Playful Ways to Improve the Brains’ Executive Functions

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There are many ways we can “scaffold” inhibitory control – i.e., help children succeed despite having weak inhibitory control:
‘Scaffolds’ enable children to function at a higher level than they otherwise could, and to practice skills they otherwise would not be able to practice.
A dad scaffolding his daughter to help her walk across a log high above a stream. With dad holding on, she’s able to walk across the log.
Inhibition can be critical in helping students to wait before speaking or acting so that they think before they act instead of impulsively reacting, and so that they resist the temptation to answer quickly, instead taking the time they need.
Young children are often capable of responding correctly -- if some way can be found to cause them to delay responding for just a few moments.
THE DAY-NIGHT TASK
(Gerstadt, Hong, & Diamond, 1994)

Semantically conflicting labels

“Day”

“Night”

Requires holding 2 rules in mind, and inhibiting saying what the images really represent, saying the opposite instead.
DITTY

Experimenter sings a little ditty ♫ think about the answer, don’t tell me ♫ before the child responds.

Imposes time between presentation of stimulus and response to make children take the time they need to ‘compute’ the answer
Percentage of Correct Responses by 4-Year-Old Children on the Song and Standard Conditions of the Day-Night Task

- **Song**: 89%
- **Standard**: 56%

Chance: ~90%
See VIDEO at:
www.devcogneuro.com/videos/daynight3.mov
In the PATHS program, children are taught that when they get upset they should stop and hold themselves tightly with arms crossed (like a Turtle gets into its shell) and take a deep breath. This is brilliant. It imposes a short waiting period AND during that period it has children do things that reduce arousal & help them to calm down.
Get rid of mirror-reversal writing without fuss or tears. Leave a card showing a 6 drawn correctly for the child, and instruct the child that in doing his/her math today, every time he’s to write a 6 put down his pencil and pick up a red pencil (thereby imposing a delay). After 1 or 2 days of this, the mirror-reversal writing of the number 6 will be gone.
Young children are often capable of responding correctly -- if some way can be found to cause them to delay responding for just a few moments.

Having them delay responding scaffolds their elementary inhibitory abilities because by the time they can respond less inhibition is needed since their first impulse has now had time to begin to fade.
Traditional games like:

Simon Says
Mother, may I?
Red Light, Green Light
Races with a spoon carrying an egg or water
Montessori programs intentionally have only one of any material so that children learn patience.
Challenge children’s Working Memory so it improves (e.g., w/ Storytelling). EFs need to be continually challenged to see improvements - not just used, but challenged.
I’m a huge fan of Storytelling
Storytelling requires and invites a child’s rapt attention for extended periods (sustained, focused attention), and **working memory** to hold in mind all that’s happened so far, different characters’ identities, story details and to relate that to the new info being revealed – without visual aids (like pictures on the page!)

A researcher (Gallets, 2005) randomly assigned children in Kindergarten & Grade 1 to storytelling or story-reading -- 2x a week for 12 weeks.

Vocabulary and recall improved more in the children assigned to STORYTELLING than in children assigned to story-reading.
The more interaction, the more conversation between someone relating a story (thru reading or storytelling) & the children, the more actively engaged the children are, the more their vocabulary improves.
The conversation that takes place in the context of reading seems to have more benefit than the reading itself.


Maybe one reason is that when you are reading to, or with, a child you are looking down at the page at least part of the time.

But when you are telling a story you are looking directly at the children & interacting more.
You probably think, “Oh what a wonderful scene!”
I would like to suggest that young children also need this: STORYTELLING - where only the teller sees the pages in the book.

Without the visual aids of pictures, puppets, or video, children need to work harder to sustain their attention and to remember details of the story like who’s who in the story.

Note: You do not need to memorize the story. You can look at the book & then look up, but do not show the pictures in the book to the children (at least not until the story is over).
Can bring in Elders from Native Communities, can bring in retirees from all communities, to tell stories to the children, to talk with them.
While Story-reading is wonderful, I predict that Storytelling should improve attention and working memory more because it taxes them more.
You may think that children need basic literacy skills to be ready for school.

They don’t.
Children need basic language skills to be ready for school.
Oral language is the foundation of early literacy (Paris & Paris, 2003; Kirkland and Patterson, 2005; Kendeou et al., 2009).

Young children need to be exposed to A LOT of RICH ORAL LANGUAGE.
The difference in the number of words that middle-income & low-income children HEAR in the first 3 years of life is HUGE (25 million words).
By 3 years of age, children whose parents are professionals know more than twice as many words as children whose parents are living near the poverty line.
Vocabulary assessed at age 3 strongly predicts reading comprehension at 9-10 years of age.

Over the course of evolution our brains became adapted to acquire oral language. We are biologically predisposed to acquire oral language.

But reading is too new; we have no biological predisposition for that.
Some children can easily learn to read at an early age. But critically, for others it is beyond their ability at that young age.

We don’t want children thinking they are failures.

We want children to LOVE learning & enjoy school, not to feel that they can’t learn & hate school.
It’s MORE important that children don’t think they’re dumb and can’t succeed, or come to hate school, than it is for them to start reading at an early age.
AVOID children having failure experiences.

Hold off on requiring that 4, 5, or 6 year olds be able to read.
Finland -- Children don’t start school or begin to learn to read until they are 7. Yet Finnish children score the best of any children in the whole world on PISA standardized tests given to 4th grade students worldwide.
And, those who could have easily learned to read early, will make up completely for any lost time when reading is introduced, precisely because it comes more easily to them.

Ex.: Finland -- They don’t have children start school or begin to learn to read until they are 7. Finnish children score the best of any children in the entire world in PISA testing.
Very often what produces the best short-term outcomes is different from what produces the best long-term outcomes.

Rosenbaum et al., 2001; many papers by Robert Bjork’s lab 2007-2012.
For example, high-stakes standardized exams produce poorer long-term learning. Teachers told to insure that their students perform well on a high-stakes exam end up having students who perform worse in the long run than teachers given the mandate to facilitate student learning.

(Flink, Boggiano, & Barrett, 1990; Flink et al., 1992)
Children drilled in reading in K will test better on reading at the end of K than children steeped in oral language in K (who haven’t received the same instruction in reading),
but I predict that by the end of 2nd grade, those steeped in oral language in K will be the better readers.
Do **NOT** push academics in preschool or kindergarten.

Do **NOT** push Literacy in preschool or kindergarten.
A fun game for practicing and improving Working Memory
When you see a circle, do this: (Hold your hands up)
What should you do when you see this?
When you see a square, do this: (Hold your arms out with your palms up)
What should you do when you see this?
What should you do when you see this?
When you see a triangle, do this: (Put your hand to your chest in a fist.)
What should you do when you see this?
and this?
and this?
and this?
GREAT! Now you are ready to play for real.
Make the movement that goes with shape the arrow is pointing to.
You can add demands on Inhibitory Control and Cognitive Flexibility by:
Changing the mappings, for example:
When you see a circle:
clap your hands once
When you see a square, do this:

(Put one hand in front of you, with the palm facing up; make a fist with your other hand and place it on the palm with the pinky down and thumb on top.)
When you see a triangle, do this: (Salute)
Now you’re ready to play for real.
Make the movement that goes with shape the arrow is pointing to.
An example of how to help children with fragile Working Memory:
Buddy Reading

a scaffold
Teacher explains, “Ears don’t talk; ears listen”
Buddy Reading
Non-verbal signs and symbols aid comprehension and memory.
Working Memory & just holding information in mind (Short-Term Memory) are different.
Working Memory & just holding information in mind

- cluster onto separate factors in factor analyses of children & of adolescents & adults (Alloway et al., 2004; Gathercole et al., 2004).

- WM is more linked to DL-PFC while maintenance more linked to VL-PFC (D’Esposito; Smith & Jonides, 1999; Owen)
Forward Digit Span assesses short-term memory
Say the numbers back in the order they appear.
Say them back in the order they had appeared.
1, 3, 7, 4
Re-ordering the Digits assesses working memory
Say the numbers back in numerical order (smallest to largest)
Say them back in order of size (smallest to largest)
Will re-order by size here

Call out the name of each as it appears
Say them back in order of size (smallest to largest)
Will re-order by size here

Call out the name of each as it appears
Mouse
Frog
Dog
Tiger
Horse
Elephant
Working Memory & just holding information in mind (Short-Term Memory) are distinct.
A Classic Simon Task
The Rules are:

Whenever you see a BUTTERFLY, press LEFT.

Whenever you see a FROG, press RIGHT.
Dots - Congruent

Push Left

Push Right

Dots - Incongruent

Push Right

Push Left
Whenever you see a Gray Disc, press on the SAME side as the stimulus.

Whenever you see a B&W Striped Disc, press on the side OPPOSITE the stimulus.

Requires the extra step of mentally translating same/opposite into Left or Right.
Comparison of Mixed Conditions of Hearts-Flowers and Simon in Percentage of Correct Responses

Davidson et al. (2006). Neuropsychologia, 44, 2037 - 2078
It’s important to try to minimize stresses in children’s lives and to give children better ways to handle the stress in their lives.
Born 12 weeks early, these twins were whisked into separate incubators. Brielle (on the left) had breathing and heart-rate problems, didn’t gain weight, and fussed when anyone tried to comfort her. Finally a nurse put the two sisters together. As Brielle dozed, Kyrie wrapped her arm around her smaller sibling. With her sister nearby, Brielle began to calm down and thrive. Sooner than expected, the girls went home.

first reported in the *Worcester Telegram & Gazette* Nov. 18, 1995
picked up by *Life Magazine*, June 1996
Hugs are superb medicine.
Exercise Reduces Stress

Virtually any form of exercise, from aerobics to a nature hike to yoga, can act as a stress reliever.

Exercise reduces feelings of depression and anxiety, and improves your sleep, which is often disrupted by stress, depression and anxiety.

9 & 10-year-old children responded to a self-report mood measure after two different types of aerobic exercise of 15 min. Significant increases in positive mood and significant decreases in negative mood were found after each exercise treatment.

*Annals of Behavioral Medicine* (1999): College students who exercised regularly coped with stress better and had 37% fewer physical symptoms than those who did not exercise regularly. Sedentary students had 21% more anxiety than the students who exercised regularly.


Exercise improved the mood of depressed individuals. 80 volunteers took a mood test prior to an aerobics class; 52 were determined to be in a depressed mood. The questionnaire was given again after the class. Participating in the class improved the mood of depressed individuals and reduced feelings of anger.
Pets can reduce stress
The presence of a dog in the classroom reduces stress and helps children perform better.


Bringing a Dog to Work Reduces Stress

Barker et al. (March 2012)
International Journal of Workplace Health Management

Employees’ dogs reduce stress in the workplace and make the job more satisfying for those with whom the dogs come in contact.

The differences in perceived stress between days a dog was present or absent were significant.
Meditation can reduce stress
Several Montessori activities are essentially walking meditation, though Montessori never called them that.

Walking meditation is more age-appropriate for little kids than sitting meditation.
An activity from Montessori schools, that is essentially a type of walking meditation.

Everyone (even the grown-ups) gets a bell and walks in a line or circle. The goal is for no one’s bell to make a sound.
Games that target Cognitive Flexibility
Which 2 cards go together?

Why?

(of course you demonstrate first)
The 3rd card is feeling very lonely.

Is there any way that it is the same as one of the other cards?

Why did you put those 2 cards together?
Which 2 cards go together? Why?
The 3rd card is feeling very lonely.

Is there any way that it is the same as one of the other cards?

Why did you put those 2 cards together?
Two of the cards have not been grouped together yet.

Can you think of any way in which those 2 cards are similar to one another?
This card is similar to 3 of the cards above for 3 different reasons. Which cards are they and what are the reasons?
In what way is a carrot like a cucumber?
In what way is a carrot like an orange?
In what way is a carrot like a potato?
In what way is a carrot like an apple?
Try to think of really unusual ways you might use a TABLE.

What are all the things you might use a table for besides eating or writing on it?
You could dance on top of a table.

Might turned it on its side and use it to keep a door closed or as a shield against anything being thrown at you.

You could get under it to hide or to keep dry.

You could cut it up for firewood.
What unusual uses can you think of for a SPOON?
What unusual uses can you think of for a piece of STRING?
A fun way to target all 3 core Executive Functions
Vygotsky: Engaging in social pretend play is critical for developing executive function skills in very young children. It is emphasized in *Tools of the Mind*.

Children must plan who they want to be in a pretend scenario, and the teacher holds them accountable for
• During social pretend play, children must hold their own role and those of others in mind (working memory)

• inhibit acting out of character (employ inhibitory control), and

• flexibly adjust to twists and turns in the evolving plot (cognitive flexibility)

--- all three of the core executive functions thus get exercise.
An example of a *Tools of the Mind* activity where EF training is the primary focus is **social pretend play** (e.g., playing doctor & patient or grocery store).

Mature make-believe play challenges & helps build all 3 core EFs: children must **inhibit** acting out of character, **hold in mind** the role they’ve chosen & those of others, & **flexibly adjust** in real-time as their friends take the play scenario in directions they never imagined.