Games that Work: Technologies to Improve Outcomes for FASD

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Workshop Plan
1. “Serious Games” and FASD
   - Cognitive (Re)habilitation (25 minutes)
   - Understanding “serious games” (15 minutes)
2. Games that have “worked” for FASD
   - Safety Games (Strickland, et al.) (15 minutes)
   - Attention Games (15 minutes)
3. Games Being Developed
   - (15 minutes)
4. Why do Games Work in FASD?
   - Discussion and Audience participation (15 minutes)

A Discussion of Cognitive Re/Habilitation
Kimberly Kerns, Ph.D.

WHAT IS COGNITIVE RE/HABILITATION?

➢ A process whereby children and families affected by cognitive, behavioural, or emotional consequences of developmental or acquired neurological conditions,
➢ work with psychologists, therapists, teachers, and members of the wider community,
➢ to achieve their optimum psychological, social and educational functioning at home, at school and in the community

Deficits in Attention, Working Memory, and Executive Function

Common To Many Childhood Conditions Including:

➢ Acquired brain injury (across the life span)
  - TBI
  - Anoxia, Stroke
  - Cancer treatments affecting the central nervous system
➢ Developmental disorders
  - ADHD
  - Fetal Alcohol Spectrum Disorders (FASD)
  - Learning disabilities
  - Autism spectrum disorders (ASD)
➢ Other developmental conditions such as low birth weight and prematurity, seizure disorder, spina bifida
The Impacts of Difficulties in These Areas Commonly Include

- Problems with learning, life skills and adaptive functioning at school and at home
- Difficulty with coping skills, especially when demands, stress, and frustration increase
- Negative impacts on self-esteem
- Decrease in motivation to try and avoidance of cognitive tasks – cognitive ‘learned helplessness’

In the school setting attention and memory difficulties result in:
- Inconsistent learning profiles
- Knowledge gaps

Executive difficulties result in:
- Limited self-regulation of learning
- Impaired ability to plan and organize behavior to complete tasks
- Inconsistent self-regulation of mood and emotion

Repeated failures result in:
- Frustration, anger and acting out
- Withdrawal, avoidance and low self-esteem

These difficulties are also common in adults following TBI

- Research in adult cognitive rehabilitation has a long history – may provide models.
- Example: Process specific training approaches for improving attention and working memory in this population have established empirical support.
- Can methodologies used or principles learned in this population be useful for children with similar difficulties?

CAUTIONS!

Although we can adapt what we have learned from adult rehabilitation to some degree, there are unique developmental and contextual issues at all stages of recovery and treatment for children

- Age at injury or impact of neurodevelopmental condition
- Developmental stage
- Functional maturation
- Key role of family and school
- Life tasks specific to children

(Anderm, 2009)

Many neurodevelopmental conditions have similar behavioral impact as ‘traumatic brain injury’ (same frontal striatal systems involved)

- Memory and learning difficulties may result in a broadening gap between the child’s skills and those of their peers
- Young children with brain injury may ‘grow into’ impairments over time as new maturational skills such as executive control are required
- Damage to the young brain may be more detrimental than similar insults in adulthood

Cognitive Re/Habilitation in Context

CAUTIONS!

Cognitive Re/Habilitation in Context
Rehabilitation literature in adults supports ‘Errorless’ or Error Free Learning Procedures

- Baddeley and Wilson, 1994
- Demonstrated that people with brain injury learned better and forgot less if they were prevented from making mistakes while learning
- Many replications of this finding in the literature
- Note: Many features in common with Direct Instruction
  - Task analysis
  - Sufficient modeling
  - Carefully guided practice
  - Prevention of guessing and thus chancing errors
  - Gradual fading of prompts
  - Systematic corrective feedback

Review of the Principles of Direct Instruction

- Teach to mastery
  - Don’t try something until the necessary knowledge/skill is in place
  - Scaffolding is important!
- Maintain consistently high rates of success and engagement
  - Minimize errors
- Plan and program for generalization
- Provide frequent and cumulative review

Not originally designed for educating children with disabilities, but shown to be highly effective

Evidence for Effectiveness of Direct Instruction in Childhood TBI

- Glang et al, 1992 (follow-up review in 2008)
- 3 case studies (children with TBI; 6, 8, and 10 years old)
- DI customized to students’ neuropsychological profiles
- Tutoring provided 2-3 times/week for 6 weeks
- All made gains:
  - Discrete skills (math facts, sound identification)
  - Complex skills (math story problems, logical deductions)
  - Self-management (e.g., staying calm following error correction)

Using Effective Skill Teaching Strategies

Strong evidence base for two approaches in children with learning needs (Swanson, 1999)

- Meta-analysis of 180 studies of the effectiveness of instructional components in special education
- Validated in both typically developing and children with disability
- Most effective approach for students with learning problems, regardless of etiology combines:
  - An explicit instruction model (e.g., Direct Instruction)
  - Cognitive Strategy Intervention

Evidence of changes in brain function with direct interventions!

‘Constraint-induced movement therapy’

- in individuals with hemiplegia constrain ‘good limb’ and use behavioral shaping
- improvements in function of affected limb & change in brain activation (e.g., Taub, 2004)
- Evidence in animals
- Adult stroke populations
- Children
What is the effectiveness of process specific interventions being developed for cognitive abilities that are more diffusely organized and broadly activated and ‘why try’?

- Attention
- Working Memory
- Executive Function (EF)

“Experience Dependent” Neural Plasticity
(Klein & Jones, 2008)

- Overwhelming evidence that the brain continuously remodels its neural circuitry in order to code new experiences and enable behavioral change
- This is the neurological basis of ‘learning’
- Also the mechanism by which the damaged brain “re-learns” lost behavior or supports new behavior in response to both habilitation and rehabilitation.

Important Principles of ‘Experience Dependent’ Neural Plasticity
(Klein & Jones, 2008)

1. Use it or lose it
   - Failure to drive specific brain functions can lead to functional degradation
   - Neural circuits not actively engaged in task performance for an extended period of time begin to degrade

2. Use it and improve it
   - Training that drives a specific brain function can lead to an enhancement of that function
   - Improvements in sensory & motor skill training are accompanied by profound plasticity and drives reorganization in remaining cortical regions after injury

3. Specificity
   - The nature of the training experience dictates the nature of the plasticity
   - Learning or skill acquisition is required to produce significant changes in patterns of neural connectivity - repetition of a previously learned or unskilled movement fails to drive this plasticity

4. Repetition Matters
   - Induction of plasticity requires sufficient repetition
   - Repetition of a newly learned or relearned behavior is required to induce lasting neural changes – animal studies show neural change occurs after seven days of training despite significant behavioral changes
   - It is repetition that instigates skill within neural circuitry making the acquired behavior resistant to decay in the absence of training

5. Intensity Matters
   - Induction of plasticity requires sufficient training intensity
   - Documented in aphasia rehab - intensity is an important predictor of outcome
   - Animals trained on a skill reaching task performing 400 reaches per day showed increased synapses in motor cortex, however an animal only performing 60 reaches per day did not

6. Time matters
   - Different forms of plasticity occur at different times during training
   - Neural plasticity is a process; during motor training, gene expression precedes synapse formation which in turn precedes changes in the motor map
   - When dealing with brain injury there are time windows in which training is more effective in directing neural plasticity

7. Salience matters (reward and attention)
   - Engaging the neural systems that mediate saliency (motivation and attention) is critical for driving experience-dependent plasticity
   - The forebrain cholinergic system appears involved with brain changes only seen when attention/reward are part of training
   - In auditory and motor systems training fails to drive plasticity if the subject’s attention is drawn away from the activity

8. Transference
   - Plasticity in response to one training experience can enhance the acquisition of similar behaviors
   - Plasticity in one set of neural circuits promotes concurrent or subsequent plasticity (e.g. training fine digit movement increases corticospinal excitability)
   - Coupling training with peripheral/central stimulation may drive transference effects (e.g., interest in the impact of exercise on brain health)

9. Age matters
   - Age affects underlying factors such as neurogenesis, expression of plasticity related molecules, accumulation of neurotoxic factors – studies suggest younger brains are more responsive to experience
   - These principles may be more important following injury
* Key Ingredients *

- Approach: Grounded in theory
- Intensity: Massed practice
- Saliency: Make it fun!
- Organization:
  - Hierarchical
  - Individualized approach
- Generalization must be planned for!

Using “Serious” Games for “habilitation” in FASD

- How can the “game” format contribute to learning in a child with neurodevelopmental deficits?
- How is “game learning” beneficial for FASD?

What are “serious games”?  

- What is a “serious game”?
- How are they used?
- How is learning enhanced when games are used?
- How have games been used in developmental disabilities and education?

“Serious Games”

- There are more than 20 meanings for the word “game”!
  - “an amusement or pastime”
  - “a competitive activity involving skill, chance or endurance”
  - The components of such activities...
- A “serious game”, however,
  - Has a serious purpose...
  - Uses “game” techniques for education, training, other non “entertaining” activities.
  - Maybe be electronically based or not!

Common Users of “Serious Games”

- US Government
  - Flight simulations
  - Military operations training ("Militainment")
- Medical/Health Care
  - Emergency Triage
  - Disaster Training
  - “Exergaming” (e.g., Wii)
- Educational Settings
  - Many applications ("Edugames")
- Businesses/Marketing (e.g., using MMORPGs to teach business ethics)

Some characteristics of computer games that support learning

- Multimodal/multisensory
- Engaging
- Child (Self) Directed/paced
- Repetitive
- “Patient”
- Convenient
How is learning enhanced when games are used?

Multimodal Experience

- "Computer games replicate in a "virtual world" the multimodal learning experience that is most effective in the "real" world. The child engaged in game playing has the visual, auditory and motor experience and feedback that is associated with more efficient learning and retention of information."* 


Motivation for learning

- Engaging. "The computer game format is an effective way to present... information... since most preschool and elementary age children enjoy this activity."

The activity is enjoyable because there are frequent reinforcements; the game is structured to allow rapid, incremental learning at the learner's own pace.

The game allows repetition until mastery is achieved

- Repetition. "Children will play games repeatedly and can do so on their own or with minimum adult supervision. Such repetition may be aversive for adults or boring for those with more cognitive ability but the computer is patient and will continue to support the child's learning as long as necessary."

The computer is "patient"

- "Children with attention problems and learning delays may need more repetitions than typical children to encode information"... the ... "game allows them to learn at their own rate and to repeat the information as often as they want to."

Convenience

- "...a game that is effective in engaging children and teaching them appropriate skills could be used at both home and school as an adjunct to direct adult instructions."

To learn more about games

- Do2learn.com-Website devoted to games and activities for parents and children with educational needs and developmental disabilities. http://do2learn.com
- SAGE for Learning -(Simulation and Advanced Gaming Environments) Their website, http://www.sageforlearning.ca/, features many demos of newly developed games and simulations, which are available in both English and French.
Using serious games for Mental Health, Developmental Disabilities and Education

- Many different formats used
  - Instructional games (e.g., Reader Rabbit)
  - VR-Virtual reality
    - Total immersion
    - Computer based
  - Role playing games (Avatar-based)
  - Simulation games (e.g., SimCity, the SIMS)
  - Modeling systems (e.g., Virtual Solar System)

Applications: Mental Health-Phobias

- Overcoming Phobias by Virtual Exposure: Dorothy Strickland, Larry Hodges, Max North, Suzanne Weghorst, Do2learn.com

- Treating Anxiety with Virtual Reality Exposure: Larry Hodges, Barbara Rothbaum, Kenneth Graap, Emory University School of Medicine

Considerations in Designing Games for Children with DD*

- Developmental Level
- Motivation
- Time Limitations (attentional constraints)
- User Controls
- Instructions (Type: Visual/Verbal, Multimodal; individualized to learner levels)
- Learning methods employed


Learning Methods: Behavioral “rules”

- Direct Instruction
- Use Observational Learning
- Positive reinforcement
- Do not allow “wrong choices” to avoid reinforcing such an action. That is, avoid learning incorrect sequences that will then have to be extinguished.
- Avoid “trial and error” learning. Set up world to ensure “errorless learning”.
- Provide feedback (“debriefing”)

Some Examples...
Games for Adaptive Functioning: Using Computer Games to Teach Alcohol-Affected Children About Fire and Street Safety

Claire. D. Coles
Dorothy C. Strickland
Lynne Padgett
Lynnæ Beilmoff

Acknowledgments

Research was carried out at the Marcus Institute (now the Marcus Autism Center) and was supported by a Grant to Dr. Strickland, NIAAA # AA13362. More of her work can be found on do2learn.com

We want to thank all the families and children who participated in this research!

Why safety games for children with FAS(D)?

• Unintentional injuries leading cause of death and disability for children in USA
• Those with Developmental problems have higher rate of injuries than other groups
• Cognitive and behavioral characteristics of FASD put them at high risk
• Computer games are multisensory, attractive to children, and “patient”

Hypotheses

1. Computer games, employing a “virtual reality” model, will teach alcohol-affected children, ages 4 to 10 years, safety skills. Children will show significantly increases in ability to verbalize safety rules for games to which they are exposed while failing to show such gains for a 2nd game to which they are not exposed.

2. Learning from computer games will be “generalized” to real world simulations immediately following learning.

3. Information and actions learned through computer games will be retained at 1-week follow-up.

What are the games like?

• Virtual World-Home Fire or Street
• Provide a “multimodal” learning experience—sound, sight, motor activity
• Presented on a PC with key board direction keys using standard 3D engine software and Java programming
• Training conducted by dog named “Buddy” who shows correct actions in incremental steps and reinforces correct actions

Using “virtual reality” to teach Safety Skills

Buddy in the Street Crossing World

Buddy in the Home Fire World
Some learning “rules”

- Children are both told rules and shown correct actions by Buddy.
- They are shown actions in small, incremental, manageable steps.
- Correct actions are reinforced by success and by Buddy providing verbal reinforcement.
- Dangerous behavior is not reinforced:
  - Children cannot run into fire or street without stopping program and placed back and told, “try again.”
  - They are not permitted to learn incorrect sequences of action (e.g. L/R/L).

Safety Skills for Fire and Street Safety for Young Children

<table>
<thead>
<tr>
<th>Fire Safety Skills</th>
<th>Street Safety Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>“What would you do if you saw a fire in the room?”</td>
<td>“What would you do if you needed to cross the street?”</td>
</tr>
<tr>
<td>1. Move away from fire.</td>
<td>1. Take adult hand.</td>
</tr>
<tr>
<td>2. Walk out of room.</td>
<td>2. Look “left/right/left”</td>
</tr>
<tr>
<td>3. Go to the “meeting place”.</td>
<td>3. Check for moving cars.</td>
</tr>
<tr>
<td>4. Sit and wait at meeting place for adult</td>
<td>4. Stay inside the white lines when you cross.</td>
</tr>
</tbody>
</table>

Recruit sample (N=32)
and Pretest all children on Verbal Response both sets of Questions

Fire Safety Group (n=16) Plays Fire Game
Street Safety Group (n=16) Plays Street Game

Demonstrate Generalization
Retest Both Groups on both sets of Questions

After 1 week’s time

Research Design and Procedure

Procedure

- Participants recruited from Marcus FAS Clinic, ages 4 to 10 years.
  - IQ >50
  - Not in other study
  - Had dx other than FAS, pFAS
  - Stable living environment
  - Parents asked not to discuss safety skills with children during the study

Children’s Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Fire Group</th>
<th>Street group</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>6.98 (1.64)</td>
<td>6.85 (1.97)</td>
<td>ns</td>
</tr>
<tr>
<td>Ability StScore</td>
<td>83.13 (14.7)</td>
<td>77.53 (16.9)</td>
<td>ns</td>
</tr>
<tr>
<td>% FAS</td>
<td>56.3</td>
<td>62.5</td>
<td>ns</td>
</tr>
<tr>
<td>% pFAS</td>
<td>43.8</td>
<td>31.3</td>
<td>ns</td>
</tr>
<tr>
<td>% Male</td>
<td>87.5</td>
<td>43.8</td>
<td>&lt;.009</td>
</tr>
<tr>
<td>% Medicaid</td>
<td>80</td>
<td>93.3</td>
<td>ns</td>
</tr>
<tr>
<td>% Adopted</td>
<td>56.3</td>
<td>62.5</td>
<td>ns</td>
</tr>
<tr>
<td>% Caucasian</td>
<td>68.7</td>
<td>50</td>
<td>ns</td>
</tr>
</tbody>
</table>
Differences Scores

- Because some children knew some skills, it wasn’t “fair” to compare the mean correct responses for each group.
- Used “difference scores” to control for previous knowledge.
  - -1=From correct to incorrect
  - 0=no change
  - +1= From incorrect to correct

Using Difference Scores

- Each child’s difference scores summed for each category of Safety Skills.
- Summary scores used as dependent variables (DV) to compare group performance with Game Type as the IV
- Controlled for age, diagnostic severity, ability level in analyses of variance. No effect of covariates on outcomes.

Mean Difference Scores in Verbal Response:

- **Fire Safety Group** (n=16)
  - Change in Verbal response to Safety Skill Items
  - Pre-Post vs. Pre-Follow

- **Street Safety Group** (n=16)
  - Change in Verbal response to Safety Skill Items
  - Pre-Post vs. Pre-Follow

Results (Comparing verbalization of learned vs. unlearned rules)

- **Played Fire Game**
  - Pretest-Posttest
    - $F_{(1,31)}=18.94, p<.000$
  - Pretest-1-week Follow-up
    - $F_{(1,31)}=15.56, p<.000$

- **Played Street Game**
  - Pretest-Posttest
    - $F_{(1,31)}=16.3, p<.000$
  - Pretest-1-week Follow-up
    - $F_{(1,31)}=3.31, p=.096, \text{ ns}$

Both groups showed significant improvement in verbalization of rules they are exposed to. Fire game seems slightly more effective in teaching and retaining verbalization of rules.

Generalization

- Important that child be able to apply safety rules in a “real world” situation as well as inside the computer
- Ability to generalize is particularly a concern in children with developmental disabilities
- Asked children to demonstrate skills both immediately following learning and 1-week later
- Asked only to demonstrate skills they had actually learned
Percentage of Correct Generalization at Times 1 and 2 for Fire and Street Game Groups

Study Limitations

- Only done with FASD and not with typical children or other disabilities. Limit generalization of results
- Did not compare with other methods for teaching safety skills. No way to know what is most effective

Conclusions

- Computer games may be a useful tool for teaching safety skills to children with developmental problems
- Games can be played at home and school
- Characteristics of computer games may be supportive of learning for children with FASD
  - Repetitiveness
  - Multisensory
  - Learning at their own rate

Cognitive Re/Habilititation in Context

Goals of Process Specific Approaches are to directly impact these capacity-limited cognitive processes

- Interventions are designed and believed to improve the underlying impaired process directly.
- The change in underlying capacity is assumed to be secondary to neural plasticity and/or reorganization of neural systems as previously discussed – as such the principles of neural plasticity should guide the intervention!

Principles of Attention Process Training (APT; Sohlberg & Mateer, 1989)

1. Adopt a treatment model grounded in attention theory
2. Use therapy activities that are hierarchically organized
3. Provide sufficient repetition to re-establish skills
4. Base treatment decisions on performance – adapt the level of difficulty based on success
5. Actively facilitate generalization to functional activities from the start
Research in adults

- Attention process training is supported as a “practice standard” for adults in the post-acute stage. Reviews of the literature:
  - Michel & Mateer, 2006
  - Cappa et al., 2005
  - Cicerone et al., 2005
  - Lincoln, Majid, & Weyman, 2005
  - Sohlberg et al., 2003

Pay Attention!

Application of ‘Pay Attention’ APT in children with FASD

- 20 Labrador Inuit children (ages 6.8-11.9, 11 girls, 9 boys)
- 2 groups matched for age and non-verbal IQ
- Randomly assigned to sustained attention training or contact control group condition
- 12 daily 30 min individual training or support sessions (approx 3 weeks)

PAY ATTENTION! TASKS

- Focus on both visual & auditory
- Utilize Sohlberg & Mateer’s Hierarchical Model of Attention

Pre- & Post-test assessments

Psychometric Measures of Attention

- Auditory sustained attention
  - (TEA-Ch Score & Code Transmission)
- Visual sustained attention
  - (KITAP Ghosts’ Ball)
- Visual selective attention
  - (TEA-Ch Sky Search & KiTAP Happy/Sad Ghost)
- Alternating attention
  - (TEA-Ch Creature Counting & KiTAP Dragon’s Castle)
- Divided attention
  - (KiTAP The Owls)

Pay Attention Training Materials

- Pay Attention! sustained attention modules

Contact Control Materials

- Worksheets, games, and art activities tailored for academic concepts and typically available within the regular academic environment
Significant treatment effects were found on many of the post-test 'untrained' measures of attention.

Significant treatment effects were also seen on measure of non-verbal reasoning (CTONI) – probably due to better attention to the test.

Teachers rated all children as having post-test improvements in attention and executive functioning regardless of treatment group – ‘halo effect’.


Post-test Findings for Children with FASD

Visual Sustained Attention

Auditory Sustained Attention

Selective Attention

Alternating Attention
**CPAT: Computerized Attention Training Program**

- CPAT tasks train 1 of 4 proposed attention networks based on Posner’s model:
  - sustained attention, selective attention, orienting of attention, executive attention (Posner & Peterson, 1990)
- Efficacy studies in child ADHD samples
- Game like tasks in which participants advanced in difficulty based on the speed and accuracy of their performance – program self-adjusts
- Tasks completed with research assistant monitoring/encouraging during the training

Shalev, Tsal & Mevorach (2006)

**Examples of Training Tasks**

- Orienting attention: Bringing attention to stimulus at spatially diverse locations with a ‘marker’ 🕵️‍♂️
- Sustained attention: Monitoring for a target stimulus 🎨
- Selective attention: Ignoring distractors and attending to selective features of target stimulus 🎨
- Executive attention: Monitoring ‘global’ and ‘local’ aspects of stimuli 🎨

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**CPAT in Children With FASD: A Pilot Study**

- Sample included 10 children (6 males and 4 females) who were identified by the participating school district as having FASD
- Ages 8-15 (M = 12.3, SD = 2.67) IQ (M = 91.00, range 60-107)
- Intervention provided 4x a week, 30 minute sessions conducted at school as part of the school day
- On average, participants completed 30.5 sessions over a period of 9.5 weeks to reach the required total of 16 training hours.
- Children are administered the CPAT individually by research assistant who provided behavioral support and metacognitive strategies to enhance performance
- External motivators were provided based on improvement and performance as tracked in the CPAT

Kerns et al (in press)

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**Measures**

- Pre & post testing conducted by research assistants who didn’t work with the children
- Measures included:
  - KITAP tasks, Span tasks & Academic Fluency (WJ-III)
  - Evoked potential study pre/post using the Children’s Attention Network Test & Flanker tasks (assessing ERN)
- All pre/post tests conducted within 2 weeks of commencement/conclusion of intervention

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**RESULTS**

- ERP analyses are still being completed

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**Computerized training of working memory**

- Increases in visuospatial and auditory working memory after 5 weeks of working memory training
- Improvement was associated with changes in fMRI in frontal and parietal cortex, areas classically involved in working memory

Olsson, Westerberg & Klingberg, 2004
WORKING MEMORY TRAINING IN CHILDREN

Klingberg, Forssberg & Westerberg, 2002
Klingberg et al., 2005

Cogmed's ROBOMEMO

COMPUTERIZED WORKING MEMORY TRAINING IN CHILDREN WITH ADHD

- Randomized, double-blind studies
- Each working memory task presented daily for 5-6 weeks
- 2002: 14 children ages 7-15
- 2005: 53 children ages 7-12
- Conducted at home or school

<table>
<thead>
<tr>
<th>Treatment Condition</th>
<th>Placebo Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasks started simple and became more difficult according to individual progress</td>
<td>Tasks started simple and did not change in difficulty – no hierarchical adjustment</td>
</tr>
</tbody>
</table>

Results

<table>
<thead>
<tr>
<th>2002</th>
<th>2005 Post-test</th>
<th>2005 3-month follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Spatial Working Memory (trained task)</td>
<td>***</td>
<td>Not given</td>
</tr>
<tr>
<td>Digit span</td>
<td>Not given</td>
<td>**</td>
</tr>
<tr>
<td>Span Board</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Raven's Matrices</td>
<td>***</td>
<td>**</td>
</tr>
<tr>
<td>Stroop</td>
<td>*accuracy)</td>
<td>** (accuracy * timing)</td>
</tr>
<tr>
<td>Head Movements</td>
<td>***</td>
<td>Not given</td>
</tr>
<tr>
<td>Choice reaction time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conners &amp; 18 DSM-V items</td>
<td>Not given</td>
<td>**Parent - att</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Parent - att</td>
</tr>
</tbody>
</table>

* p<.05  **p<.01  ***p<.001

CogMed training in Children

Holmes et al., [2009]

- Randomized intervention trial
  - N=22 - adaptive WMT (12 ♂)
  - N=20 - non-adaptive WMT (15 ♂)
- Selected via routine screening
  - Below the 15th percentile on 2 tests of WM
  - 345 children screened in 6 schools
- 8-11 years of age, randomized by school to intervention condition
- Children completed tasks from the AWMA pre/post and at 6 month followup
- Children in the adaptive training also made significant gains on a task of following instructions and a task of mathematical reasoning at followup

On AWMA tasks the children in the adaptive training made significantly greater gains than did the non-adaptive. These gains were maintained at a 6 month followup except in Verbal STM

WMT in Children with ADHD on Medication

Holmes et al., [2009]

- Measures from the Automated Working Memory Assessment (AWMA, Alloway, 2007)
- 25 Children with ADHD (21 ♂ 4 ♀) with ADHD-C > 6 months prescribed medication
- Tested initially off meds (24 hours), on meds, after training and 6 months following training
- Medication only improved VS-WM while WMT impacted both STM and WM

Combining Attention, WM & IC Training?

Should we try?

- Many of the children we see may exhibit deficits in all 3 of these domains, or at least inconsistency within domains
- These abilities are rarely used in ‘isolation’ in the real world
- Within a school environment it is necessary for children to be able to ‘maintain’ abilities across longer durations of time and with ongoing distractions
Computerized intervention combining WM, Attention and IC training
Kerns et al (in progress)

• “Cognitive Carnival” has been designed:
  – To be played ‘as a game’ with an X-box controller
  – As a hierarchical and adaptive intervention
  – To provide ongoing reward throughout game play
  – With several games emphasizing varying levels of sustained attention
  – With both visual and auditory working memory demands
  – Distractors that increase as level of play increases
  – To include inhibitory control components

Results

KITAP Attention Tasks

![Graph showing improvement in KITAP attention tasks](image)

Prem = p < .10

“Cognitive Carnival” for children with Epilepsy A Pilot Study
Kerns et al (in progress)

• 8 children with epilepsy between the ages of 6 & 13
• Weekly 30 minute sessions for 14 weeks (~ 6 hours tx)
• Intervention provided one-on-one with RA's who provide motivation and metacognitive supports
• Children chose which games to play with the condition that all games be played at least once within 2 sessions
• Pre/post measures included
  – KITAP - Sustained (Ghosts Ball) and Selective (Happy Ghost) tasks
  – Digit and Spatial Span Tasks
  – Academic tasks (WJ-III Reading/Math Fluency)

Results

Span Tasks & Academic Fluency

![Graph showing improvement in span tasks and academic fluency](image)

* = p < .01

Preliminary CPT Results

Based on available data
7 Controls and 5 Intervention Participants
Interactions are statistically significant with trends for Pre/Post changes

Cognitive Carnival in Children with FASD
Kerns, Pei & Rasmussen (in progress)

• Randomized clinical control trial in 18 children with FASD
• Children ages 7-13 all with current diagnosis of FASD or pFASD
• Randomly assigned to control or intervention condition
• Control condition - equal amount of time with therapist using computer education materials (science/biology/space)
• Pre/post assessments include neuropsych battery including:
  – Selected NEPSY & Working Memory Test Battery for Children (WMF C), Reading & Math fluency (WJ-III), CPT
  – Testing completed by research assistants blind to group assignment
• Majority of participants will have also received pre/post DTI scans (co-enrolled in longitudinal DTI study)
• Post assessments are currently underway so data is preliminary
A game to develop effortful control (Executive Functioning)

F-Focus and
Plan
A-Act
R-Reflect

Successful Intervention strategies for FASD (Evidence Based)

- Early diagnosis and treatment.
- Dealing with child as individual.
- Educating parents about disorder and its “brain” base.
- Educating interventionists about disorder and its characteristics.
- Helping children learn to control arousal levels (AKA-self regulation).
- Behavior Learning Methods
- Specific skill building

Characteristics of Games that promote change in FASD

Benefits of Computer-based Instruction

- has motivating features: music, tone intensity, character vocalizations, animation.
- is cost-effective.
- is shown to be an effective instructional tool for children with ASD.
- can be customized for individual students.
- is easy to disseminate in school and home environments.

Some disadvantages of computer games as teachers/trainers

- Expensive to develop and maintain
- Requires research to demonstrate effectiveness
- Requires “special” equipment
- May not be “stand alone” is some cases. Outcomes will depend on how effectively they are used.
References


