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What does research tell us about the specific learning needs of young children with Down syndrome (birth to 5 years)?

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Setting the scene for effective education

- What do we know about the effects of Down syndrome on development?
- First – the big picture across all areas of development
- Second – a closer look at the areas of specific weakness
  - Speech and language
  - Working memory
- Do we know any of the reasons for this profile?
- What are the implications of what we do know for intervention strategies?
- If we apply these strategies –can we improve the areas of weakness and change the profile?

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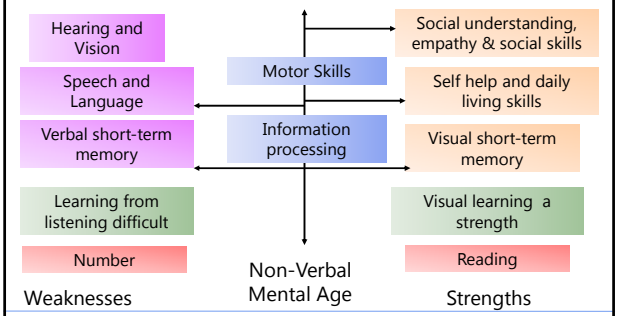
Effects of Down syndrome on development

- Most children will have delayed development
- There is a very wide range of individual differences from mild delays to more severe levels of disability
- For most children, severity of disability cannot be predicted at birth or in early years
- Not all aspects of development are equally delayed
- Research in the past 15 years has highlighted a profile of strengths and weaknesses
- We can use this information to be more effective in helping children reach their full potential – development is not fixed at birth

Typical profile associated with Down syndrome (see, Hodapp, Fidler, Buckley in DSRP 9 (3) on website



The specific developmental profile associated with Down syndrome – research overview 1

Social understanding and non-verbal communication a strength

- Good social interactive skills from first days of life
- Good empathy and positive personalities but sensitive to failure and to negative emotional cues
- May use social skills to distract/avoid difficult tasks!
- Good behaviour relative to mental ability and communication skills

Movement control delayed

- Delayed early motor development – affects early learning
- Good practical self-help/daily living skills over time

The specific developmental profile associated with Down syndrome – research overview 2

Significant risk of vision and hearing impairments

Specific speech and language delays relative to non-verbal mental abilities

- Clear and fluent spoken language a challenge
- Strengths in understanding and in use of gesture

Cognitive strengths and weaknesses

- Specific verbal working memory difficulties
- Strengths in visual memory and processing

Academic learning

Strengths in reading – can be at age level (10%)

Number more difficult – often 2 years or more behind reading

The importance of the weaker areas – speech, language and working memory

- Language underpins cognitive and social development for all children
- Words for knowledge – vocabulary size
- Language for remembering, thinking, reasoning
- Language for self-control and planning
- Language for dealing with emotions and worries
- Language for communicating with others
- Language for friendships

Any child with language delay will have cognitive (mental) delay

Working memory is important for all learning – more later

Learning to talk

- Talking is for **communicating** – getting the message across, engaging with others
- Starts with looking, smiling, pointing – non-verbal skills for commenting, requesting, answering
- Then words – **vocabulary** learning – working out meanings and saying the words
- Then sentences – **grammar** learning – stringing words together for more complex meanings
- Talking requires clear **speech** skills – takes time for all children

Speech and language development

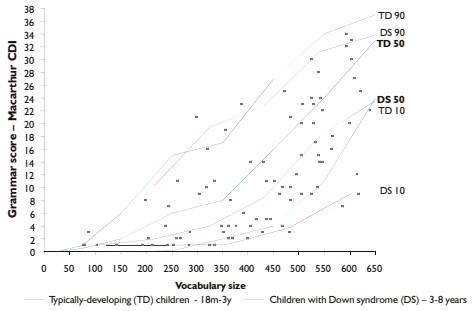
For most children with Down syndrome spoken language is delayed for mental age but they show an uneven profile

- **Communication** skills are usually good
- **Vocabulary** is delayed but grows steadily
  - understanding is ahead of expression
- **Grammar** is more difficult
  - tend to be 'telegraphic' talkers, using key content words
  - understanding is ahead of expression
- Clear **speech** is more difficult and means speech is difficult to understand

Vocabulary/grammar link

- Vocabulary size pushes along grammar development
- Children with Down syndrome have a vocabulary delay
- 200-250 words are needed are needed before grammar starts
  - Understanding will be ahead of production
- May be a sensitive period after which grammar permanently compromised
- See next slide

Vocabulary/grammar link (Pennanen, Buckley & Archer 2000)



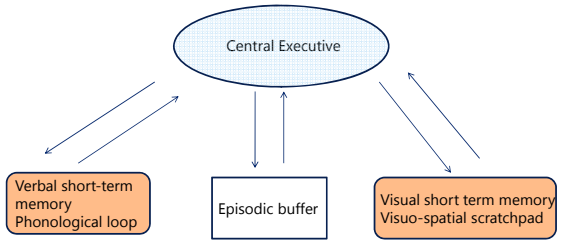
Why this learning profile?

- Hearing loss plays a part
- Auditory processing may play a part
- Slow vocabulary learning may delay grammar
- Difficulties with verbal short-term memory play a part
- We know nothing of early speech discrimination in children with Down syndrome
- We know very little about causes of speech-motor issues
  - Not just a motor issue
  - Planning component
  - Verbal short-term memory component

Looking in more detail at weaker areas – working memory

- Working memory is the immediate memory system that supports all mental activity
- The working memory system has several components
- The central executive which holds and processes information
- Supported by limited capacity stores
  - the visual spatial scratchpad - to hold visual information
  - the phonological loop - to hold verbal information
  - both hold information from senses for about 2 seconds
- the episodic buffer which links to long-term memory
- Capacity in working memory increases with age

Baddeley's 2006 Working Memory Model



Working memory is important for all children

- 'Working memory is the mental workplace in which information can be temporarily stored and manipulated during complex everyday activities such as understanding language and doing mental arithmetic'.
- listening to another speaker
- decoding an unfamiliar word whilst holding the meaning of the previously decoded text in mind
- writing while formulating the next part of the text
- engaging in mental arithmetic
- See excellent book S. Gathercole & T. P. Alloway. Working memory and learning: practical guide for teachers. Sage 2008

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Verbal short term memory & language

- The phonological component supports verbal short-term memory(VSTM)
- Verbal short term memory span improves with age and can be measured with digit and word span tasks
- Verbal memory span is influenced by increases in speech perception and production rates, and by reading ability
- The phonological loop influences the learning of vocabulary and syntax – and the storage and processing of sentences
- It seems to influence spoken language output – may play a role in holding the phonological structure of speech prior to output (Gathercole et al 2005)

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Working memory in children with Down syndrome

- 4 year old children have a digit span of 3, 16 year olds a span of about 6/7, teenagers with Down syndrome only have spans of 2/4
- For children with Down syndrome their working memory skills are delayed for mental age – a specific deficit
- We do not have much information on central executive function in children with Down syndrome as the tasks used to measure this at present are too difficult for most of the children
- Most of the research has measured verbal and visual short term memory
- Consistently, visual memory skills are significantly better than verbal memory skills

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Why this profile?

- A number of research studies by Chris Jarrold and team at Bristol University, UK have shown that the deficits cannot be explained by hearing loss or speech difficulties
- They suggest a phonological loop deficit – which will affect word learning as well as memory.
- They have shown children with Down syndrome have specific difficulty learning the accurate phonological or sound pattern of words - more on this in later workshops
- There is some evidence that training can improve working memory function in some groups of children – including computer training
- We are about to pilot the latest computer based training with children with Down syndrome

Effects of poor verbal short term memory function

In other children with poor verbal STM

- Speech characterised by short utterance length
- Immature syntax
- Limited range of vocabulary
- Has a role in output of speech also
- Storage and processing of sentences
- Poorer reading and poorer maths

See Gathercole et al (2005) Developmental consequences of poor phonological memory in childhood. Journal of Child Psychology and Psychiatry 46 (6) 598-611 and also in 47 (1) 4-15 on memory in developmental disorders

Implications for intervention and education

Use social/emotional strengths

- build on emotional responsiveness – encourage social communication, looking, smiling, gesture
- early social communication underpins cognitive and language development
- talk to and play naturally with children
- build on social understanding – encourage 'good' behaviour

Always encourage AGE appropriate behaviour – do not 'baby' or 'spoil' child (or adult), have clear expectations and boundaries

Implications for intervention and education

- Target speech and language difficulties from infancy and through school years
  - encourage and teach speech sound discrimination
  - provide speech sound practice, word and sentence practice- talking needs to be worked on
- Use *reading to teach talking* from early (2 to 3 years) and through school years
- *Learning from listening* will be specially difficult but *learning from looking easier* so always use visual supports – signs, pictures, reading, the computer
- Enable understanding to be demonstrated without the need to say it – choosing, pointing, selecting

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Implications for intervention and education

- Progress with grammar is linked to total vocabulary size for children with Down syndrome – therefore teaching vocabulary is an important goal from early – for world knowledge, cognition and grammar
- Speech skills start in first year – therefore intervention should start then – games to develop discrimination and encourage production of speech sounds
- Non verbal communication skills predict talking (joint attention and pointing) therefore intervention should start in first year
- Gesture use can close the comprehension/production gap but we need more research on the proper use of signing

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Implications for intervention and education

Compensate for 'weaknesses'

- Hearing, vision – regular checks, good health care – speak clearly, use signs, limit background noise. Involve sensory impairment team
- Address working memory difficulties with sound and word discrimination games from infancy, improving spoken language development and playing memory games
- Encourage motor development at all times
  - Active practice
  - Encourage active movement through play
  - Sporting skills are good for fitness as well as social skills

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In summary

- Children with Down syndrome are visual learners
- They find learning from listening particularly difficult
- This effects learning to talk and it effects processing spoken language and instruction

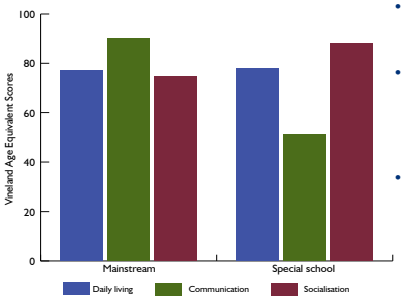
If we plan interventions to

- to focus on teaching spoken language
- support all learning visually – especially with print
- to improve and compensate for working memory

Can we make a difference?

Our data for teenagers taught in this way from preschool years suggests we can

Closing the speech-language/non-verbal ability gap



Comparison across domains

- This is another version of the earlier coloured profile slide
- One group show the expected profile – social and practical strengths, language weakness ->2year lag
- The 'adapted input' mainstream group show language skills as good as their other skills – it is possible to change the profile

We can change the profile

- We can make a difference
- Outcome data from a study of teenagers shows significant gains in spoken language as a result of comprehensive interventions from early years
- Significantly better language and clearer speech
- Significantly better reading skills
- Linked to immersion in mainstream school
- More on this in the third keynote tomorrow morning
- Buckley, Bird, Sacks and Archer – see at http://www.down-syndrome.org/reports/295/

Education and intervention resources

Down Syndrome Issues and Information series on Development and Education - Range of small books on all aspects of development by age group (0-5, 5-11, 11-16) – an overview, speech and language, motor skills, social development, reading and writing, number and school issues - available as a pack or as individual books

- On-line versions available at down syndrome online see down syndrome online tab at top of main website at www.downsed.org for online versions
- Down Syndrome Education International DVDs – infant development, preschool speech and language, inclusion in education
- See international or USA shop tab on website for purchase details at online

The evidence for a specific phenotype or profile

- See Deborah J. Fidler (Colorado State University) for a recent review of the evidence – preschool age
- *The Emerging Down Syndrome Behavioural Phenotype in Early Childhood.* Infants and Young Children (2005) 18, 2, 86-103
- See also Freeman, S. F.N. & Hodapp, R.M. (2000) *Educating children with Down syndrome: Service needs and new educational strategies*. Down Syndrome Quarterly 5, 1-9. – school age
- Down Syndrome Research and Practice 9 (3) special section on the specific profile free at
- http://www.down-syndrome.org/research-practice/

Relevant research evidence is growing

- Whole journal issues devoted to Down syndrome – important review papers in 2007
- Mental Retardation and Developmental Disabilities Research Reviews 13 (3) 2007
- Journal of Intellectual Disability Research 51 (12) 2007
- Important recent review papers and chapters on cognition (Silverman), language (Fidler et al., Roberts et al, Abbeduto et al., education (Fidler & Nadel), reading (Groen et al., Buckley, Snowling et al.), social development (Iarocci et al, Cebula & Wishart)
- Gathercole & Alloway articles and books on working memory for teachers

References

- J.E. Roberts, R.S. Chapman, & S.F. Warren (Eds.), *Communication and language intervention series: Speech and language development and intervention in Down syndrome and fragile X syndrome* (pp. 233-254). Baltimore: Paul H. Brookes Publishing Co. Very good review and practical – for professionals
- Abbeduto, L, Warren, S.F. & Conners, F.A. (2007) Language development in Down syndrome: from the prelinguistic period to the acquisition of literacy. Mental Retardation and Developmental Disabilities Research Reviews 13: 247-261
- Gathercole et al (2005) Developmental consequences of poor phonological memory in childhood. Journal of Child Psychology and Psychiatry 46 (6) 598-611 – also same journal (2006) 47 (1) on memory in developmental disabilities