EXECUTIVE FUNCTIONING AND AAC

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Some reflections

- Skills and knowledge
- Planning and execution
- Technological demands and conversational demands
Where does executive functioning fit?

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Executive functions are higher-order processes that enable us to:

- plan,
- sequence,
- initiate, and
- sustain our behaviour towards some goal,
- incorporating feedback and making adjustments along the way.

They enable us to plan, organize and develop strategies or rules.
Specifically for today:

**Attention**
- Attention control
- Stimulus orienting
- Selective attention
- Joint attention

**Memory**
- Working Memory
- Event Memory
Typical development

- EFs emerge towards end of 1st year
- major developments 2 & 5 years
- some aspects reaching adult levels at 12
- others continuing to develop into adulthood.

Zelazo and Muller (2002)

Atypical development

- Most studies children with autism & ADHD
- Children with SLI found deficits in both inhibiting schemes and updating

Im-Bolter et al. (2006)
The evidence available on executive function is not entirely clear.

Developing competence is likely to facilitate the development and use of aided communication.

It is possible that some children likely to benefit from aided communication will experience difficulties in this area.

What might be the implications for organisation of and learning how to use an aided system?
Attention control

- Sustained attention: Progresses from 5-10 secs @ 3 months to mature duration @ 18 months (Anderson, 2002).

- 18 months: executive attention emerges & develops 'til the mid teens, enabling allocation of cognitive resources etc.

- Driving to a destination and wondering how you got there!
Stimulus orienting (e.g. Richards, 2004) is present from birth,

Courage et al. (2006) describe 4 stages in attending to a stimulus (i) automatic interrupt, (ii) stimulus orienting (iii) sustained attention and (iv) attention termination.

Well documented on typically developing infants, there appears to be limited research on infants or who use or are likely to use aided communication.
Selective Attention

- Selective attention (Anderson, 2002): In the first year, influenced by the novelty of the stimulus.

- Up to 4 years, selective attention to complex material requires cueing (Shepp et al, 1987- 4, 7, 10 yr old)

- Cress (2002) AAC - greater demands: sustain and shift attention
Joint attention

- More social or communicative aspect of attention - ensuring communication partner attending to same event, object or person as you

- 'the capacity to jointly follow, initiate and maintain attentional focus...' (Tomasello, 1999)

- Quantity and quality of joint attention - influences early semantic and pragmatic development. AAC system adds new dynamic (i) triadic: (child - partner - referent) (ii) quadratic: (child - AAC system - partner - referent)

- Aided symbol-infused joint engagement (Belligno & McCarthy, 2012) - aided system is a focus

- Joint attention: Reduced relative to language level in children with physical disability (Cress, 2004) and language delay (Topbas et al, 2003)
Menu page: hi-tech dynamic device

- people
- action words
- animals
- adjectives
- food
apple
salad
fish & chips
orange
sandwich
sausage
pineapple
soup
pizza
Memory

- **Working memory**: 'the process of holding new visual or auditory information in mind as you retrieve older knowledge or procedures to apply to new material' (Cowan 2001)
- **Central executive - phonological loop - visuo-spatial sketchpad**

Seeing an image – route of analysis (Baddeley, 2012)
Hearing a word - semantic/ non-semantic (Baddeley, 2012)

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Elephant, umbrella, sweltering

Toy, ball, shoe, chair

Hat, bat, cat, fat, mat
Working memory – rehearsing sequences of information

Baddeley (1990 – 2012)
Phonological loop

- Articulatory rehearsal of noun material at 4;6 in typically developing children

Bishop & Robson (1989)

- Articulatory rehearsal of noun material in adults with CP

Murray (2009)

- Articulatory rehearsal of noun material in children with CP

- PL: (i) articulatory control process (Word Length Effect); (ii) Phonological store (Phonological Similarity Effect).

- Aided communicators use WM but across grammatical elements

- The study presented here looked at manipulation of verb and adjective based material
Exploratory study: Hypothesis: the emergence of articulatory rehearsal is affected by the word class involved in the task.

- 30 children, aged between 3 & 6 years, cerebral palsy
- Reference group: 30 typically developing
- Both groups trained in ‘eye pointing’ & sequencing procedure
- Testing was discontinued when failed twice on a given sequence length
- Inclusion/exclusion criteria
- Training exclusion criteria & inter-rater agreement
- 3 sets of 6 items (i: control, ii: long, iii: phonologically similar words)
- 8cmx6cm, coloured pictures
- E-Tran frame
- Presented silently and named (visuo-spatial/phonological routes)
E-Tran frame set up (spoken and silent presentation)
Results: mean memory scores

Mean memory sequence

CP
TD

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<th>CP</th>
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<tbody>
<tr>
<td>3</td>
<td>1.3</td>
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3.5
Results: (ANOVA & Post Hoc analysis)

**Verbs:** There was no significant group x age x word interaction effect:
- Phonologically similar (spoken) $F(5,40)=0.47$, not significant at $p<0.05$;
- Phonologically similar (silent) $F(5,40)=0.14$, not significant at $p<0.05$;
- Long (spoken) $F(5,40)=1.10$, not significant at $p<0.05$;
- Long (silent) $F(5,40)=1.68$, not significant at $p<0.05$.

**Adjectives:** a significant group x age x word interaction effect was found in:
- Phonologically similar (silent) $F(5,40)=3.84$, $p<0.01$. Related t-test: age 6 typically developing grp, $t=3.22$, $p<0.025$

No other evidence of articulatory rehearsal was found:
- Phonologically similar (spoken) $F(5,40)=0.66$, not significant at $p<0.05$;
- Long (spoken) $F(5,40)=0.96$, not significant at $p<0.05$;
- Long (silent) $F(5,40)=0.52$, not significant at $p<0.05$. 

No evidence of articulatory rehearsal
Summary

- Evidence of rehearsal that is non-articulatory in both groups across verbs and adjectives.
- No evidence of articulatory rehearsal of verb material at any age.
- Evidence of emerging articulatory rehearsal of adjective material in the typically developing group at 6 years.
- Rehearsal strategies identified differ from findings related to rehearsal of noun material where there was evidence of articulatory rehearsal from 5 years.
Tentative implications:

- WM skill development seems to be affected by type of word being rehearsed.

- What opportunities do symbol communicators have to practice WM strategies?

- What influence does the transparency of the symbolisation have on WM development?

- What influence does the location of the symbol have on WM development?
What aspects of WM are you using to say the following?

Pathfinder 128 +
dynamic strip

big

dog

PCS sequence
Menu page – communication book

- People
- Action words
- Animals
- Adjectives
- Food
Memory

- **Semantic memory**: non-linguistic (e.g. concepts) and linguistic components (labels/words expressing mental representations) Keil (1987), Neisser (1987)

- **AAC literature**: tend to adopt a Piagetian view of altered experiential learning (Bedrosian, 1997; Calculator, 1997; Iacono, 1992, Paul, 1997)
Single word stage: nouns predominate

Early AAC interventions: nouns predominate (Blockberger, 1995; McNaughton, 1993; Schlosser, 1997, 2002, 2014)

Nelson (1973): language learning styles (referential & expressive)

Labels and words - organisation

- Nelson (1985) Event theory: reciprocal influences of semantics and syntax + the familiarity of the event
- McNaughton (1993) reviewed scaffolding techniques to aid semantic development. An explanation of the icon may interfere with processing
- Light et al, (2013) VSD aiding contextual understanding and knowledge
Paradigmatic relationships
Syntagmatic relationships
Familiarity of events

e.g. Minsymbols

- dog eating
- fast forward
- snack
- apple
- wheelchair
- pumpkin
- apple
- cook
- pancakes


e.g. PCS

Example: Dynamic low and hi-tech devices

Both methods 1 & 2 available within the system combining schematic and taxonomic symbol organisation

Method 1: select 'food' from a menu page; this automatically takes you to a food vocabulary page. From the taxonomic array of food you select 'apple'.
Method 1: Menu page: low-tech system

- People
- Action words
- Animals
- Adjectives
- Food
food

apple

orange

pineapple

salad

sandwich

soup

fish & chips

sausage

pizza
From menu page? - recipe page

- recipe
- cake mix
- cookery book
- bowl
- pancakes
- wooden spoon
- cook
- water
- feed
Example contd: Dynamic hi-tech device

Method 2: select ‘food’ from a menu page; automatically takes you to a food vocabulary page. Select the icon ‘recipe’. This takes you to a schematic arrangement of vocabulary required for an utterance around the making of ‘pancakes’.
Method 2: from menu - recipe page
1. Get pan and spatula. Place pan on the stove.

2. Butter 2 pieces of bread. Turn on the stove. Place one slice of bread butter side down in the skillet.

3. Place a slice of cheese on top of the bread in the skillet. Put the other piece of bread on top of the cheese so that the butter side is on top.

4. Turn the sandwich with the spatula until it is cooked on both sides and the cheese is melted.
Example 2 contd: Mixed static/Dynamic hi-tech device

The method available within this device combines encoded schemas and taxonomic symbol organisation

Method 3: The message ‘apple’ can be produced from using the static display only (encoded schemas) or a combination of static and dynamic strips (taxonomies)
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<th>A</th>
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<td>NAME</td>
<td>LABEL</td>
<td>BRICKS</td>
<td>BIGED</td>
<td>SWING</td>
<td>JUDGE</td>
<td>OPPOSITE</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>EYE</td>
<td>YOU</td>
<td>DOG</td>
<td>EAR</td>
<td>TOMATO</td>
<td>THELMA</td>
<td>BRIDGE</td>
<td>ANGEL</td>
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<tr>
<td>4</td>
<td></td>
<td>NURSE</td>
<td>WATCH</td>
<td>KNOT</td>
<td>CHAIR</td>
<td>HOUSE</td>
<td>UMBRELLA</td>
<td>JACKET</td>
<td>PAINT</td>
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<tr>
<td>5</td>
<td></td>
<td>SUN</td>
<td>WORK</td>
<td>MOTHER</td>
<td>CAR</td>
<td>BEDROOM</td>
<td>TV</td>
<td>WHEELCHAIR</td>
<td>TEACHER</td>
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Method 3: a mixed static/dynamic hi-tech device:
In conclusion

- Executive functioning skill underpins all on-line communication
- Addressing off-line *drill and practice* facilitates later *on-line* functional and real time communication skill
- Effective rehearsal of word classes may emerge at different age-stages and times
- If you are not moving forward in the way you thought you might with a child: re-visit executive functioning skills and activities.