

Cognitive Interventions for Individuals with Fetal Alcohol Spectrum Disorder (FASD)

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Date:

March 9, 2011



The FASD Learning Series is part of the Alberta government's commitment to programs and services for people affected by FASD and those who support them.

Overview

- ▶ FASD
- ▶ Cognitive interventions
- ▶ Math intervention
- ▶ Language intervention
- ▶ Memory intervention
- ▶ Executive functioning intervention
- ▶ Attention process training intervention

FASD

- ▶ FASD Diagnosis
- ▶ FASD Prevalence and Cost

Fetal Alcohol Spectrum Disorder (FASD)

- ▶ Prenatal alcohol exposure (PAE) produces a range of effects including:
 - Fetal Alcohol Syndrome (FAS)
 - Fetal Alcohol Effect (FAE)
 - Fall under the umbrella term FASD
- ▶ FASD refers to individuals who may have physical, mental, behavioral, and/or learning disabilities as a result of maternal alcohol consumption (Chudley et al., 2005).

FASD Diagnosis

- ▶ Growth Deficiency
- ▶ Facial Features
- ▶ CNS damage
- ▶ Alcohol Exposure
- ▶ 92% of children with FASD had no growth deficiency and 66% had no facial features (Rasmussen et al., 2006).

FASD Prevalence and Cost

- ▶ FASD is one of the most common known causes of mental retardation, yet in theory it is preventable.
- ▶ ~1/100 children is affected with FASD
- ▶ The annual cost of FASD in Canada (aged 0 to 53) is ~\$5.3 billion, with an annual cost per individual of nearly \$22,000 (Stade et al., 2009).
- ▶ In Alberta, estimated lifetime cost for one person with FASD is \$1.1 million (Thanh & Jonsson, 2009).
- ▶ U.S. estimates place the lifetime cost of a child with FASD at \$2 million.

Cognitive Intervention

- ▶ Cognitive Intervention: Traditional
- ▶ Cognitive Intervention: Context Sensitive

Cognitive Intervention: Traditional

- ▶ The focus is on the underlying impairment
- ▶ Goal of restoring cognitive functions (e.g., attention, organization, memory, reasoning, problem solving)
- ▶ Increasingly the focus has expanded to include the use of compensatory strategies to support interventions across areas of functioning for the individual
- ▶ Cognitive remediation is often done outside of the functional contexts or environments of the individual (e.g., in a hospital or clinical setting)

Cognitive Intervention: Context Sensitive

- ▶ The focus is on understanding how the underlying impairments impact functional activities in everyday life, and/or the individual's participation in chosen life activities (e.g., school).
- ▶ Flexible combination of cognitive exercises, task-specific training of relevant everyday skills, and intervention for strategic thinking and compensatory behavior in functional contexts.
- ▶ Important to this approach is environmental modifications, including changes in the support behaviors of relevant people in the individual's natural environments (e.g., in home or school).

Cognitive Intervention: Context Sensitive

- ▶ In contrast to traditional cognitive remediation approaches, this intervention is typically embedded within the person's natural environments (e.g., in the home or classroom setting).

Math Intervention

- ▶ Math Interactive Learning Experience (MILE)
- ▶ Results of Math Intervention

Math Intervention

- ▶ Kable et al. (2007) assignment children (3-10 years) with FASD to two groups
 1. Math Intervention Group
 2. Standard Psychoeducational (contrast group)
 - Neurodev evaluation, Individual Education Plan
- ▶ All parents received parental instruction on FASD: the math intervention group was focused on math and contrast group on standard education.
- ▶ Children were assessed on behaviour and math before and after the 6 week intervention

Math Interactive Learning Experience (MILE)

- ▶ 6 weeks of tutoring in math, focusing on the cognitive deficits that contribute to math difficulties
 - Slower pace of instruction to compensate for lower processing speed
 - Used physical objects and tools (number lines) to assist with visual spatial deficits and poor working memory
 - Repetition: verbal and visual spatial
 - Adapted the 'Handwriting without Tears' program to assist with poor graphomotor skills

Results of Math Intervention

- ▶ Children in math group showed more improvements in math than the contrast group
 - More likely to have clinical significant gains in math (>1SD increase)
- ▶ Parents of children in both groups reported improvements in behaviors
- ▶ **Follow-up 6 months later:** Math group still had higher math scores than contrast group, and both groups still showed improvements in behaviour (Coles et al., 2009)

Language Intervention

Language Intervention (Adams et al. 2007)

- ▶ Language and literacy training (LLT) program for children with FASD in South Africa.
 - 40 children with FASD (aged 9 years) randomly assigned to intervention or control group
 - 25 non-exposed children
- ▶ LLT: children worked with an Speech Language Therapist twice a week for 9 months.
 - Emphasized phonological awareness and other literacy skills involved in reading and spelling

Language Intervention (Adams et al. 2007)

- ▶ Children completed scholastic, language, and literacy tests and parents and teaching completed ratings before and after the intervention.
- ▶ Compared to the FASD control group, the LLT group showed significantly more improvements on measures of language and literacy:
 - Syllable manipulation, letter sound knowledge, written letters, word reading, non-word reading, and spelling.
- ▶ The LLT, FASD control, and non-exposed control groups showed similar changes on general scholastic achievement.
- ▶ The intervention was effective!

Memory Intervention

- ▶ Memory Training in FASD

Memory Training in FASD

- ▶ Loomes, Rasmussen, Pei et al. (2008) examined whether teaching children with FASD a verbal rehearsal strategy increases their memory span
- ▶ **Participants:** 33 children (19 males and 14 females) with FASD. Age range: 4 to 11 years.

Children were assigned to two groups:

1. **Experimental group (n=17):** who received rehearsal training (children were told to whisper items repeatedly in their head)
2. **Control group (n=16):** who received no training

	Pretest Day 1	Posttest 1 Day 1	Posttest 2 ~ 1 week later	
Experimental	☹️	🗣️	🗣️	🗣️ Rehearsal Training
Control	☹️	☹️	☹️	☹️ No Rehearsal Training

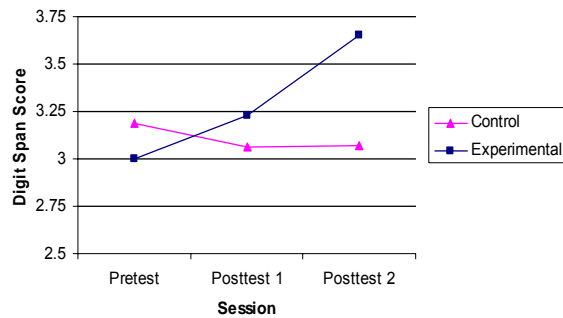
Pretest: Both groups completed a digit span task (1-4, 2-4-7)

Posttest 1: Exp. group received rehearsal training, then completed the digit span task. Control group had a break with training, then completed the digit span task.

Posttest 2: Exp. group was given a reminder on how to rehearse, then both groups completed digit span task

- Behavioral evidence of rehearsal (e.g., whispering, moving lips, or saying the stimuli repeatedly) was also recorded.

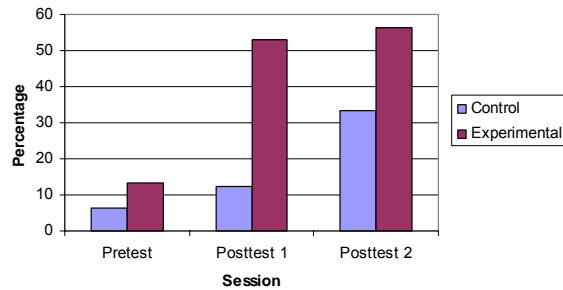
Results: Rehearsal Training



- Age was **not** correlated with whether children showed and increase in memory span

Results: Behavioral Evidence

Percentage of Children Showing Behavioral Evidence of Rehearsal



Conclusions

- ▶ Rehearsal training is effective in improving memory for numbers among young children with FASD
 - Age was not related to increases in memory span indicating that rehearsal training may be beneficial for children of all ages (even preschool)
- ▶ More children in the experimental group showed behavioral evidence of using rehearsal after the intervention
 - Age was not related to behavioral evidence
 - Older children were more able to articulate that they were using rehearsal

Executive Functioning Intervention

- ▶ Executive Functioning in FASD
- ▶ Executive Functioning Interventions

Executive Functioning (EF) in FASD

- ▶ EF: higher order cognitive process
 - Inhibition, set-shifting, working memory, planning, organization, decision making, fluency
- ▶ Children and adults with FASD and PAE are impaired on a variety of EF tasks. EF is mediated by frontal lobe, PAE negatively effects the prefrontal cortex (see Rasmussen, 2005)

Importance of EF (Diamond et al., 2007)

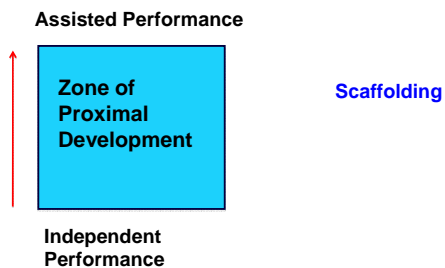
- ▶ EF is important for academic achievement
- ▶ Poor EF linked to problems with social functioning and mental health
- ▶ Poor EF linked to poverty

EF Interventions

- ▶ Diamond et al. (2007) evaluated EF intervention program "Tools of the Mind"
 - 147 preschoolers in low-income urban preschools
 - 85 randomly assignment to Tools and 62 to contrast group (supports academics but not EF)
- ▶ Children were in program for 1-2 years
- ▶ Completed EF tests after the program
 - Measuring inhibition, rules, switching attention

Vygotsy: (Bodrova and Leong, 2007)

- ▶ Based on Vygosky's theory of cognitive and EF development.



Tools of the Mind Program (Diamond, 2007)

1. Concrete, External Aids

Buddy Reading: Children in pairs with picture book, take turns telling each other story

- ▶ Visual aids (picture of ear when time to listen)
- ▶ After a few months pictures not needed
- ▶ Listener asks a question about the book at end

'Clean up song' used when cleaning up after activities

Tools of the Mind Program (Diamond, 2007)

2. Regulate Others' Behavior

- ▶ Counting done in pairs: One child counts and one watches, and then checks counting after
 - Self-reflection and inhibition

3. Self-Regulatory Private Speech

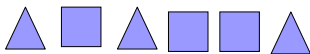
- ▶ Self-directed speech out loud
- ▶ Teachers model and encourage private speech
- ▶ Pretend play

Tools of the Mind Program (Diamond, 2007)

4. Private Speech During Rule Switching

- ▶ Private speech important when tasks become more difficult and involve rule switching

Pattern movement game



- ▶ Different shapes assignment to different movements, then switch rule
- ▶ Encourages use to private speech to remember new rules

Tools of the Mind Program (Diamond, 2007)

5. Mature Dramatic Play

- ▶ Children think and plan play scenario ahead of time, then act out scenario
- ▶ Repeat with different scenario
- ▶ Think ahead (and talk) and plan
- ▶ Remember the role and the scenario
- ▶ Inhibit other behaviors

6. Teacher Training

Results (Diamond, 2007)

- ▶ After the program, children in Tools performed much better than contrast group on measures of EF (inhibition, rules, and switching attention).
- ▶ More demanding EF tasks showed largest effects and correlated most with academic measures.
- ▶ EF **CAN** be improved in young children attending regular classrooms.
- ▶ Long-term effects?

Using Computer-Based Interventions

- ▶ There is interest in the use of computer programs claiming to enhance brain function (e.g. Wii, Nintendo DS)
- ▶ Intervention efforts which utilize computer based materials do so in conjunction with meta-cognitive and behavioral interventions and positive outcomes have been identified
- ▶ However, given the number of materials being produced and becoming available online and in other formats due diligence is required

Using Computer-Based Interventions

- ▶ NOT A CURE or FIXALL – While these techniques may not restore (or remediate) cognitive function to full capacity, they may improve function enough to allow children to engage more in learning or other compensatory strategies.
- ▶ Process specific training should be delivered within the context of an overall remediation plan.
- ▶ Participants have increased sense of self-esteem which can lead to increased benefit for other interventions & therapies.

Cognitive Carnival

Our current work-in-progress:

- ▶ Combines working memory, inhibition control and attention training.
- ▶ Designed with key aspects in mind:
 - Consists of 3 games: Liftoff, Wheel and Platform
 - Played as a “game” with an X-box controller
 - Levels are hierarchically organized by difficulty
 - Internal and external rewards provided throughout game play
 - Each level requires ≥90% accuracy to advance
 - Levels can be re-tried as many times as necessary
 - Noises indicate omission and commission errors

Liftoff

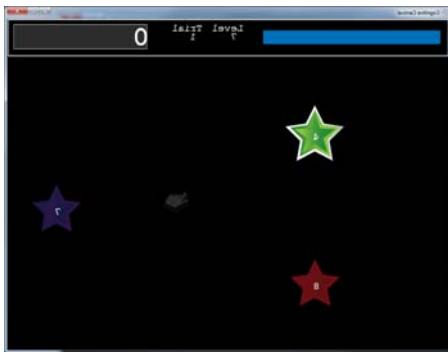
- ▶ Measure of auditory and visual spatial working memory
- ▶ Total of 18 levels
 - 9 trials per level that also increase in difficulty - three levels with 3 items, three levels with 4 items, three levels with 5 items

Liftoff

▶ Variables:

- Location of items on screen
- Visual or auditory presentation of items
- Visual and auditory distracters
- Speed of presentation
- Rule complexity: repeat sequence or put in numerical/alphabetical order and ignore shape
- Number of items: standard is 3, 4, 5 – can be increased or decreased depending on child's age and abilities

Liftoff



Wheel

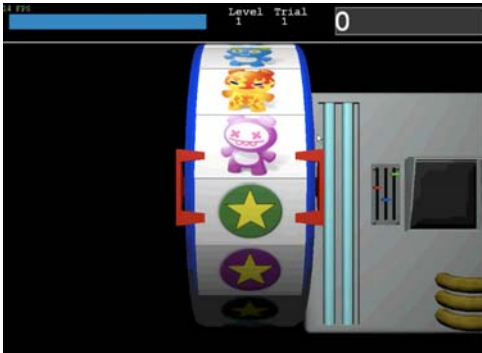
▶ Measure of sustained attention

▶ Total of 19 levels

▶ Variables:

- Length of time (increases from 3 to 7 minutes over trials)
- Target present (20-30%)
- Speed of presentation (slow, medium, fast)
- Number and location of distracters
- Rule complexity:
 - Press "A" when you see blue star
 - Press "A" when you see red square followed by green circle

Wheel



Platform

- ▶ Measure of auditory and visual working memory
- ▶ Total of 20 levels
- ▶ Variables:
 - Number of items to find (increase from 3 to 7 over levels)
 - Type of item (fruit, balls, flags)
 - Distracters (spikes and “bad guys”)
 - Visual or auditory presentation
 - Rule complexity: forward or backward

Platform



Cognitive Carnival

- ▶ Application of metacognitive skills, self-regulation and scaffolding
- ▶ Children are explicitly encouraged to make errors and learn from them
- ▶ Children are encouraged to employ additional strategies when performance is weak
 - Child may help brainstorm different strategies with interventionist

Metacognition

- ▶ Consists of:
 - Monitoring cognition: self-reflection of own thought and thought processes
 - Controlling cognition: using metaknowledge to regulate information processing and behaviour
- ▶ Necessary for self-regulation – the volitional process of being aware of goals and monitoring and controlling cognitions, emotions, behaviours, and environment for the achievement of self-goals
 - Deliberately controlling one's thoughts and actions

Scaffolding

- ▶ Back to Vygotsky
- ▶ Used to facilitate learning in combination with the metacognitive strategies
- ▶ Scaffolding:
 - Is individualized - support is tailored to child and context
 - Is calibrated - support is dynamic and provided at specific level
 - Fades - scaffold provided as necessary and reduced over time as competence increases

Strategies

- ▶ Rehearsal strategies:
“Try repeating the numbers as you hear them.”
- ▶ Visualization strategies:
“Picture the shapes in your mind.”
- ▶ Reducing speed:
“Take some time to memorize the items before starting the level.”

Executive Functioning Training in Children with FASD: A Pilot Study

- ▶ March to June 2010 we completed the pilot study using Cognitive Carnival with children diagnosed with FASD
- ▶ Randomized clinical control trial with 18 students in Edmonton Public Schools
- ▶ Each child received 24 half-hour sessions over a 12-week span

Executive Functioning Training in Children with FASD: A Pilot Study

- ▶ Children ages 7- 13 (mean 9.5 years)
- ▶ Randomly assigned to control or intervention condition, all had an FASD
- ▶ Control condition: equal amount of time with interventionist using computer education materials; for example: animals/geography/strategy games

Cognitive Carnival Pilot Study Cont.

Pre and Post Measures	
NEPSY and NEPSY-II	<i>neuropsych: memory, visuo motor, visuospatial, attention & inhibition</i>
Spatial Span (WISC IV Integrated)	<i>working memory</i>
Digit Recall (WMTB-C)	<i>working memory</i>
WJ-III Reading Fluency	<i>reading</i>
WJ-III Quantitative Concepts	<i>math</i>
CPT	<i>attention</i>
Day/Night Task	<i>inhibition</i>
Go/No-Go	<i>inhibition</i>
BRIEF Parent and Teacher	<i>executive functioning</i>
Conners Parent and Teacher	<i>attention</i>

Cognitive Carnival Pilot Study Cont.

- Testing completed by research assistants blind to group assignment
- Majority of participants also received pre/post DTI scans (co-enrolled in longitudinal DTI study)
- For analysis we looked at differences in raw scores between pre- and post- intervention

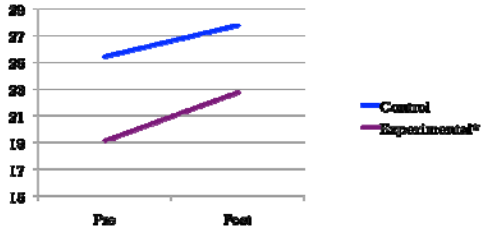
Cognitive Carnival Pilot Study Results: Subtests that improved pre- to post-test

Control Group	Experimental Group
NEPSY II Memory for Names	NEPSY II Memory for Names
NEPSY II Memory for Names Delayed	NEPSY II Memory for Names Delayed
WJ-III Quantitative Concepts	WJ-III Quantitative Concepts*
NEPSY Visuomotor Precision: completion time	NEPSY Arrows
NEPSY Auditory Attention: total correct	NEPSY Auditory Attention: total errors*
NEPSY Auditory Attention: omission error	WMRT-R Word ID

*Approached significance

Cognitive Carnival Pilot Study: Noteworthy Results

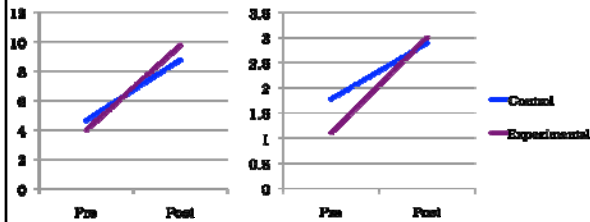
■ WJ-III Quantitative Concepts includes identifying terminology, formulas, sequences and number patterns related to math.



*Approached significance

Cognitive Carnival Pilot Study: Noteworthy Results

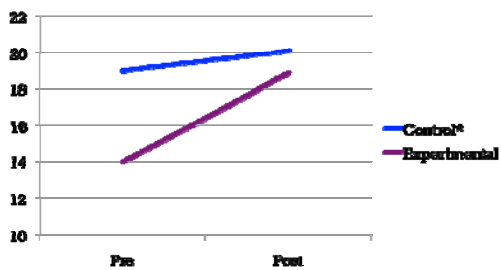
■ NEPSY-II: Memory for Names ■ NEPSY-II: Memory for Names Delayed



Both statistically significant.

Cognitive Carnival Pilot Study: Noteworthy Results

■ NEPSY Arrows: Visuospatial processing



*Not statistically significant

Issues we encountered:

- ▶ Small groups (9 control, 9 experimental).
- ▶ Pre- and post-measures not sensitive enough.
- ▶ Time-lapse between intervention and post-testing.

Important to note...

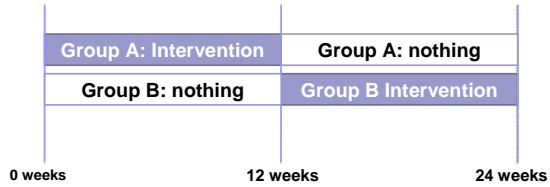
- ▶ The control group in 2010 still received an educational computer intervention.
- ▶ While Cognitive Carnival is designed to target executive functioning, the personal component (coaching, scaffolding, one-on-one time) is essential.
 - The control group still received the personal component of the intervention.
 - Our results may be due to the positive effect that one-on-one time and coaching have on students with FASD.

2011 Intervention

We used the 2010 pilot study to modify our approach...

- ▶ **Increased age range:** currently working with 24 students ages 6 to 16 (mean 11.8 years).
- ▶ **Using a delayed-treatment control approach:**
 - 2 groups ($n_1=11$, $n_2=13$)
 - All students are tested 3 times:
 - Before Group A receives intervention (0 weeks)
 - After Group A receives intervention but before Group B starts (12 weeks)
 - After Group B completes intervention (24 weeks)

Delayed-treatment Control Method



- ▶ Using this delayed-treatment approach:
 - Group B will be a control (12 weeks with no intervention)
 - Group A will measure retention (12 weeks after intervention)

2011 Intervention

- ▶ Using this delayed-treatment approach:
 - Group B will be a control for itself and Group A.
 - Group A will look at whether changes are retained for 12 weeks after intervention.
- ▶ Benefits of this approach:
 - Allows us to still have a control group without using a “sham” intervention (educational games etc.)
 - Eliminates group differences
 - Determine if there is sustained learning
 - Easier to administer intervention to half the number of students at one time

2011 Intervention

Additional Changes

- ▶ New measures:
 - Tasks of Executive Control (TEC)
 - KITAP: Flexibility, Distractibility, Divided Attention
- ▶ Measures that we kept:
 - Reading and math fluency (WJII)
 - Digit Recall (WMTB)
 - Spatial Span (WISC IV Integrated)
 - Parent and teacher rating scales (changed)

2011 Intervention

Additional Changes

- ▶ Pre-, mid-, and post-testing is being done in the schools rather than the university, to eliminate caregiver burden and time-lapse.
- ▶ Better communication with teachers: allow input about when students are taken out of class for intervention.

2011 Intervention

Our hopes for this year...

- ▶ We hope to find measurable differences using our new, more sensitive measures, new procedures and design.
- ▶ With two larger groups and a total n of 24, we hope to find significant results.

Cognitive Interventions: Overall Conclusions

- ▶ Show promise for individuals with FASD
- ▶ Need to be studied to ensure effectiveness, and then implemented within a larger context of support - no quick fixes but rather part of a larger system of support

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**For information on upcoming sessions
in the FASD Learning Series:
www.fasd-cmc.alberta.ca**

**Please take the time to fill out the
on-line evaluation**

Thank You!
