



# Building executive function and resilience through play

Robbin Gibb, PhD

Claudia Gonzalez, PhD

Canadian Centre for Behavioral Neuroscience





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Requires 21-30 hours of your time (19 self-paced modules)

Certificate of Completion



HOW BRAINS ARE BUILT:  
INTRODUCING THE BRAIN STORY

Palix Foundation

**download video**

Free

# Building Better Brains

The process of building a **healthy brain** is influenced by a wide range of factors, particularly in the first 2000 days from conception

- a strong foundation
- protection from toxic stress
- strong “air traffic control” skills
- **SERVE AND RETURN**



# Brain Architect Level 1

a course for parents/caregivers/educators

Refresh your understanding of early childhood brain development, increase your confidence as a caregiver and learn how simple, quality interactions, like play, build a **sturdy brain foundation** to support all future learning and development

- 1 hour
- Free
- Certificate of Completion



<https://www.buildingbrains.ca/>

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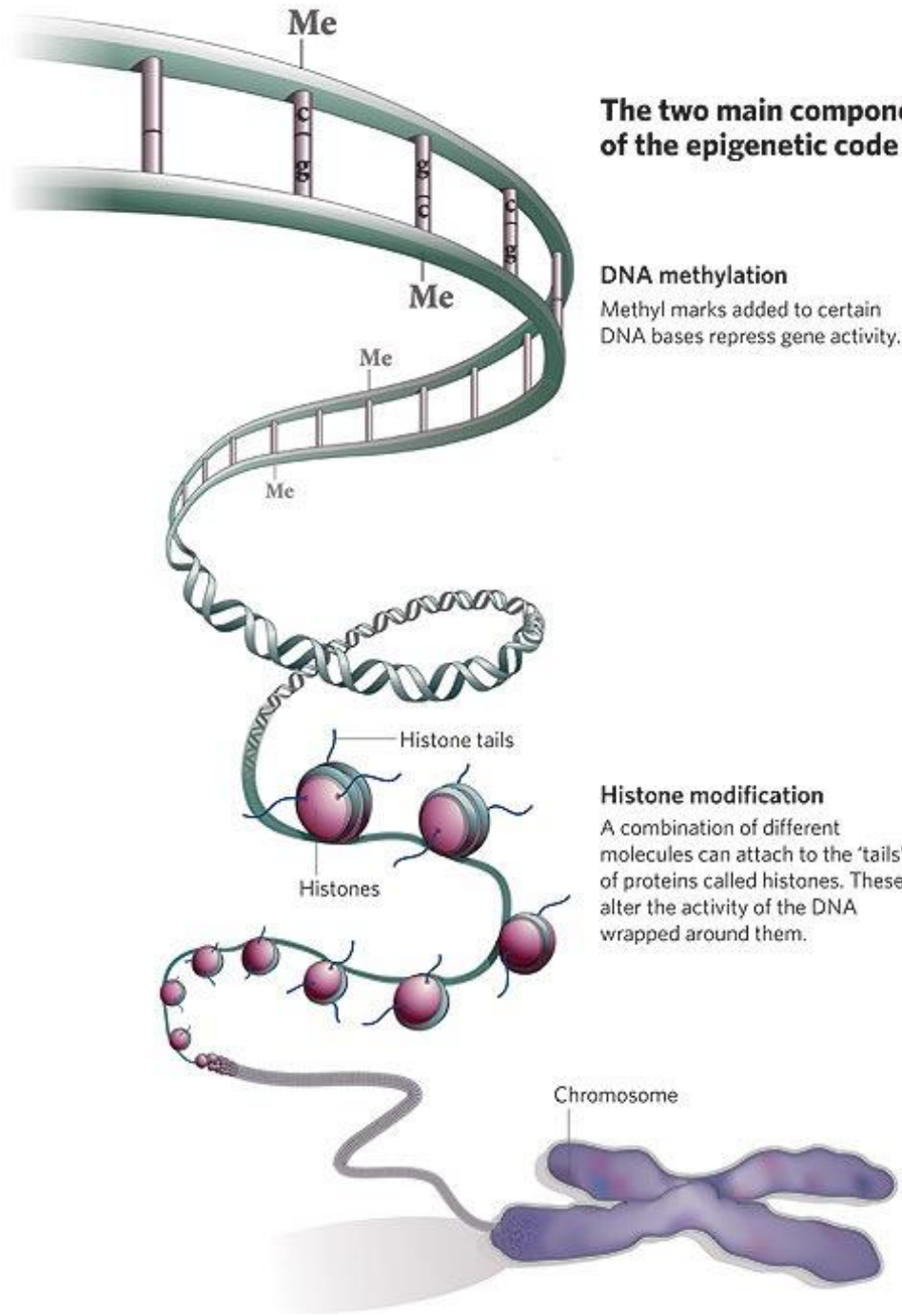


# Nature/ Nurture

- No longer a debate
- Environment leaves its mark on our genome and can modulate future gene expression in a sometimes heritable fashion
- The study of how environment leaves its footprint on the genome falls into the domain of ***Epigenetics***



Harry Harlow -early work on surrogate mothers



**The two main components of the epigenetic code**

**DNA methylation**  
Methyl marks added to certain DNA bases repress gene activity.

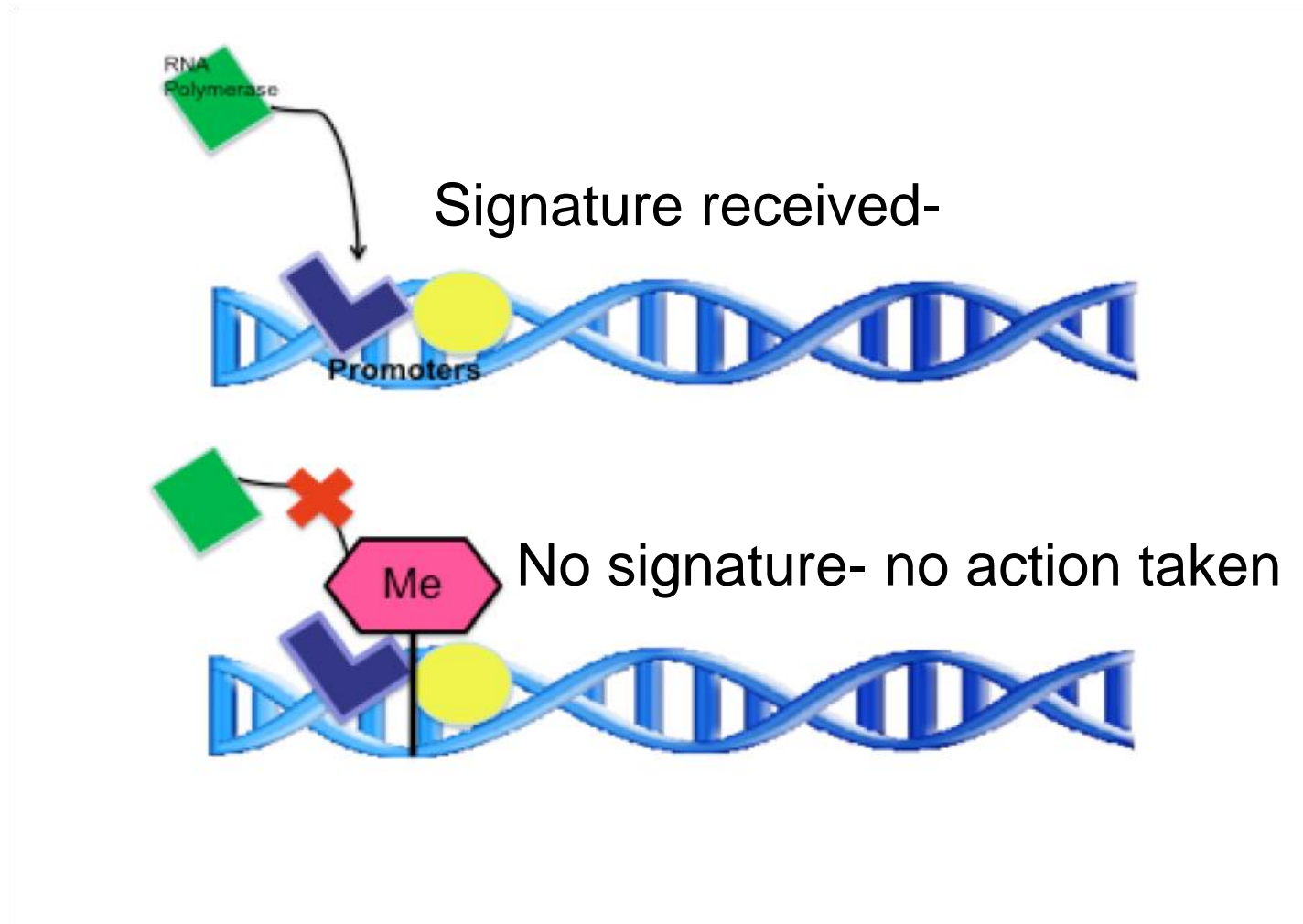
**Histone modification**  
A combination of different molecules can attach to the 'tails' of proteins called histones. These alter the activity of the DNA wrapped around them.

Each gene (Nature) contains a unique set of instructions that is carried out if endorsed by the environment (Nurture).

This is what is known as the “signature effect”



# Methylation



# Brain and Human Development

Nature

Nurture

Genes



Epigenetics



Stimulation  
& Nutrition



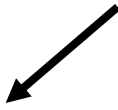
Gene Function



Neurobiological  
Pathways



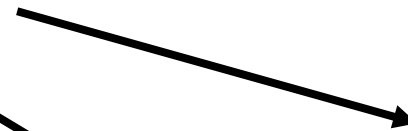
Physical  
Health



Mental  
Health



Behaviour



Learning &  
Cognition

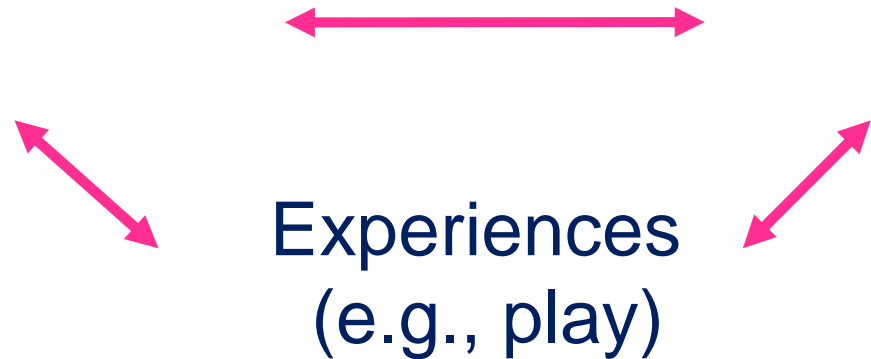


# Epigenetic Changes Cause Brain Changes: Brain Plasticity

- Brain plasticity offers an adaptive advantage. We can **“learn”** from our **experiences** and that should allow us to engage more appropriate behavioural responses in future situations

• Brain changes

Behavioural changes



This is fundamental to **Resilience**

# What every child must have to grow, learn, and flourish: Greenspan and Brazelton

- **NUMBER 1 NEED? NEED FOR ONGOING, NURTURING RELATIONSHIPS**



# The Prefrontal Cortex

- Selects behaviours appropriate to the particular time and place
- Adapts behaviour appropriately to the environmental context
- Acts much like a composer, selecting our actions
- Frontal lobes are strongly connected to amygdalae
- Frontal lobes act as the brain's executive (Luria, 1980)

# Executive Function

- A set of skills that help us define and achieve goals.
- Three main categories are: working memory, cognitive flexibility, and behavioural inhibition.
  - Problem solving, attention, monitoring, planning and organizing materials, self-regulation, emotional control etc., contribute to the executive system.
- Better EF skills confer *resilience* and are reflected by better school performance and lifelong success
- Connected to **emotional** centre to aid in interpreting situations

# Success Requires:

- **Well developed air traffic control**



Air traffic control refers to “executive functions” supported by the PFC

-EF’s are more important for school readiness than IQ

Predicts math and reading competence thro’ school years

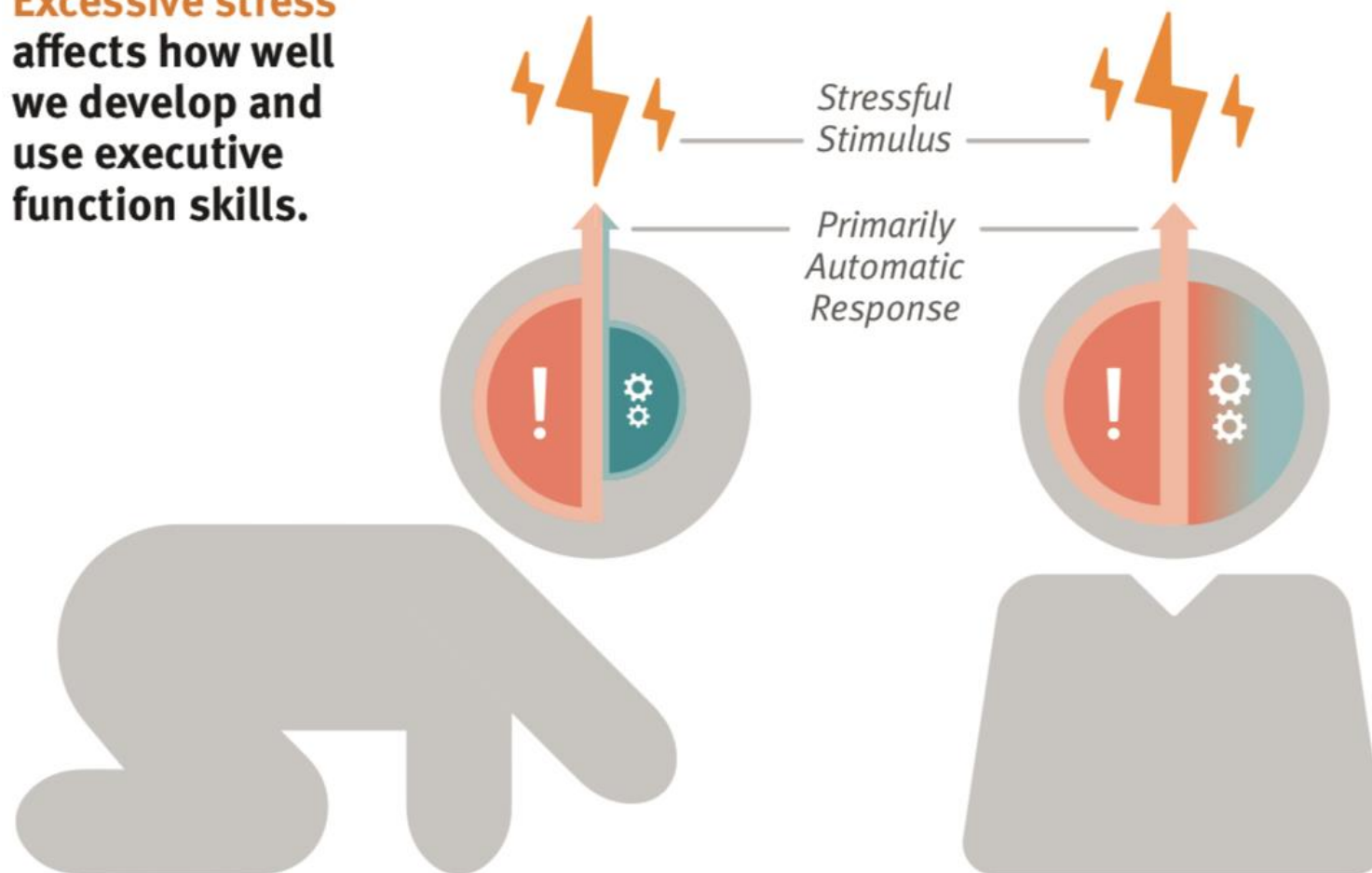
# Adults who had inadequate EF skills as children show problems with resilience

- Have worse mental and physical health outcomes
- Earn less money
- Commit more crimes

All studies were controlled for IQ, Gender, and SES

Even small improvements in EF can translate into improvements in health, wealth, and lower crime rate for a nation (Moffitt et al. PNAS 2011) .

**Excessive stress** affects how well we develop and use executive function skills.



### **Early Childhood**

Severe, frequent stress redirects children's brain development away from planning and impulse control toward building the capacity for rapid threat response.

### **Adulthood**

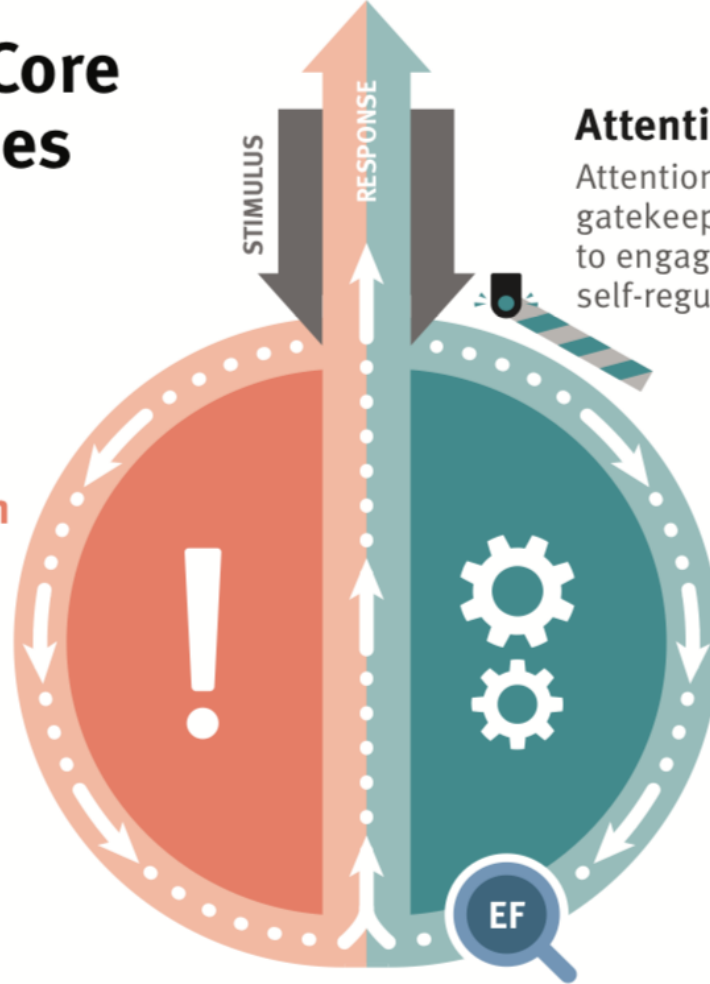
Excessive stress overloads adults' ability to use executive function and intentional self-regulation skills, leaving them to rely primarily on automatic responses.

Harvard Centre for the Developing Child

# How Our Core Capabilities Work

## Automatic Self-Regulation

Rapid, impulse-directed  
“Fight or flight” response  
Important for urgent situations



## Attention

Attention is the critical gatekeeper that’s needed to engage intentional self-regulation.

## Intentional Self-Regulation

Conscious, planful, proactive  
Inhibits automatic responses  
Important for achieving goals

Essential capabilities such as planning, focus, and self-control are all orchestrated by the balance of two kinds of self-regulation mechanisms: **automatic** and **intentional**. The proper balance ensures appropriately responsive and productive actions.

REQUIRES

## Executive Function

- 1 Inhibitory Control
- 2 Working Memory
- 3 Mental Flexibility

Harvard Centre for the Developing Child



# Features of Resilience

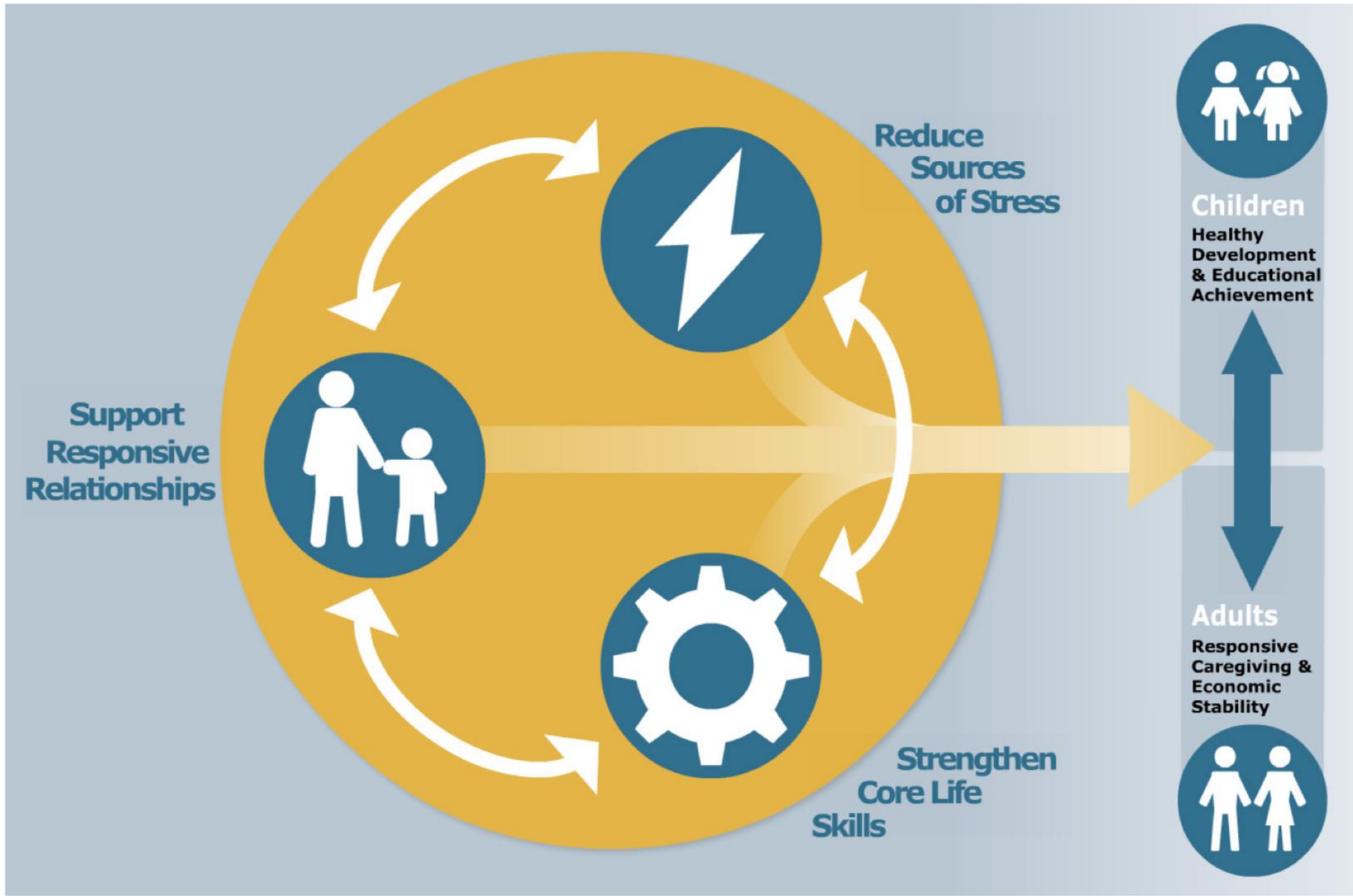
- Resilience “requires” relationships- not self determination and individualism
- Capabilities underlying resilience can be strengthened at any age
- Individuals who show resilience following one adversity may not be capable of the same response to another adversity
- Resilience is a “state not a trait”

# Resiliency is promoted by release of Oxytocin “The BONDING HORMONE”

- Increases in the presence of an attached adult
- Reduces stress
- Increases brain plasticity

Humans thrive on relationship

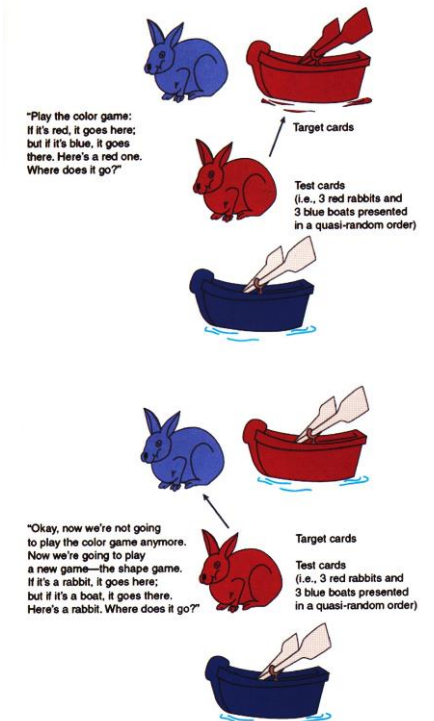




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Developing Child

# Ways to Improve EF function?

- Language Learning & Music
- Exercise, Sports
- Nutrition
- High Quality and Enough Sleep
- Mindfulness Practices (Yoga, Martial Arts)
- Protection from TOXIC stress
- Classroom Curricula
- **PLAY: BBT** ([buildingbrains.ca](http://buildingbrains.ca))



# Play Changes our Physiology

- Engaging in play
  - Reduces CORTISOL- ↓ stress
  - Increases anandamide- ↑ bliss
  - Increases endorphins- ↑ pleasure

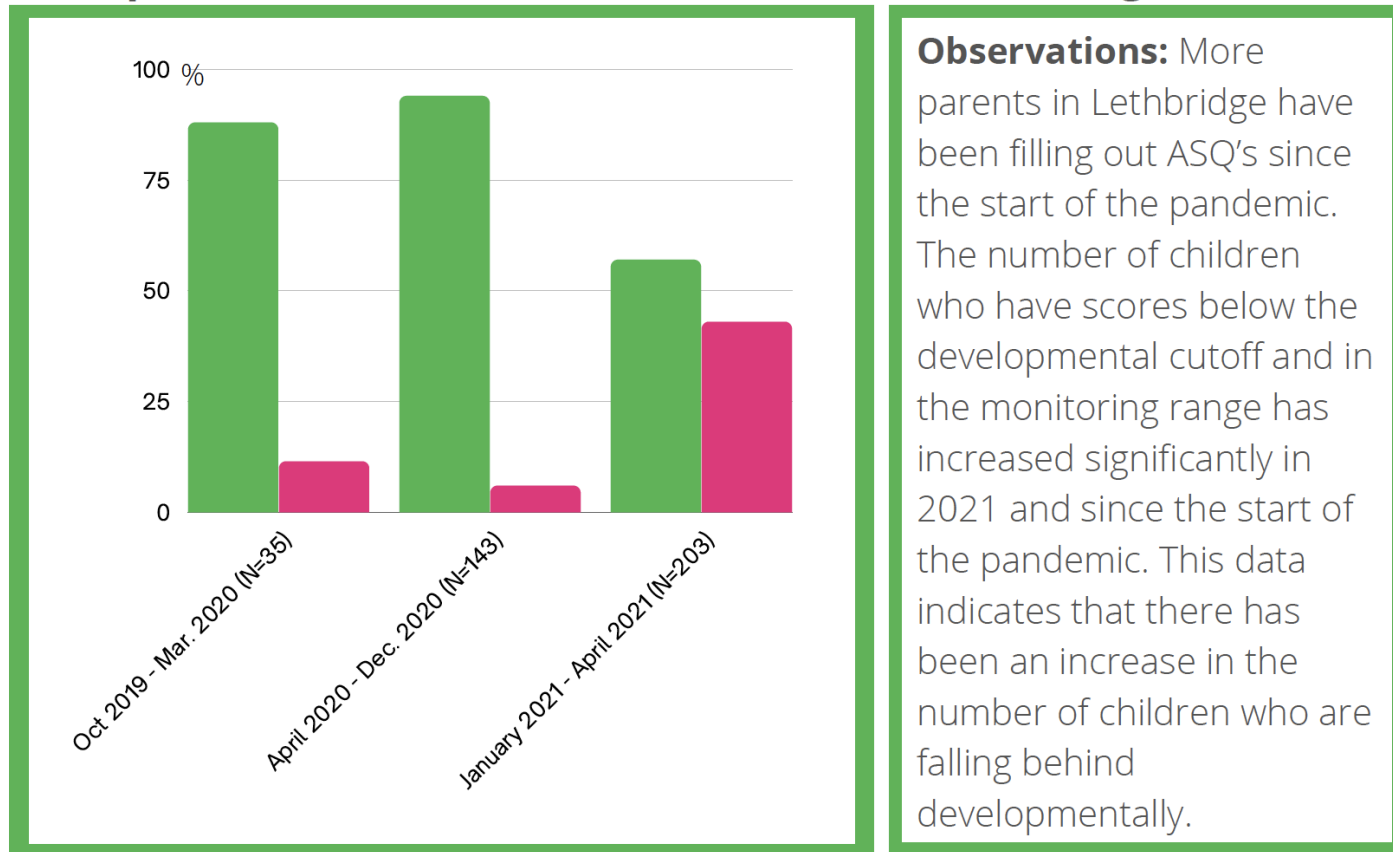
# Play Improves Relationships

- Fosters caring and compassionate responses
- Develops empathy
- Promotes trust

\*Nurturing relationships build brain



# What has the pandemic done to our children?

## Comparison of Children's ASQ Data - Pre and During Pandemic



**Observations:** More parents in Lethbridge have been filling out ASQ's since the start of the pandemic. The number of children who have scores below the developmental cutoff and in the monitoring range has increased significantly in 2021 and since the start of the pandemic. This data indicates that there has been an increase in the number of children who are falling behind developmentally.

Similar findings by Unicef in Asia and in US health care authorities

 Above the cutoff and in normal developing range  
 Below the cutoff and in the monitoring or referral range

For more information  
visit [BuildingBrains.ca](https://BuildingBrains.ca)



# Harvard Centre for the Developing Child

Suggests Parents Should:

1. Maintain healthy nurturing relationships with your children
  2. Maintain social connection
  3. Take a break when feeling overwhelmed
- These suggestions can all be managed through PLAY





# The Power of Play: A Pediatric Role in Enhancing Development in Young Children

Michael Yogman, MD, FAAP,<sup>a</sup> Andrew Garner, MD, PhD, FAAP,<sup>b</sup> Jeffrey Hutchinson, MD, FAAP,<sup>c</sup> Kathy Hirsh-Pasek, PhD,<sup>d</sup> Roberta Michnick Golinkoff, PhD,<sup>e</sup> COMMITTEE ON PSYCHOSOCIAL ASPECTS OF CHILD AND FAMILY HEALTH, COUNCIL ON COMMUNICATIONS AND MEDIA

Children need to develop a variety of skill sets to optimize their development and manage toxic stress. Research demonstrates that developmentally appropriate play with parents and peers is a singular opportunity to promote the social-emotional, cognitive, language, and self-regulation skills that build executive function and a prosocial brain. Furthermore, play supports the formation of the safe, stable, and nurturing relationships with all caregivers that children need to thrive.

# Defining Play

- PLAY: isn't about ultimate outcomes. In the moment, it has no purpose outside of the play itself
- PLAY: occurs spontaneously, but can be directed
- PLAY: is driven by curiosity and exploration
- PLAY: creates bliss or "flow"

# Play is Built on “Serve and Return”

- Emerges in infancy

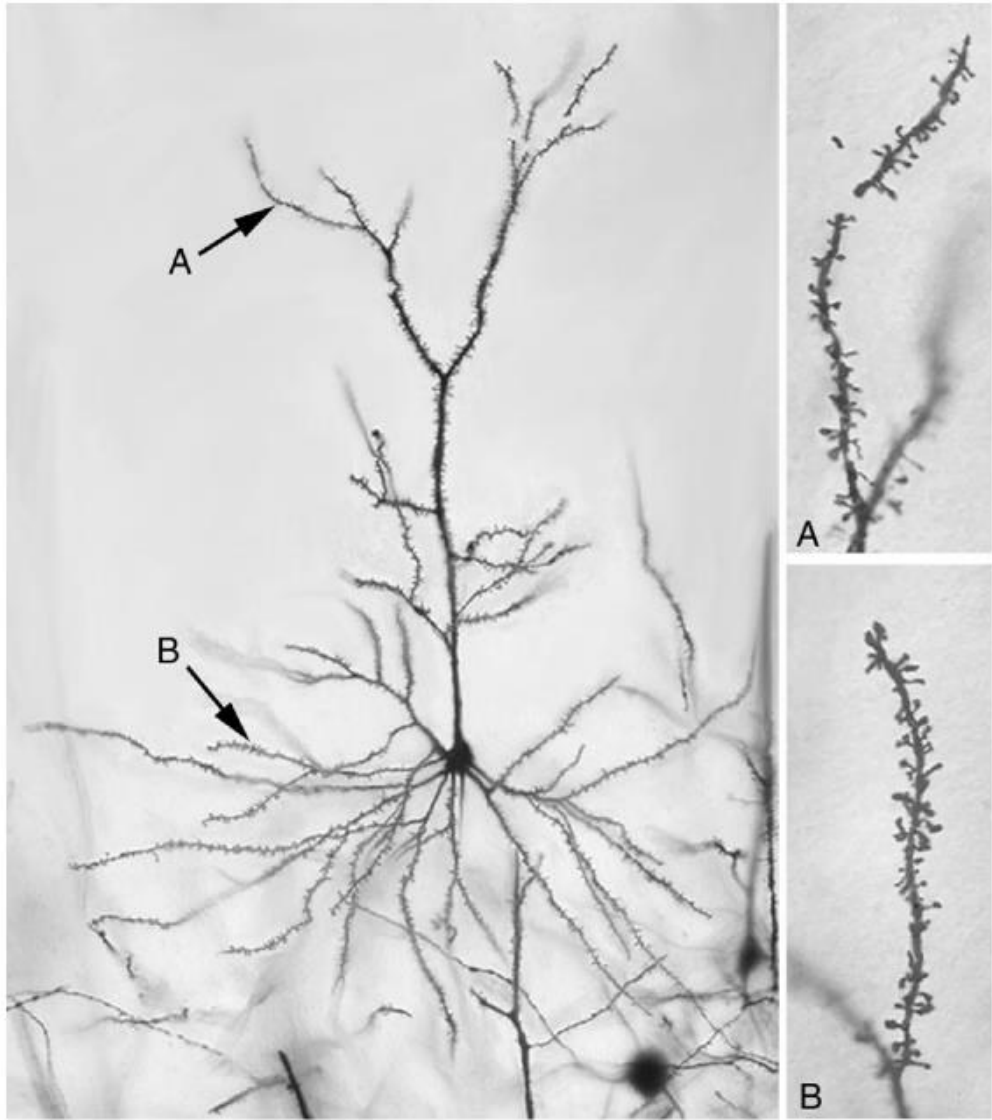


# Who are your playmates?

Who? & How many?

- Mom
- Dad
- Siblings and other family
- Friends
- Caregivers





**The amount of play affects the complexity of cells in the prefrontal cortex.**

**Because these cells control EF, play can modify EF capabilities in a child.**

# Dr. Stuart Brown- Founder of National Institute of Play (CA)



Link to video: <https://www.youtube.com/watch?v=HHwXlcHcTHc>

# 2012:

- Alberta Education decided to do a Provincial scan on kindergarten readiness using the Early Development Instrument.
  1. Physical Health and Well-being
  2. Social Competence
  3. Emotional Maturity
  4. Language and Thinking Skills
  5. Communication and General Knowledge

# 2014:

- The results were frightening.....
- Less than 50% of Alberta's children were ready for kindergarten in all domains tested on the EDI
- Alberta was behind the Canadian average and Lethbridge was behind the provincial average





## Building Brains & Futures

- 100 children participated.
- Baseline for motor & cognitive functions.
- Child enrichment program (EF) happened at school.

Post-enrichment test in June

University of  
Lethbridge



<http://uleth.ca>



Anonymous Donor

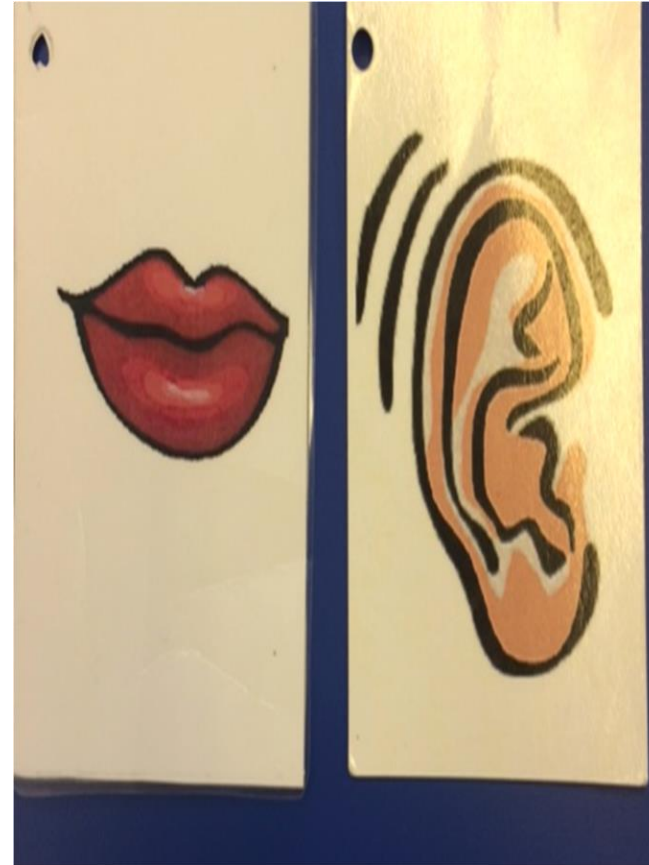
# Enrichment Activities: Buildingbrains.ca

1. Lips and Ears
2. Red light/Green light
3. Simon Says
4. Wait for It
5. Musical Freeze
6. Stroop (Opposites)
7. Pretend Play
8. Shared Project
9. Dimensional Change Card Sort
10. Right is Right!



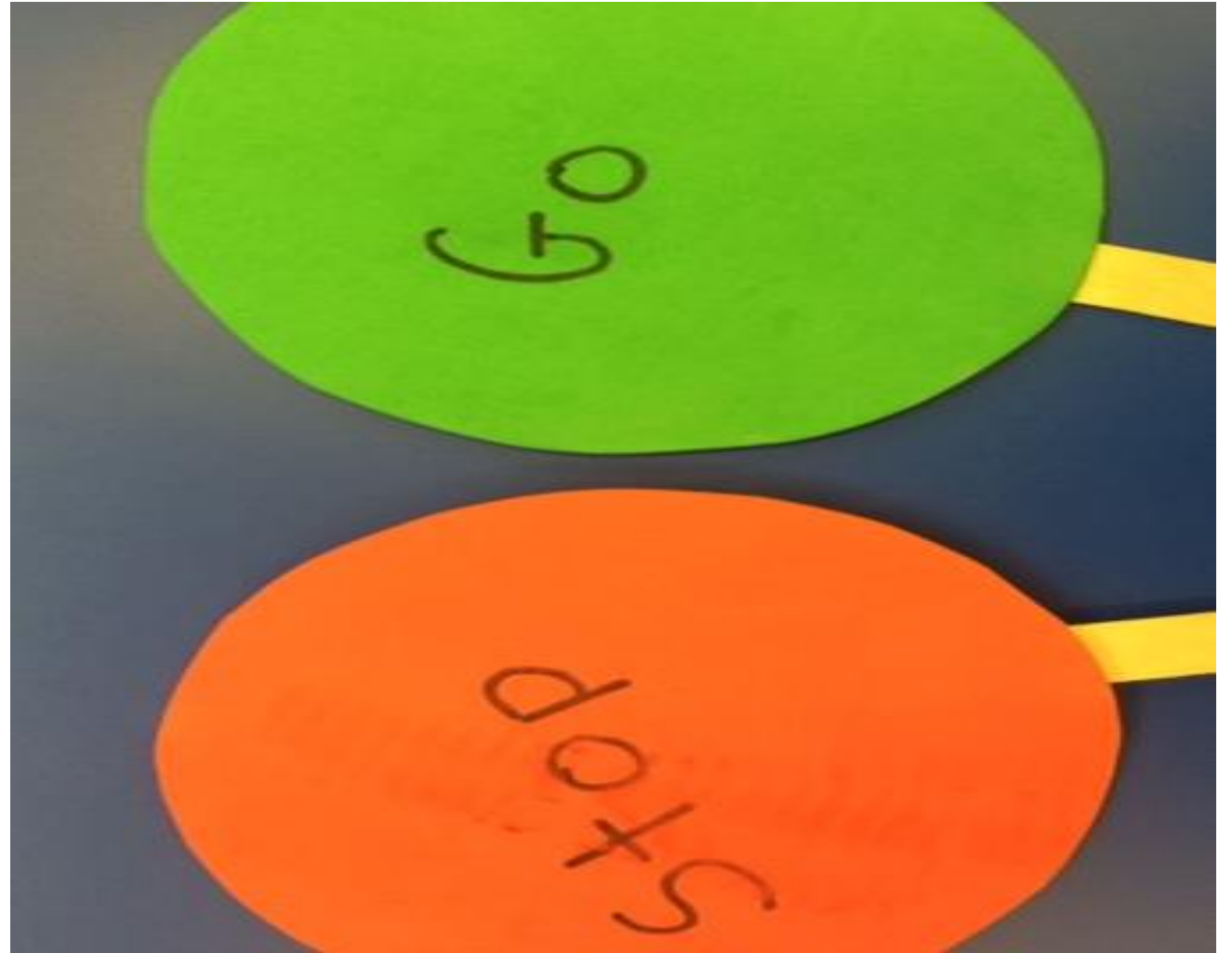
# Activity 1

Circle Time  
With Lips and  
Ears Visuals



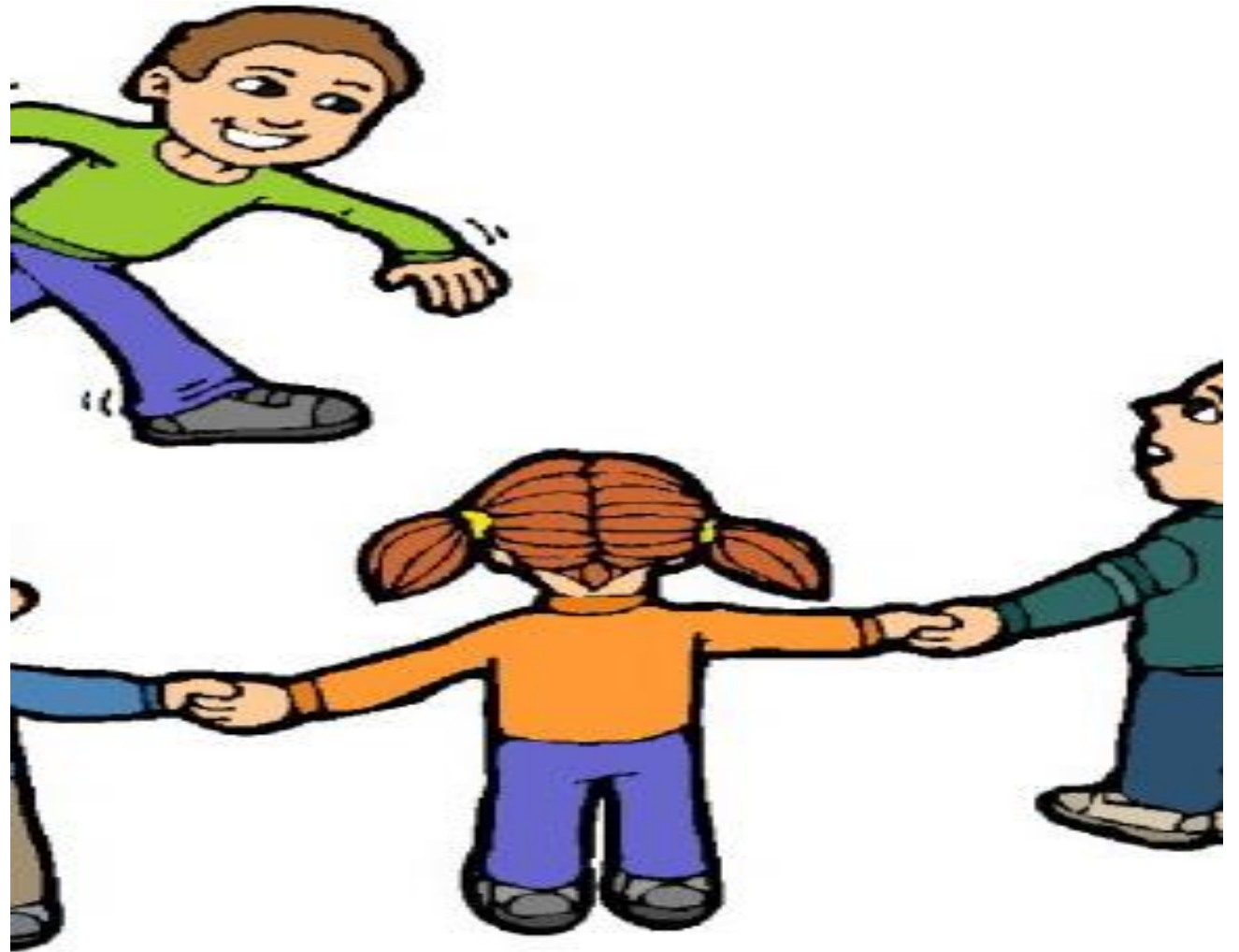
## Activity 2

Red Light,  
Green Light



# Activity 3

## Simon Says



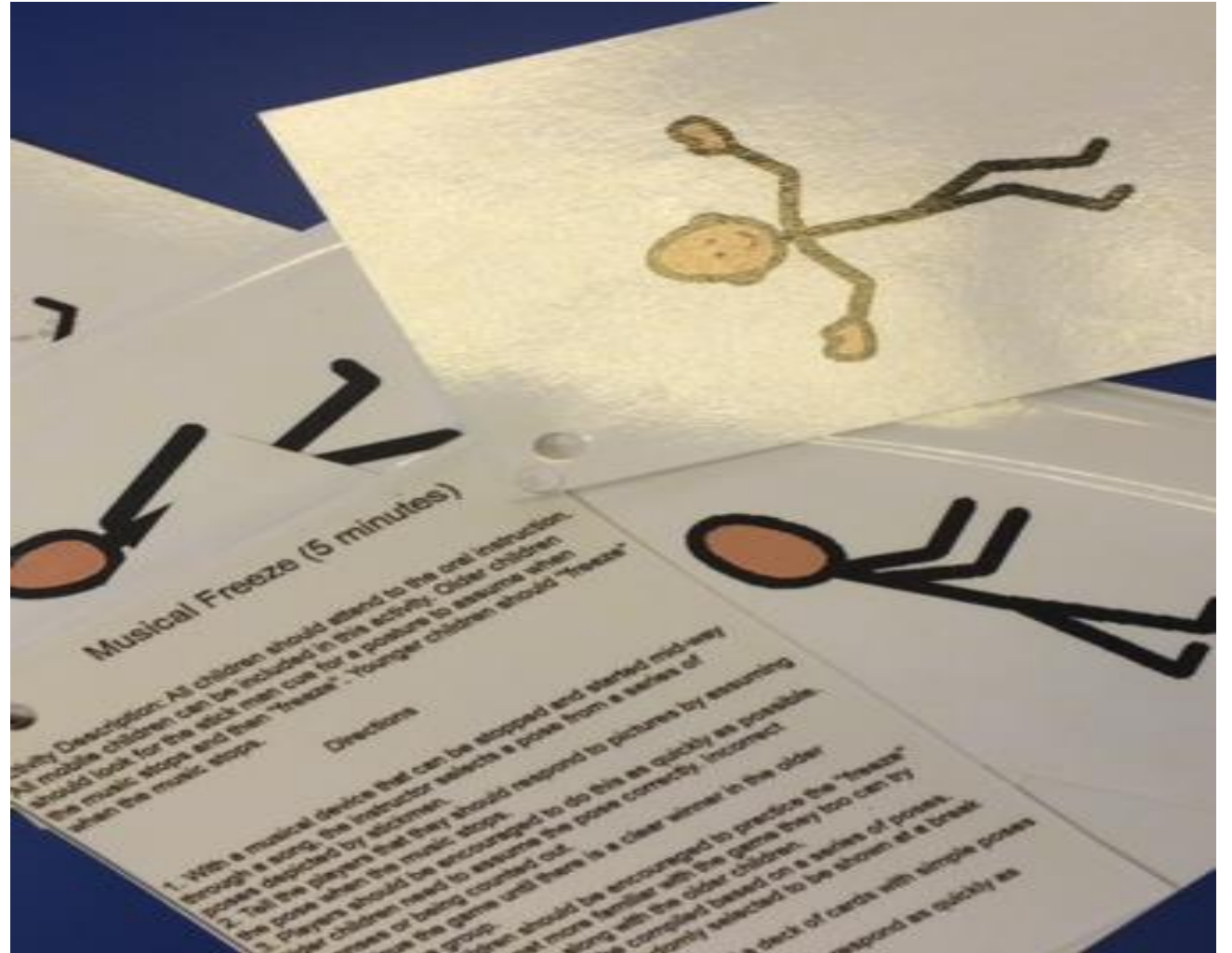
# Activity 4

Wait For It.....



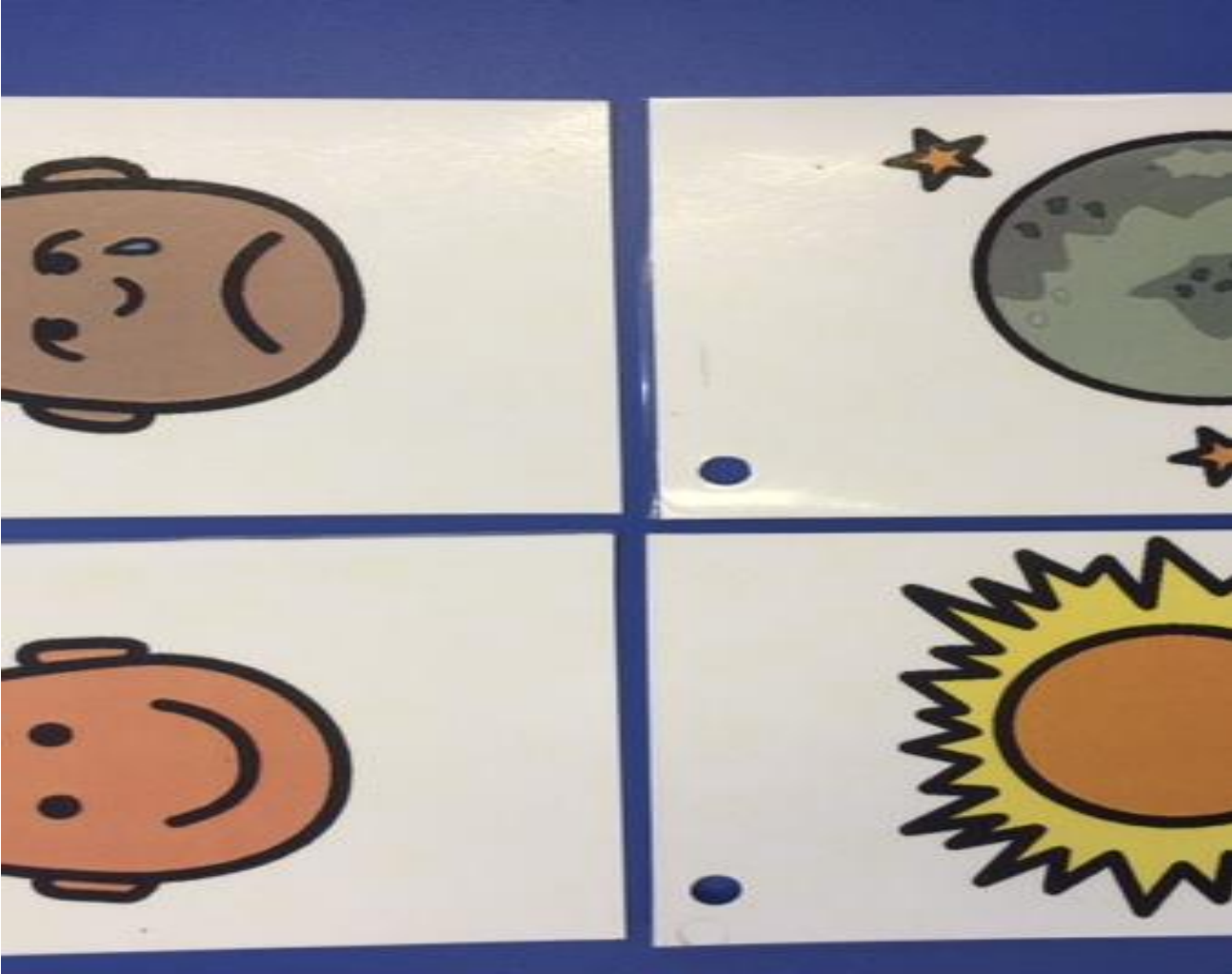
# Activity 5

## Musical Freeze



# Activity 6

## Stroop





# Activity 7

## Pretend Play



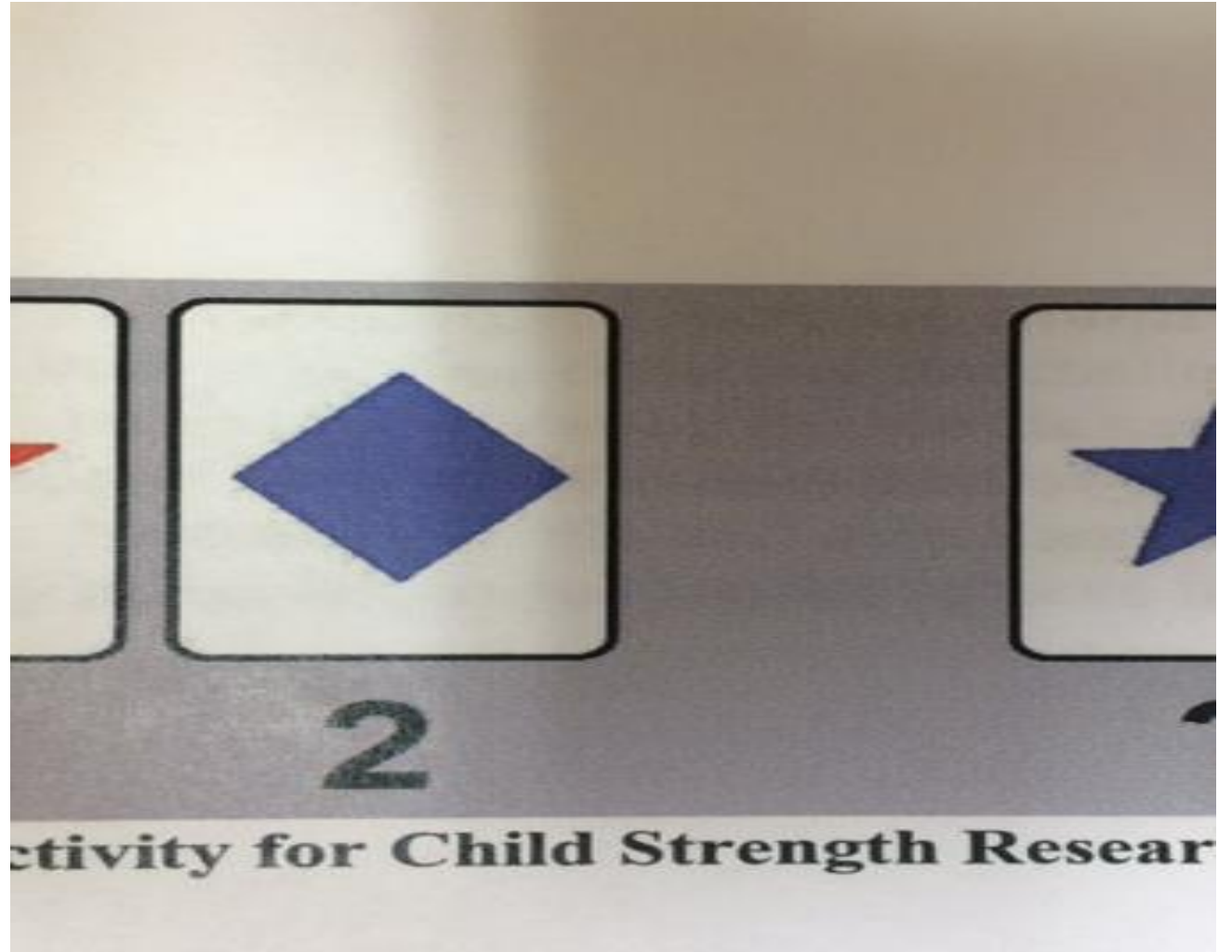
# Activity 8

## The Shared Project



# Activity 9

## Dimensional Change Card Sort



# Activity 10

Right is Right!!





# Getting the right grasp on executive function

*Claudia L. R. Gonzalez<sup>1\*</sup>, Kelly J. Mills<sup>1</sup>, Inge Genee<sup>2</sup>, Fangfang Li<sup>3</sup>, Noella Piquette<sup>4</sup>, Nicole Rosen<sup>2</sup> and Robbin Gibb<sup>5</sup>*



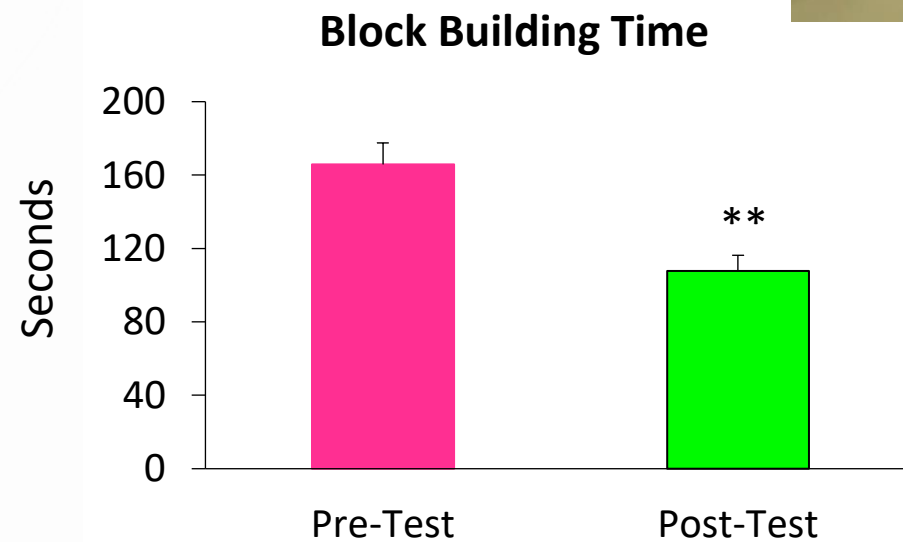
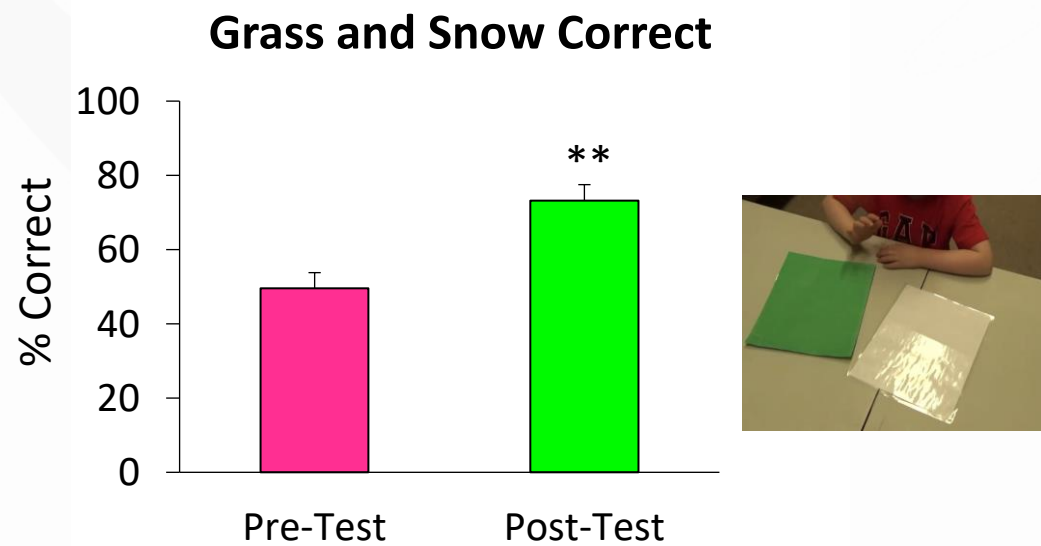
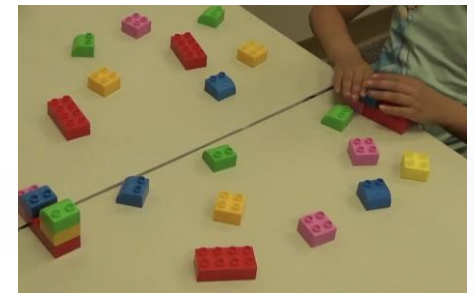
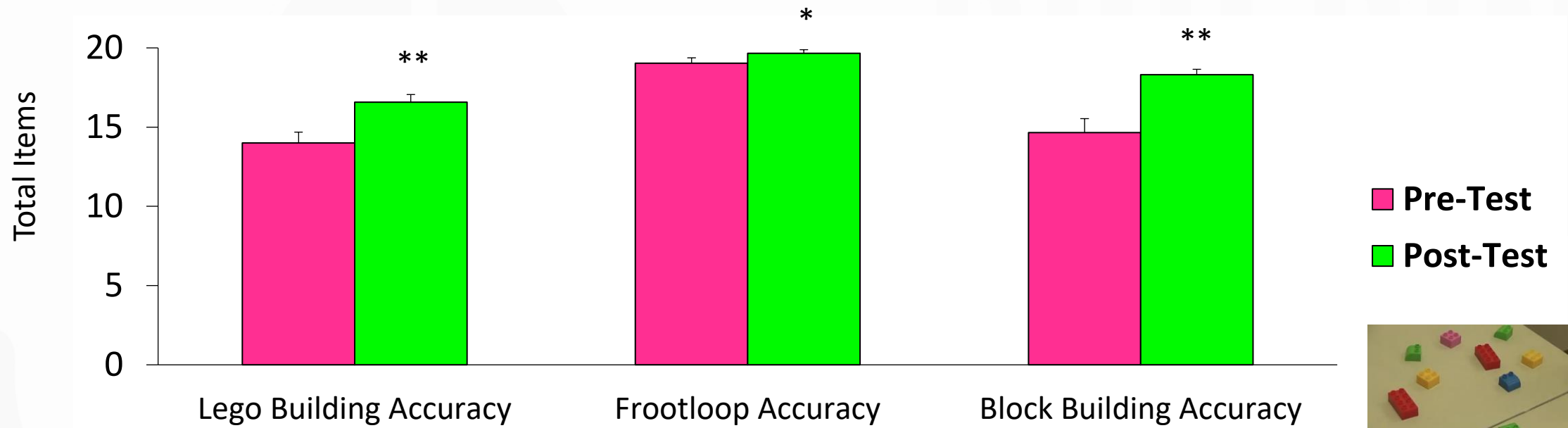
## CHILD OUTCOMES from BBF 2015-2016

	EF (BRIEF)	Language (PPVT)	EF (Stroop)	EF (Snap)	Motor (time)
High Dose	↑	↑	↑	↑	↑
Low Dose	-	-	-	-	↑

Link to Video: <https://www.youtube.com/watch?v=vj8h3xXAPSY>



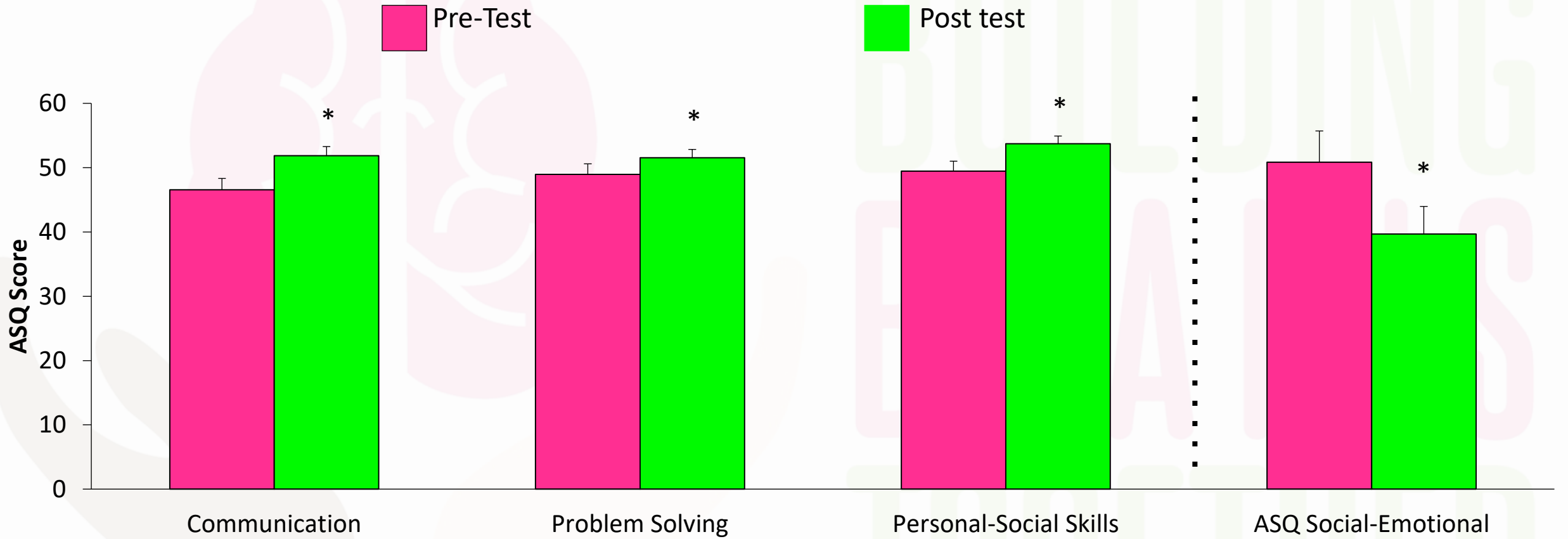
# Motor & Cognitive Tests



\*\* $p < 0.001$   
\* $p = 0.01$



# Ages & Stages Questionnaire



*\*p ≤ 0.01*



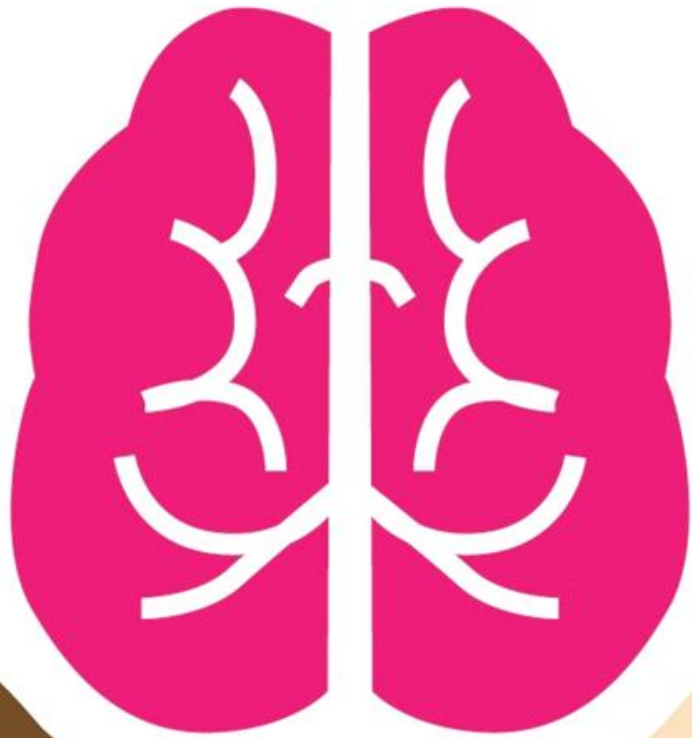
## Building executive function in pre-school children through play: a curriculum

Lara A. Coelho, Alycia N. Amatto, Claudia L.R. Gonzalez & Robbin L. Gibb

# Promoting Executive Function Skills in Preschoolers Using a Play-Based Program

*Robbin Gibb<sup>1\*</sup>, Lara Coelho<sup>1</sup>, Nicole Anna Van Rootselaar<sup>1</sup>, Celeste Halliwell<sup>1</sup>, Michelle MacKinnon<sup>2</sup>, Isabelle Plomp<sup>3</sup> and Claudia L. R. Gonzalez<sup>1</sup>*

<sup>1</sup>Department of Neuroscience, University of Lethbridge, Lethbridge, AB, Canada, <sup>2</sup>Holy Spirit Catholic School Division, Lethbridge, AB, Canada, <sup>3</sup>Lethbridge School Division, Lethbridge, AB, Canada



BUILDING  
BRAINS  
TOGETHER

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# SUMMER 2022

# TEAM



# FAMILY OUTDOOR PLAY

Tuesday and Wednesday weekly events for 6 weeks in 6 different Lethbridge locations



1,215  
Children  
-  
754  
Caregivers  
-  
1,222  
Resources



# 7 Childcare Centre Visits for Pop-Up Play



**146 Children and 27 Educators**

# LETHBRIDGE & INTERFAITH FOOD BANKS



Pop-Up Play in the Garden



Weekly Play Kits for 'After the Bell' Hampers

**Distributed 2,800 Play Kits**

# Lethbridge Family Services



# Lethbridge Farmers Markets



# LETHBRIDGE HOUSING AUTHORITY

Weekly play program at three Lethbridge Housing sites. Executive function building play. Healthy snacks. Relationship building. 3 BBQs. Play Bins.



Foxbend North



Columbia Blvd West



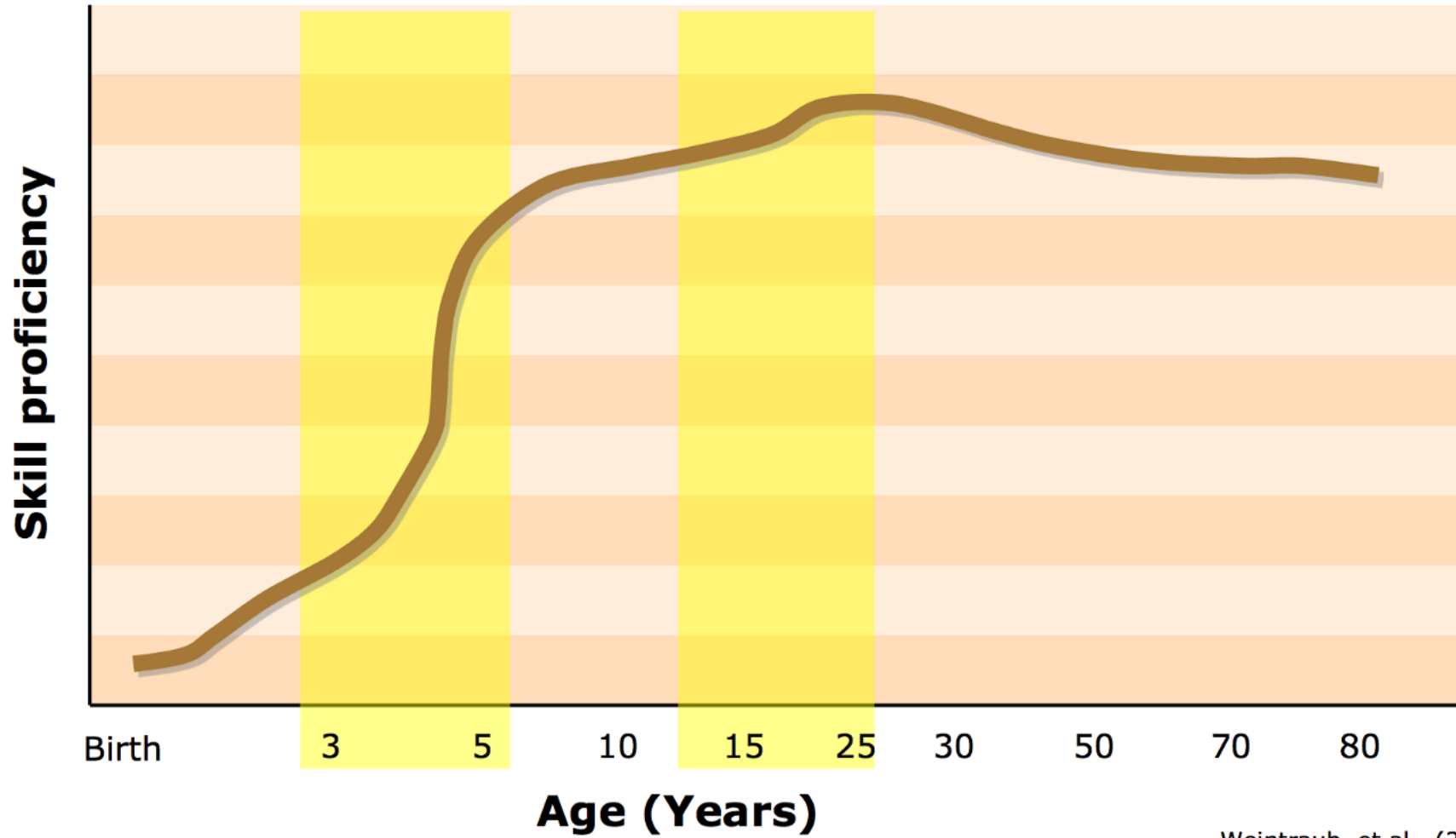
Cedar Rd South

# 47 Families

# Edenbridge Family Services

4 play events





Weintraub, et al., (2011)

Harvard Centre for the  
Developing Child

# New Resources:

Rock Paper Scissors Tag

**SLAP**

**SPOONS**

**HOW TO PLAY**

**SET UP**

**The Deck:**

- Remove one number (all 4 cards of 1) from a standard deck of cards for each person playing the game. The cards removed will make up the deck that will be played with—set the rest of the standard deck aside.
- Example: If there are 4 people playing, remove 4 of the 1s, 4 of the 2s, 4 of the 3s, 4 of the 4s and 4 of the 5s from a card deck. The deck we play with will only contain 16 cards, all 7s, 8s, 9s and 10s.

**The Spoons:**

- Place one spoon for each player in the centre of the table and remove one.

**PLAY**

Deal out the entire deck you created, each player should receive 4 cards face down.

Players pick up their cards.

As a group, all players say "PASS" and pass one of their cards face-down to the player on their left. NEXT, all players say "PICKUP" and pick up the card they received.

- This is repeated until one player has 4 of the same cards (eg. 4 7s).
- When a player has 4 of a kind, they grab a spoon.
- Once one player has grabbed a spoon, everyone must grab a spoon.
- The player who was not able to grab a spoon, receives a "letter" in the word "SPOONS".
- When a player has received each letter in the word, they are out of the game.
- When a player loses out of the game you must remove all 4 cards of one number from the deck (eg. 5s) and remove a spoon from the centre of the table.

**THINGS TO TRY**

- With a big group of players, have two less spoons than players in the centre so two players receive a letter at the same time.
- Use a shorter word like "WIN" if you desire a quicker game.

**EXECUTIVE FUNCTIONS EXERCISED**

- Working Memory** – Players have to remember what cards they've passed and what they have been receiving to determine what number they should pass etc. Players have to use information to make quick decisions.
- Inhibitory Control** – Players have to inhibit any distractions so they can focus on their cards and on the spoon pile.
- Emotional Regulation** – Players have to manage any negative emotions the game may elicit, especially when they are eliminated.
- Motor Control** – Players have to use hand-eye coordination and fast reflexes to grab a spoon in time.

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## INDIGENOUS

**Stick-and-Ball Game: The Creator's Game, Lacrosse with Grand Chief Moon**

Grand Chief Moon

"Lacrosse is known as the Creator's game, also known as the medicine game to the Indigenous people. It is a gift from the Creator. That is the main purpose of playing lacrosse and why I became involved with it. My son has played for about 11 years ever since he was 6 or 7 years of age and I fell in love with it."

"We play it because it's the Creator's game, we play it for the Creator, and we get blessed. I've been on a healing journey with it for about four years now. Ever since I began my journey after recovery, lacrosse was right there from day one as I was watching my son play. I believe in it, I'm not involved with lacrosse for the money, I'm just in it for the blessings. I truly believe I've been blessed from the game. It gives me inner peace and if you love sports and you have a lot of faith, I believe lacrosse is the best way."

"Lacrosse is also a healing game. When you're playing the game, you ask for prayers. Most of those prayers are for children, your community and for the elders and this is why it is also referred to as the Medicine Game [1,3]. Right now, we need a lot of healing not just where I come from and everywhere there are drugs alcohol and poverty that comes with this world today. This game brings a lot of healing to a person, to myself, the younger children and the elders. We need to look out for them. It is a healing game and that's why I love it" [1].

In the past, the Indigenous played 'stick and ball' to settle disputes and because they honor the medicine and the entertainment the games offer to all [2,3].

Once a person has agreed to play the Creator's Game, they must get their body and mind ready for competition. It is important to understand how the mind has the power to control your movements and thoughts. Medicines provided by the medicine man were taken to clean your body and to prepare it for the rigors of the game. Emotional control is also critical, so we don't let emotions take over our senses for the game. There are spiritual aspects to the game. We offer tobacco to inspire the medicinal, spiritual, and ancestral worlds to play in peace but at its highest level. This is the way Creator wanted everyone to play the game [2,3].

Traditional lacrosse sticks made by a Lakota native. Photo: compliments of Henry Elson Little Muskego.

www.buildingbrains.ca

## NEW GAMES



## What Doesn't Belong?

## BLOGS



8/9/22

**Three Things I Learned While Working with Building Brains Together**

Building Brains Together is pleased to hire local high school and University students each summer to engage with our community, share child development information, resources, and play! In this week's blog, hear from one of our students shares what they've learned working with BBT over the past four summers.

[Read More](#)



7/26/22

**The Importance of Children Playing with People of all Ages**

# NEW CURRICULUM For Adolescents

# Chess for Life



With Justice Involved Youth (12-17)

# The bottom line:

If we can increase resilience in children by improving EF and strengthening relationships through play, as a society we should see:

- Better academic success
- Better Health
- Greater Wealth
- Less Crime
- Reduced Homelessness and Addiction