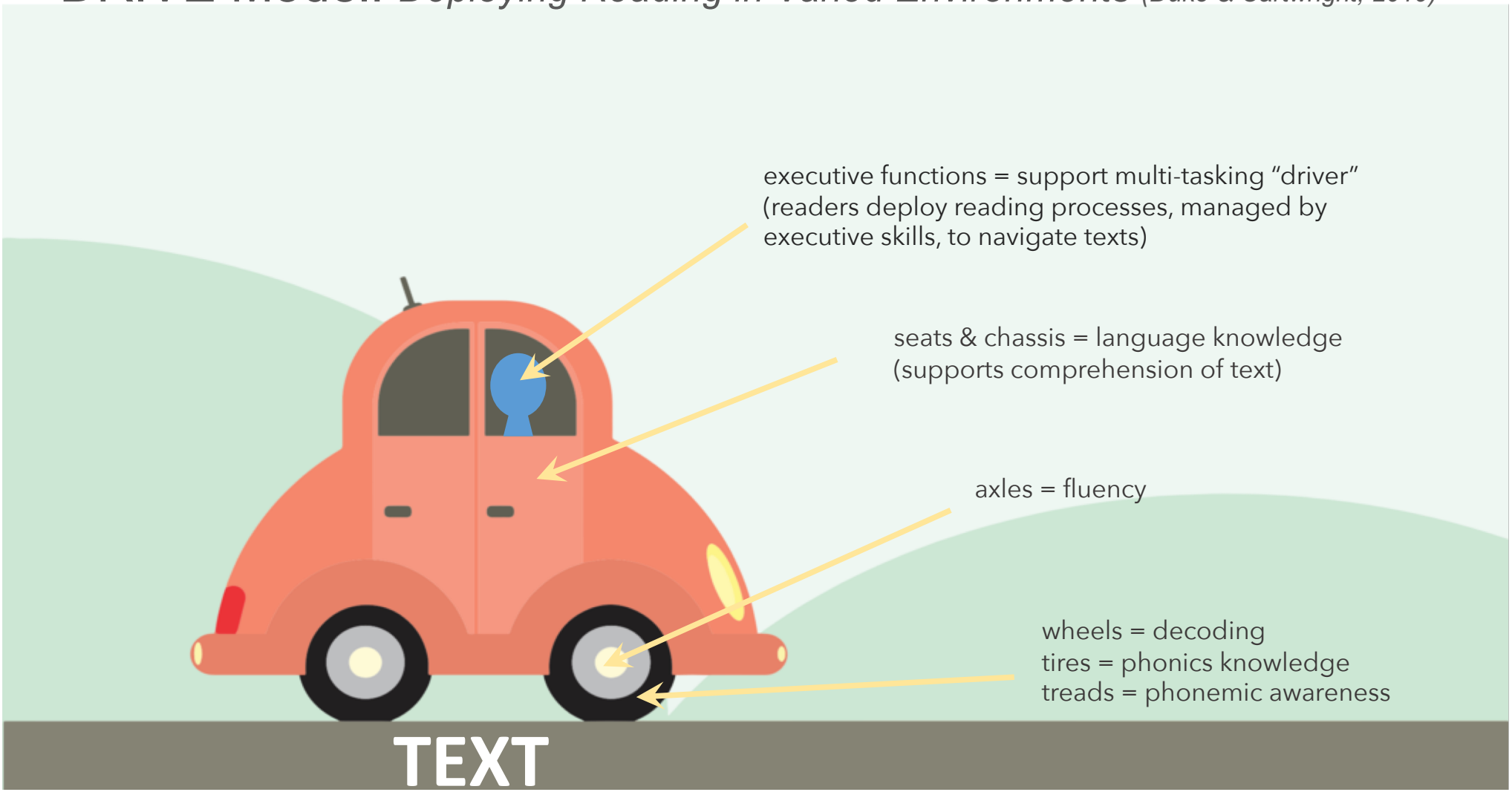
What about word reading?

EF skills are more likely to underlie RCD than WRD (Sesma, Mahone, Levine, Eason, & Cutting, 2009)

BUT, executive functions are related to aspects of word reading

- phonological awareness: cognitive flexibility (Farrar & Ashwell, 2008, 2012)
- phonemic awareness & letter knowledge: inhibition (Blair & Razza, 2007)
- word identification & fluency: cognitive flexibility (Cartwright, Marshall, Huemer, & Payne, in press)
- shifting among orthographic, semantic, syntactic, & phonological aspects of words: cognitive flexibility; Perfetti's lexical quality hypothesis (Clay, 2001; Gaskins 2008, 2011; Perfetti, 2007, LQH)

DRIVE Model: *Deploying Reading in Varied Environments* *(Duke & Cartwright, 2019)*



How can we teach executive functions to support successful reading?

Teaching executive functions…

- Requires that we TALK about THINKING in ways that may be unfamiliar to us
- Goes beyond comprehension strategies & typical think-alouds
- Is also familiar because it brings together many things that we already do!

Teacher Talk Examples:
"Good readers are good thinkers…"

- Good planners: Know why they are reading and make a plan to get there
- Organized thinkers: Know how words, stories, and books are put together and use what they know to help them remember what they read
- Are flexible thinkers: Can think about (and do) lots of things at the same time
- Have good memories: Can keep some things in mind while doing other things
- Are good at ignoring (inhibiting) things that are not important to understanding
- Are good "mind readers": Can think about characters' thoughts and feelings

EXPLICIT!

Introducing the executive functions…

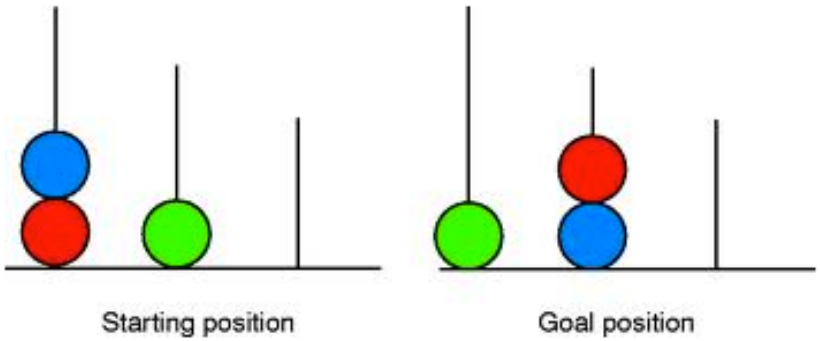
4 points for each:

- definition
- assessment example
- everyday examples, such as in familiar games
- applications to instruction

1. Planning (& Organization)

(ability to implement multi-step tasks, in proper order, to reach a goal)

- Tower of London task: arrange balls or disks on pegs to match a goal (count number of moves, errors, speed)



How many moves would it take you to get these colored balls from the starting position to the goal position, moving only ONE ball at a time?

- Games that require planning: Jenga, Chess, Checkers
- Games that require organization: 20 questions, Apples to Apples

Planning and Reading

- Draws on many things we know good readers do

- Involves goal-setting and teaching students steps they can take to reach their reading goal for a particular text

My Plan to Understand

Good readers are good planners: Know why they are reading and make a plan to get there

My Plan to Understand

First, set a goal: _____ *discuss w/students

THEN ask yourself these questions

- **Preview:** Looking through the book, what do I see to help me get there?
- **Focus:** Should I pay more attention to some parts and slow down for others?
- **Connect:** What do I already know about this topic that will help me reach the goal?
- **Question:** What goal-related question(s) can I ask myself?
- **Predict:** What do I guess will be in this book?
- What other steps can I take to reach my goal?
- What will I know when I'm done?

see Cartwright (2015) for a review

Planning for Students

My Plan to Understand

First ask: Why am I reading? What is my goal?

Then, with my goal in mind . . .

- Preview: Looking through the book, what do I see to help me get there?
- Should I pay more attention to some parts and slow down for others?
- Connect: What do I already know about this topic that will help me reach the goal?
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2. Organization

(Ability to recognize order, impose order, or create systems to manage information or objects)

How many sentences can you make with these words?

book fun a good reading is

Reading a good book is fun.
Reading a fun book is good.
A good reading book is fun.
A fun reading book is good.
A good book reading is fun.
A fun book reading is good.

Similarly, with words….

How many words can you make with these letters?

W B L O E

below
blow
bowl
elbow
bow
lob
low

teaching word study involves teaching spelling patterns = how letters are organized to create words

Organization and Reading

Recognition of organization already in words and texts

- spelling patterns (letter/sound organization)
- syntax (word order)
- text structure (narrative or various informational structures)

Ability to USE a word's organization to decode it; or a text's organization to remember what's in it

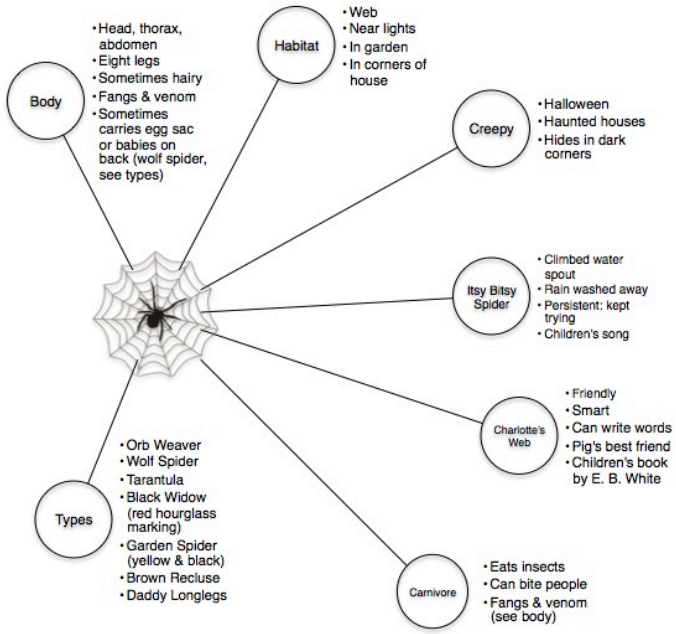
Ability to apply one's own knowledge of organization to words and texts (requires explicit knowledge of organization as a tool)

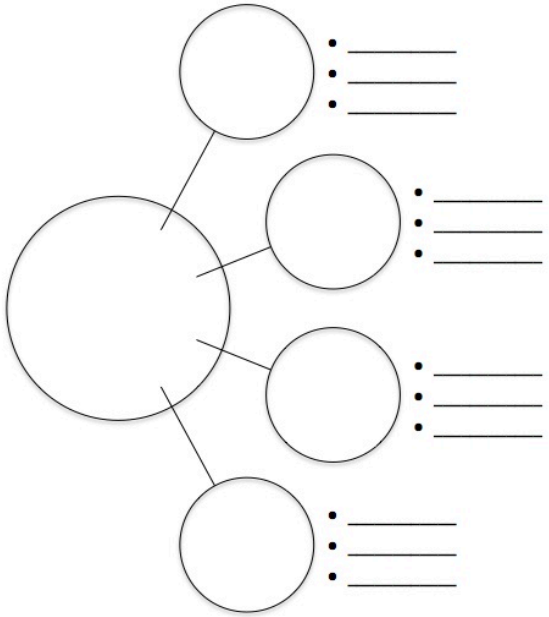
Good readers are organized thinkers: They know how words, stories, and books are put together and use what they know to help them remember what they read

Teaching Conceptual Organization

Concept Maps (organizing information in our heads)

use pre- and post-reading concept maps to assess growth of conceptual organization; have them self-assess!

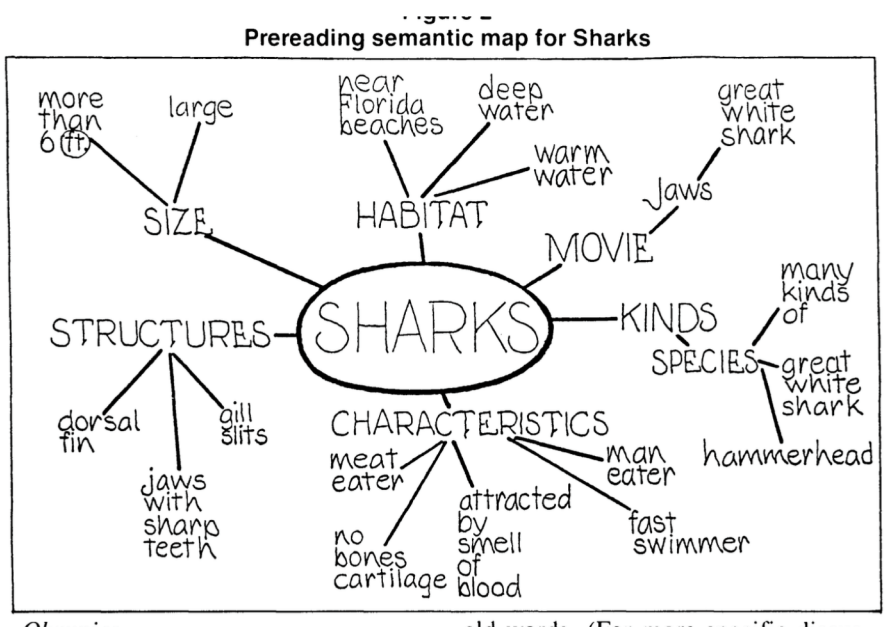


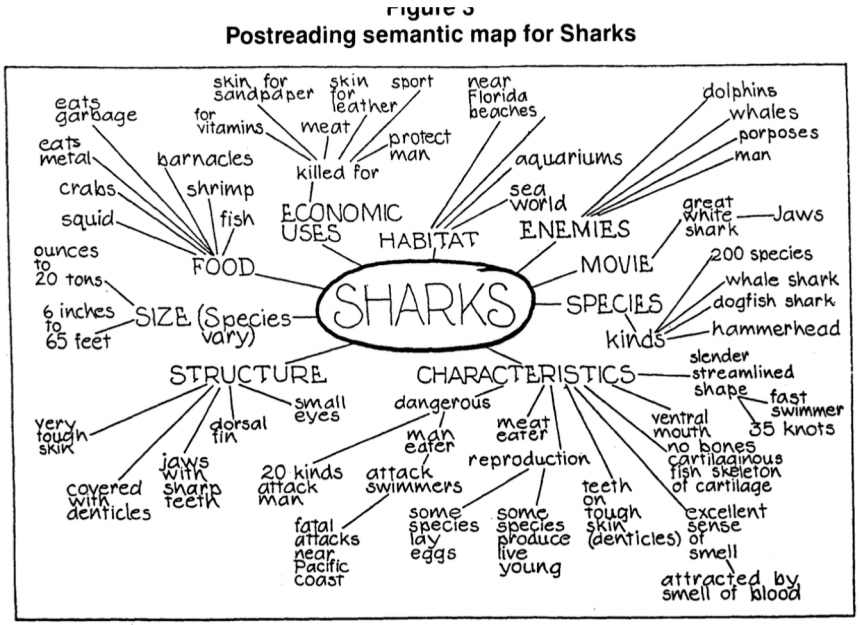


(Chang et al., 2002; Guastello et al., 2000; Oliver, 2009)

Concept Maps (Semantic Maps)

- Pre- and Post-reading Assessment (Johnson et al., 1982)





Teaching Language Organization: Scrambled Sentences

Syntax: the way language is organized to make

Example:

quickly backyard dog the she

You can do the same thing with word anagrams, teaching students to use & recognize spelling patterns

You can begin each day with a sentence anagram (scrambled sentence) on the board to provide practice! Discuss and have them explain reasons for their choices.

Guo et al., 2009; Nation & Snowling, 2000; Shiotsu & Weir, 2007)

Teaching Language Organization: Word Grouping Activity (Weaver, 1979)

quickly backyard dog the she in brushed the

First: Which word is the action word?

Next: Group the rest of the words by answering these questions

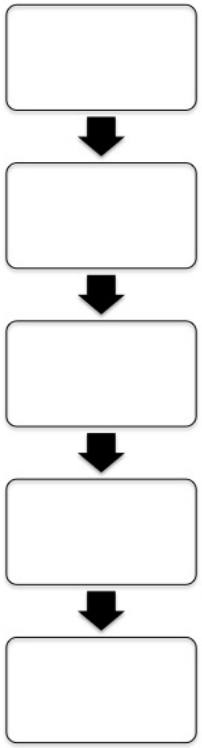
- Who did it? (The answer to this question usually goes before the action word.)
- How did they do it? (The answer to this question usually goes right before the action word)
- To whom or what did they do it? (The answer to this usually goes after the action word.)
- Where did they do it? (The answer to this usually goes at the end of the sentence.)

She quickly brushed the dog in the backyard.

Organization: Causal Connections

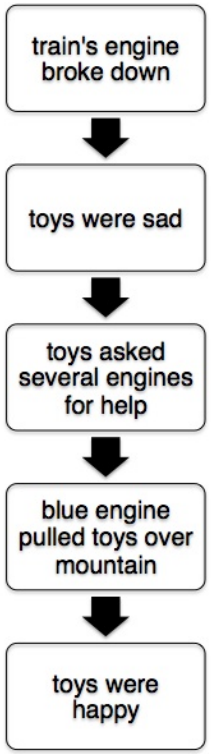
(van den Broek, 1989; Walker, Gopnik, & Ganea, 2014; Wolman, van den Broek, & Lorch, 1997)

In narratives, events are connected because of cause/effect



Think about The Little Engine that Could:

How are events causally connected?



Children with RCD struggle with understanding cause and effect in stories:

their retellings are like a string of unrelated events!

Teaching Organization: Causal Connections in Narratives

Story sequencing (putting pictures in correct order) with verbal explanation for WHY they are connected – keep track of their use of connecting words.

Google "story sequence images" & also use wordless picture books

Students' use of connecting words tells you much about their understanding of causal connections

Teach and Assess Connecting Words:

Independence Between Ideas: and, additionally, now, as well, also, in addition…

Dependence (Connection) Between Ideas: if, but, because, so, so that, in order to, however, in contrast, or else, instead of…

Time Sequence: later, first, next, since, and then, when, before, finally…

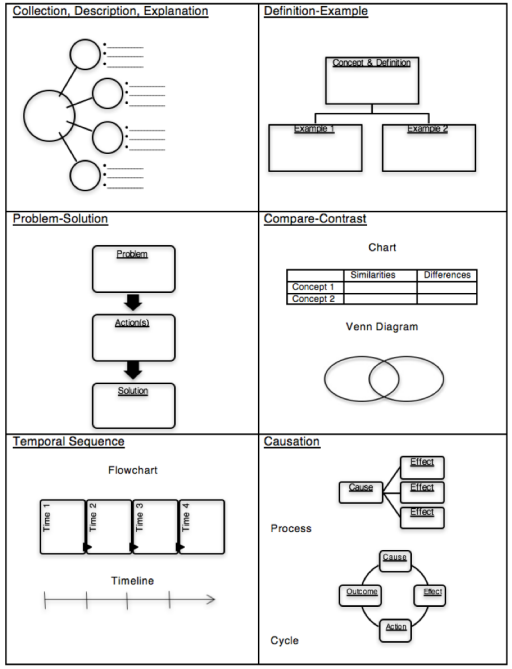
(Cain, 2003; Trabasso et al., 1981)

Teach Informational Text Organization

Teach them explicitly!

- collection, description, explanation
- definition-example
- problem-solution
- compare-contrast
- temporal sequence
- causation (process or cycle)

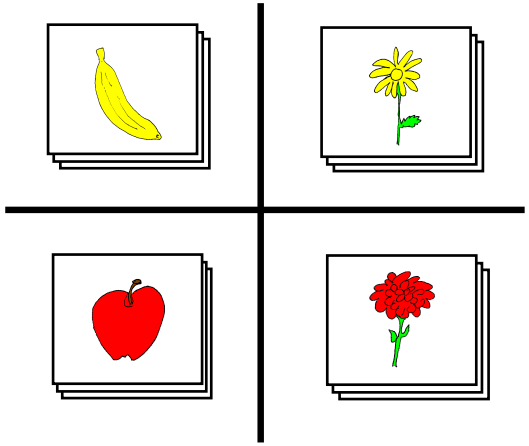
start with one at a time; then, provide multiple texts and have students identify multiple structures (some texts have more than one, too)



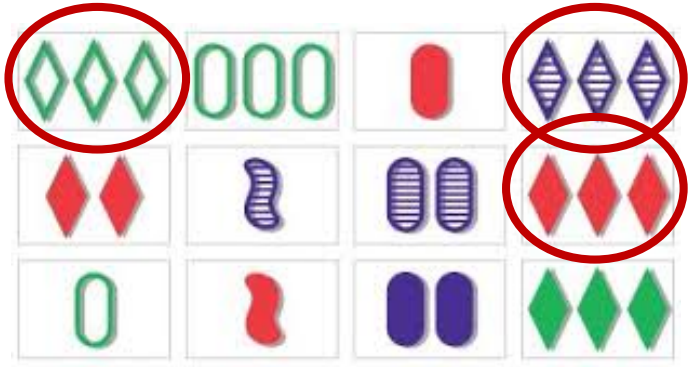
(Reutzel, Read, and Fawson, 2009; Williams, 2003, 2005; Williams et al., 2014)

3. Cognitive Flexibility

(ability to consider multiple bits of info & actively switch between them)



What two ways are these cards sorted?



- Multiple Classification tasks

  sort sets of cards along 2 (or more) dimensions at once; indica consider these dimensions at the same timetes the flexibility with which individuals can

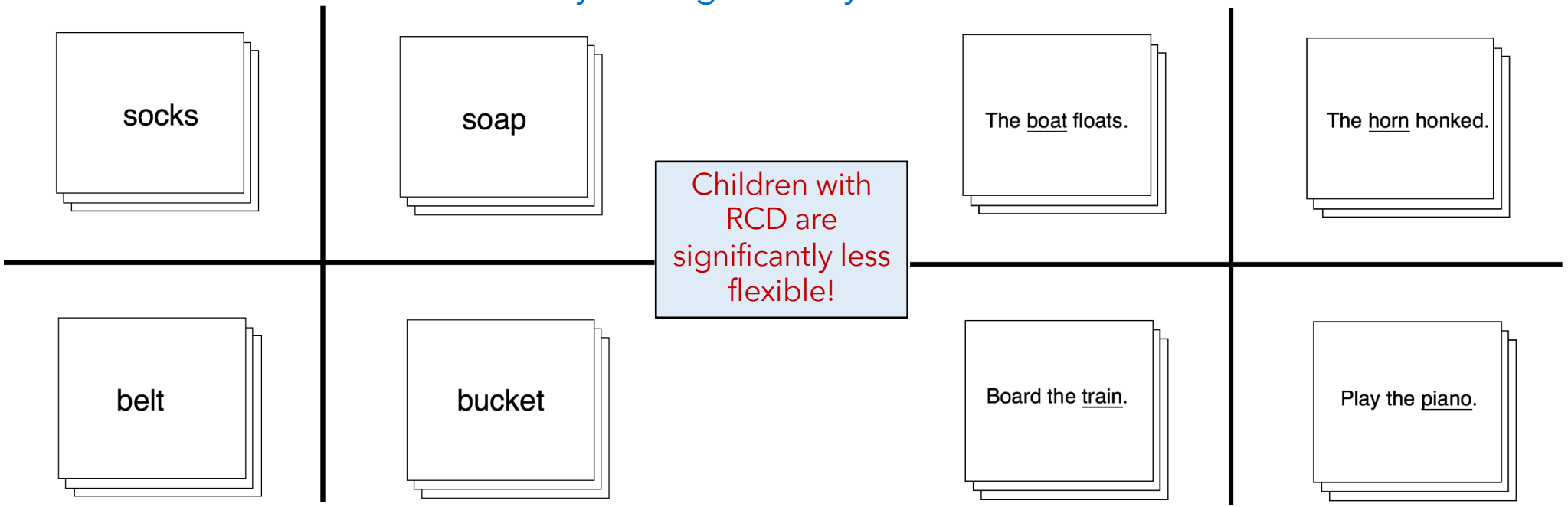
- Games: Set®

- Uno

Cognitive Flexibility and Reading (Cartwright, 2002; Cartwright, Bock et al., 2017; Cartwright, Coppage et al., 2017; Cartwright, Marshall, Dandy & Isaac, 2010)

Good readers are flexible thinkers: They can think about (and do) lots of things at the same time

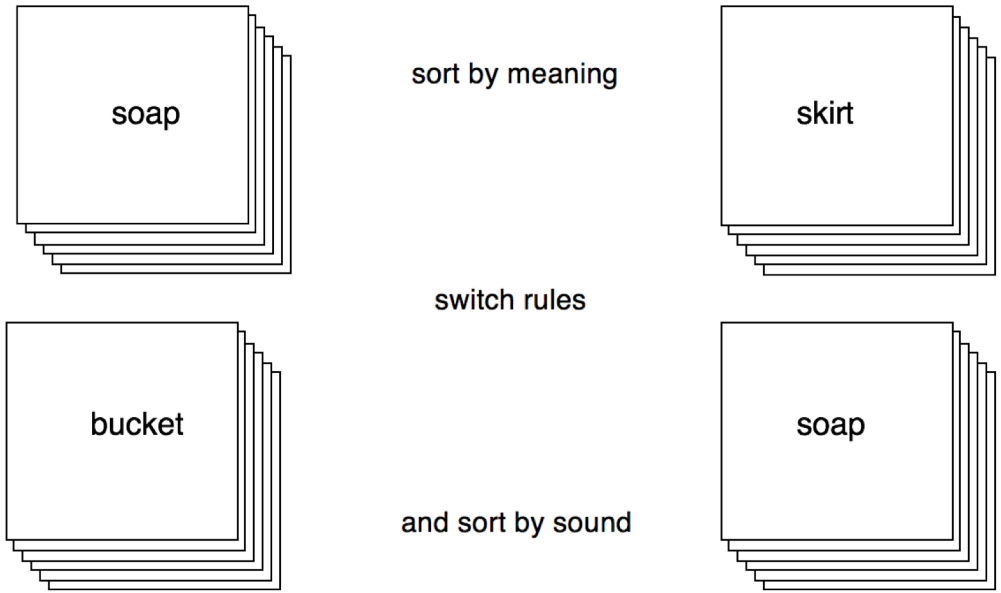
Assess by sorting two ways at the same time



Teaching Cognitive Flexibility

(Cartwright, 2002; Cartwright, Bock, et al., under review; Cartwright, Coppage et al., 2017; Cartwright et al., 2019 in press)

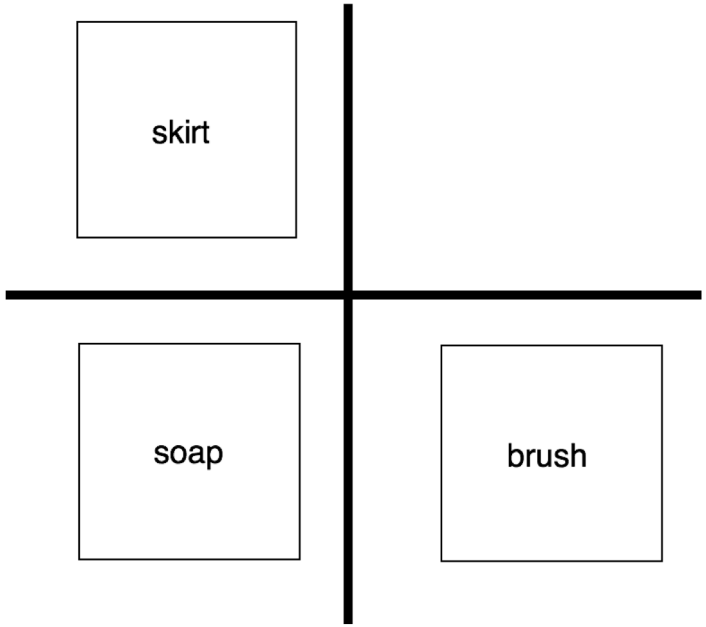
first, single sorts



2 steps with one card set

then, sort completions

(place 3, ask child to complete, then repeat)



(criterion of 4-in-a-row correct)

Teaching Cognitive Flexibility: Multi-feature Questions - sound & meaning

I am thinking of a red food that starts with /b/.

I am thinking of a flower that rhymes with *lazy*.

Tell me a /p/ word that names a kind of food.

4. Working Memory

(storage & processing: ability to hold information in mind while completing a task)

Let's try a sentence completion task…

- light, wheels, bananas

Another assessment: the letters backward task

- "I'm going to say some letters, and you repeat them backwards."
  - Q K becomes K Q
  - Z P N becomes N P Z
  - F T S B becomes B S T F

Games: "Johnny has a _____ in his pocket" & "The name game"

- Pocket Game: Students take turns, add an item each time; alphabetical order; say entire list PLUS their new item on their turn
- Name Ice breaker: Each student says their name and something they like; subsequent students must remember each student, their liked item, AND come up with their own response, adding it to the list

Working Memory and Reading

- Storage AND Processing
- Constructing and remembering text meaning (storage), while ....
  - Decoding the words in text
  - Processing anaphors (e.g., pronoun references)
  - Encountering new ideas in a text & updating
  - Connecting text with prior knowledge
  - Inferring missing bits by connecting text parts or filling gaps
  - Using strategies to monitor/maintain meaning
  - Keeping goal of reading in mind while reading

Good readers have good memories: They can keep some things in mind while doing other things

Teaching Working Memory: Resolving Anaphors

Authors use **shortcuts** when writing. They **substitute shorter words or phrases for longer bits of text**, and we have to figure out what they mean. Requires holding words in mind so you can connect them to later words.

Jim's mother said **he** couldn't have **a pet** because **he** didn't have time to take care of **one**.

(García-Madruga et al., 2013; Oakhill & Yuill, 1986; Yuill & Oakhill, 1988)

Teaching Working Memory: Inferences

It was 8:55, and the school bell rings at 9:00. Andy was pedaling as fast as he could, because he was worried that he might miss his test.

Where was Andy going? (Text-connecting, local coherence inference)

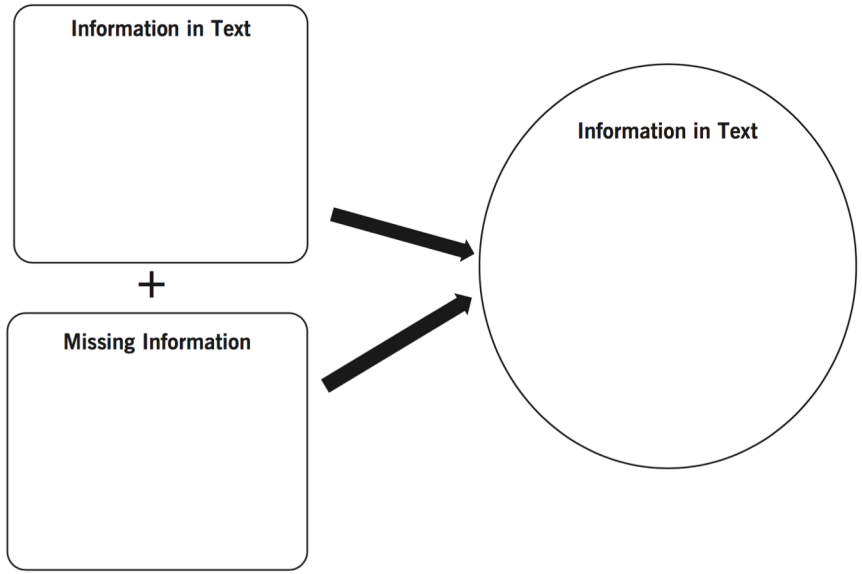
How was Andy getting there? (Gap-filling, global coherence inference)

(Bowyer-Crane & Snowling, 2005; Cain & Oakhill, 1999; Elbro and Buch-Iversen, 2013)

Teaching Working Memory: Inferences

(Elbro & Buch-Iversen, 2013)

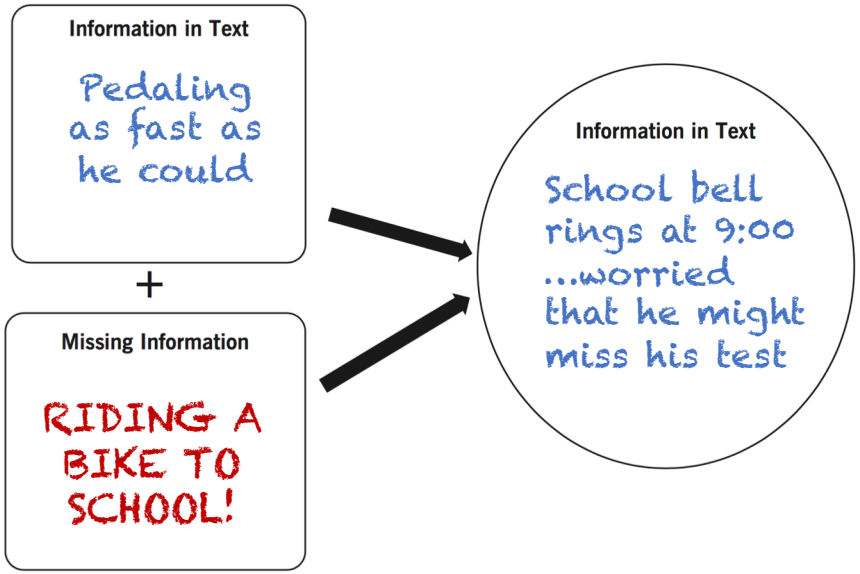
- Some inferences (global coherence, gap-filling) REQUIRE that readers supply information from their own heads
- "Authors expect us to figure some things out, like a detective!"



Teaching Working Memory: Inferences

(Elbro & Buch-Iversen, 2013)

- Some inferences (global coherence, gap-filling) REQUIRE that readers supply information from their own heads
- "Authors expect us to figure some things out, like a detective!"



Let's map our previous inference

5. Inhibition

(ability to wait, stop and think, and restrain habitual, potent responses; self-control)

In adults: color word inhibition (Stroop)

- Name patches of color 
- Read color words **green** **red** **blue** **red**
- Then, name the **ink colors** **green** **blue** **red** **red**

In children: happy/sad task

- When you see a happy face, say "sad"
- When you see a sad face, say "happy"

Games: Simon Says, Taboo (trying NOT to say a target word)

Inhibition Problems

- Calling up irrelevant word meanings (***jam***: traffic jam or edible jam)
- Trouble ignoring irrelevant details
- Reflexively blurting out "stories" that are marginally related to a text
- Trouble ignoring distractions while reading
- Reflexively blurting out the first word that comes to mind with partial letter-sound information ("bring" for "bridge")

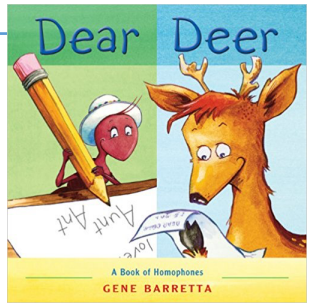
Good readers are good at ignoring (inhibiting) things that are not important to understanding

Teaching Inhibition
Resolving Ambiguous Meanings

(inhibiting incorrect ones, focusing on correct ones; also requires working memory)

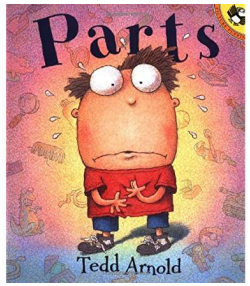
Homonyms and Homophones

e.g., bear/bare, deer/dear,



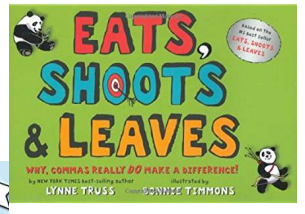
Idioms and Other Figures of Speech

e.g., hold your tongue; *Parts* and *More Parts*,



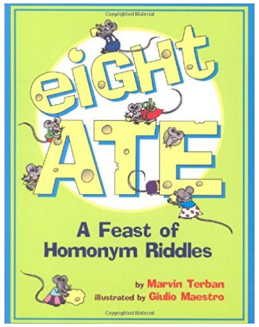
Ambiguous Sentences

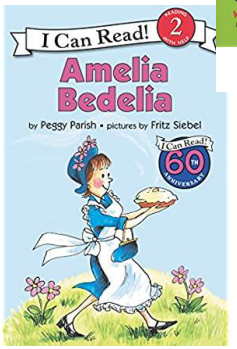
e.g., Let's eat Grandma. vs. Let's eat, Grandma.



Books with Multiple Meanings

e.g., *Amelia Bedelia*, riddles books





(Yuill, 1996, 2008; Zipke, 2008; Zipke, Ehri, & Cairns, 2009)

Teaching Inhibition: Polysemy and Academic Language

- Poly = many; semy = meanings
- Sometimes we expect students to learn (or know) academic meanings for words that also have everyday meanings

readers (and listeners) must inhibit the common meaning and pay attention to the more specialized academic meaning!

"sentence" in language arts vs. math class
"some" (part) vs. "sum" (total)

Common vs. Academic Meanings…

(Logan & Kieffer, 2017)

I scratched my **head** in confusion.

Does *head* mean:

a. cabbage
b. sneaker
c. part of the body
d. leader of a group
e. to go somewhere

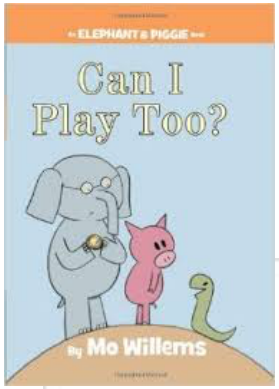
The general is the **head** of the army.

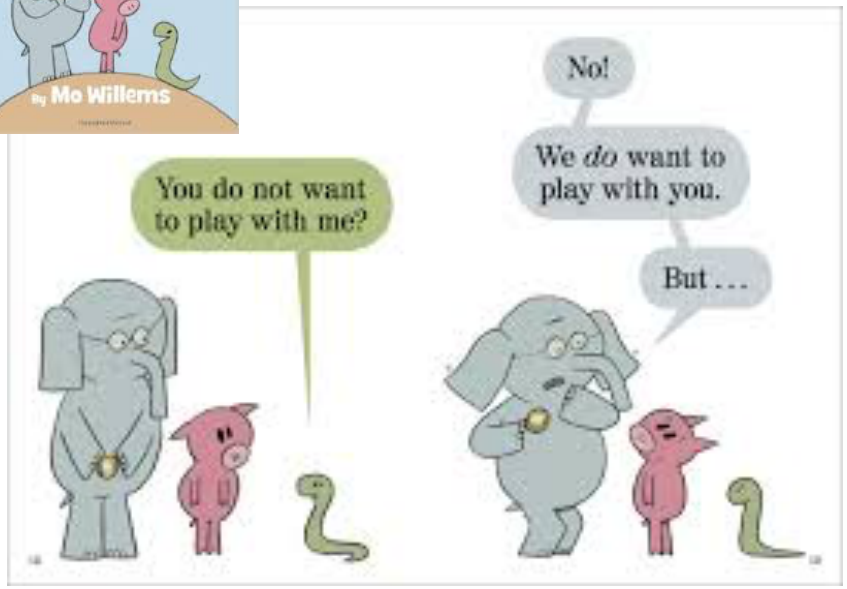
In this case, does *head* mean:

a. cabbage
b. sneaker
c. part of the body
d. leader of a group
e. to go somewhere

6. Social Understanding

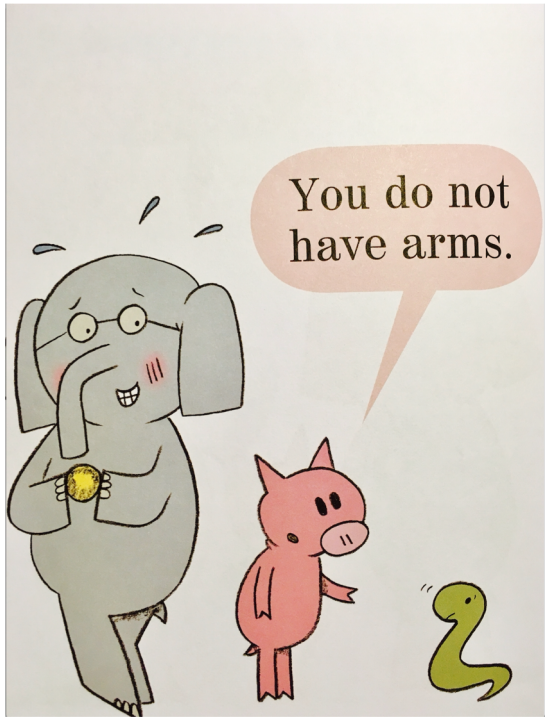
(understanding internal mental states: thoughts, feelings, intentions, beliefs, desires…)

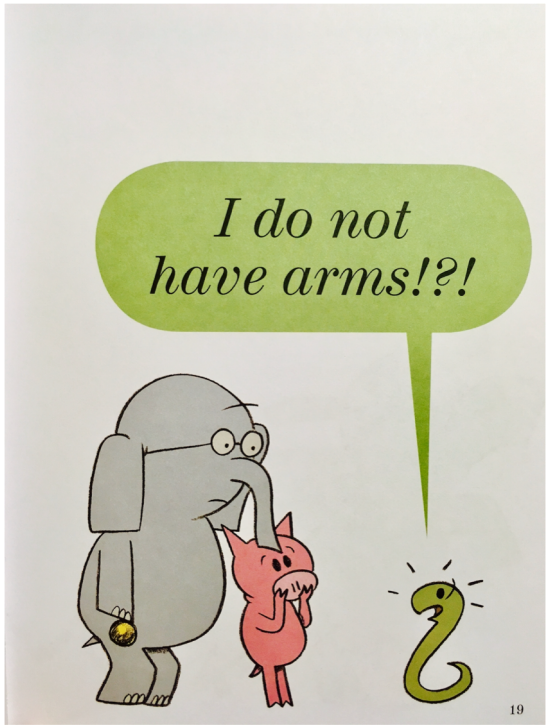




Social Understanding

(understanding internal mental states: thoughts, feelings, intentions, beliefs, desires…)





Teaching Social Understanding

(Carnine, Stevens, Clements, & Kameenui,1982; Guajardo & Cartwright, 2016; Lysaker & Miller, 2002)

- Required to understand WHY characters do what they do
- Supports **social inference-making** – essential for narrative texts and social informational texts (e.g. history and social studies)
- Supports understanding of author's purpose
- Reciprocal: Adults who read more fiction have better social understanding! (Kidd & Castano, 2013)

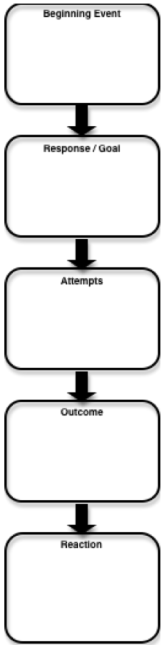
Good readers are good "mind readers": Can think about characters' thoughts and feelings

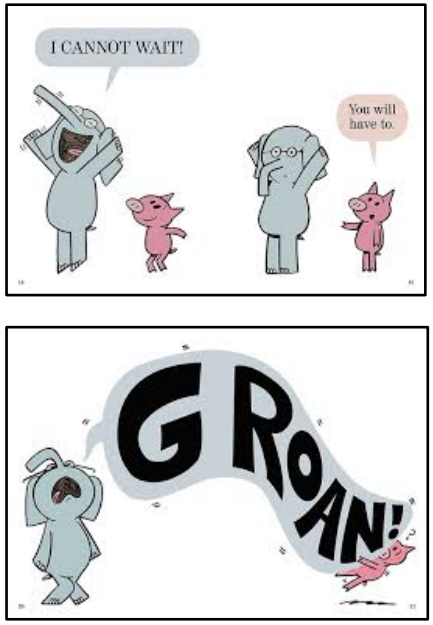
Teaching Social Understanding

(Shanahan & Shanahan, 1997)

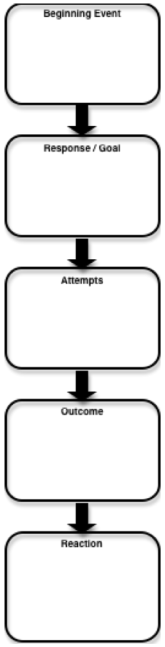
- Mapping stories from multiple perspectives

Gerald's perspective





Waiting is Not Easy – Mo Willems



Piggie's perspective

Teaching Social Understanding

Mental and emotional state vocabulary

- Assess how often these words appear in retellings
- Teach these kinds of words to improve social understanding

cognition (thinking):

believe, bet, dream, figure, forget, guess…

motivation (desires):

desire, hope, like, love, miss, need, want…

emotion (feelings):

afraid, angry, bad, bored, cry, frustrated…

(e.g., Dyer, Shatz, & Wellman, 2000)

Pulling it all together…

(Cartwright, 2015)

"Re-vision – the act of looking back, of seeing with fresh eyes, of entering an old text from a new critical direction."

-- Rich (1972, p. 18)

(familiar reading skills in underlined blue font and executive functions in **BOLD blue font**)

Before reading…

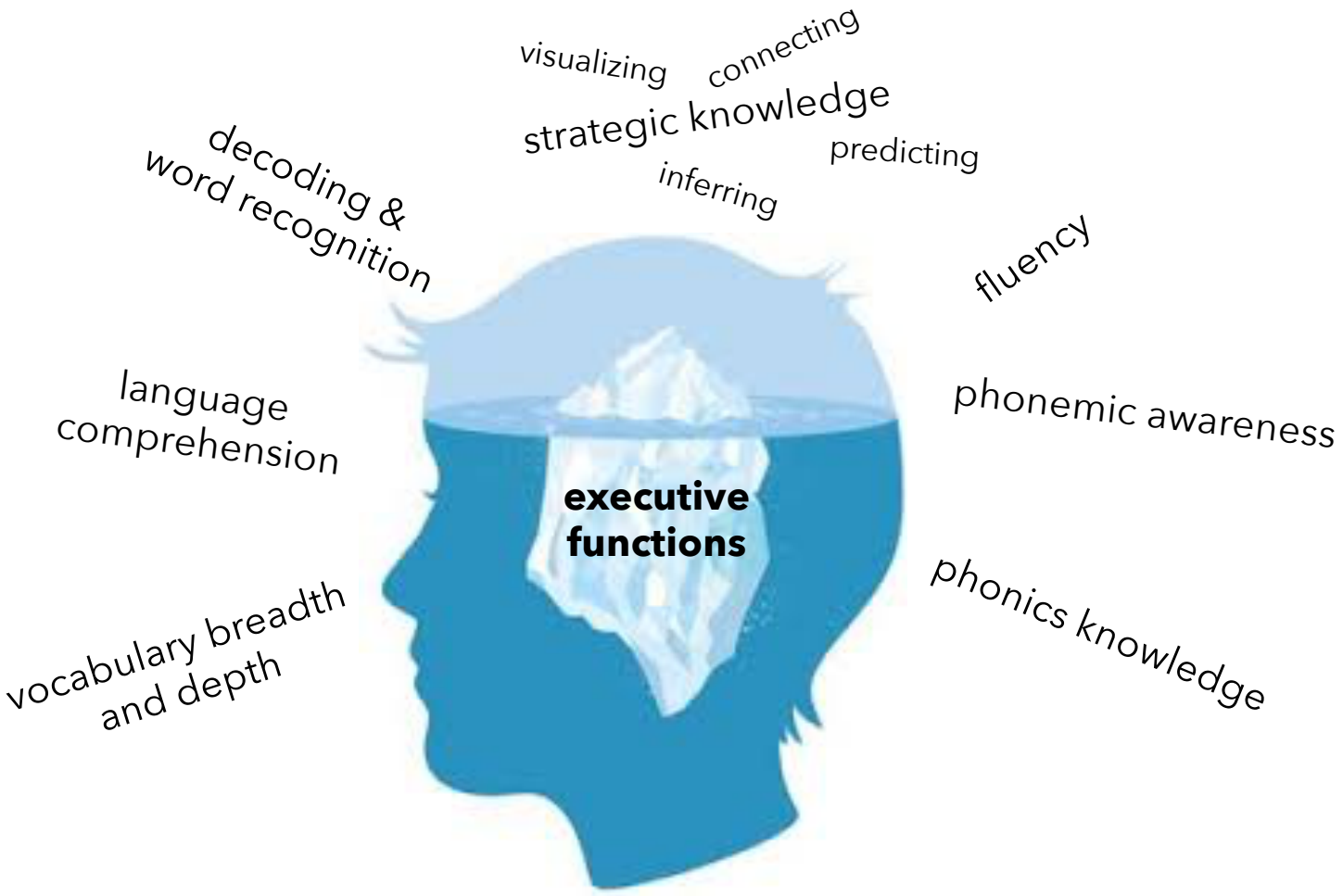
Skilled readers **approach the reading task with a plan** to understand the text for a particular purpose. To prepare to understand a text, they preview the text, making connections to their own prior knowledge about the topic of the text, asking themselves questions about what they might encounter in the text, and making predictions about what they expect to discover as they read. They preview the text's structure, because they are aware that knowledge of text structure will help them **organize incoming information** as they read and support their own construction of a model of the text's meaning in **working memory**. Thus, even when **planning** for comprehension before reading begins, skilled readers display remarkable **cognitive flexibility**, shifting between thoughts of their own prior knowledge, asking questions, making predictions, and previewing text structure, all while **maintaining focus** on their primary goal for understanding the text.

During reading…

Skilled readers build a coherent model of text meaning in **working memory.** To do this, they **flexibly juggle multiple kinds of information** as they read, such as letter sound information, information about text and language **organization**, word meanings, and links to prior knowledge, making gap filling inferences when necessary. They check predictions, visualize events, make text-based inferences, and use **social understanding** to make inferences based on characters' internal mental worlds, while continually monitoring understanding and progress toward their **planned goal**, and **updating their mental model of text meaning in working memory**. They draw on **inhibition** to suppress irrelevant information, ignore distractions, and refrain from engaging in behaviors that undermine reading comprehension. They are able to **manage flexibly** all of these processes while they identify, and **hold in working memory,** the most important features of text that will support comprehension and memory for text content.

After reading…

Skilled readers continue to reflect on text content **in working memory,** connecting the new information they have learned to their existing knowledge structures in ways that capitalize on their existing **conceptual organization**, **flexibly shifting and adjusting** their own knowledge structures as necessary in response to the new information gleaned from text. They also draw conclusions about the questions and predictions that guided their **planning** and processing of the text, and they evaluate the extent to which they were successful in implementing their **plan to reach particular comprehension goals**. These post-reading activities necessarily **recruit working memory** as readers reflect on their summary of text information and **flexibly shift between** thinking about their own prior knowledge, predictions, and questions, revising knowledge structures as necessary, and evaluating the extent to which their comprehension goals were met.



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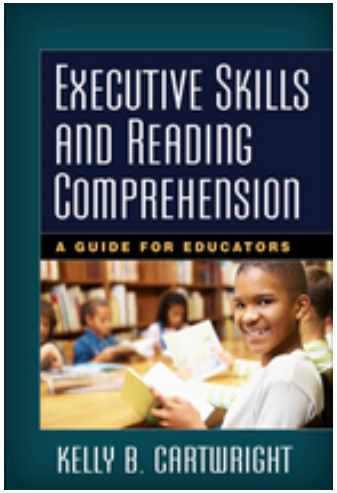

Learn more about executive functions and reading comprehension in this book!

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Thank you! Questions?

email: kelly.cartwright@cnu.edu
Twitter: @KellyBCartwrig1

More Resources – Executive Function 101: https://developingchild.harvard.edu/guide/a-guide-to-executive-function/

For more information, visit: http://www.kellycartwright.com

Learn more about poor comprehenders in this book.