Teaching to Deaf Children’s Strengths

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Outline

• How does intelligence develop?
  – Thinking before language: thinking in action
• The role of imitation and observational learning in pre-school children
  – Hearing and deaf children’s number reproduction skills
• Using signs for thinking in action
  – Solving arithmetic problems
• Working memory and thinking
  – Improving deaf children’s attention
  – Learning to rehearse
• Teaching to deaf children’s strengths
Learning from the history of psychology

• For the fathers of the study of human intelligence, there was no doubt that intelligence starts to develop before language

• Gestalt psychologists (Max Wertheimer, Wolfgang Köhler) and child psychologists (Alfred Binet, Jean Piaget) paved the way for this research on intelligence

• There is still no controversy today regarding the fact that in young children intelligence is ahead of language

• All theories about the development of intelligence include a period during which babies are able to solve problems that they cannot represent through language

• Babies communicate with gestures before language; this means that they already have a mental life before language
Detour problems: the baby wants something but cannot get to it directly. The baby moves away from the desired object to go around the barrier. This is achieved more easily if the baby can see the end of the barrier and the object at the same time.
**Tool use:** the baby wants the cake on the table but can’t reach it. The baby pulls the table cloth and the cake comes to him. Tool use is an item in intelligence tests designed for babies. Babies succeed more often when they can see the tool and the object at the same time.
Understanding **cause and effect**: babies understand that pens cause marks on paper, that light switches turn on the light, and learn how to open boxes after watching an adult. Much learning about cause and effect comes from **observational learning** (i.e. watching another person’s actions). Babies (24-34 months) copy the action of an adult that manipulates a display to obtain a marble even though the adult does not say anything about the action and only tries to obtain the baby’s attention to the display.
**Classification**: Babies have a preference for sorting things by shape. Their preference at 36 months can be changed to sorting things by color if they see an adult doing the sorting by color. Child psychologists such as Piaget and Vygotsky agree that classification is the basis for learning the meanings of words. Children can learn much about classification through observational learning even after starting to use language.
Learning from deaf mothers

- The importance of simultaneous information for young children’s language learning is recognized widely in language acquisition.

- Hearing children might be looking at an object, but not at the mother, and hear the word that is used to refer to the object.

- Even a small delay between the child’s looking at the object and hearing the word affects vocabulary acquisition negatively.

- Deaf and hearing mothers of deaf children were observed interacting with their children.

- The aim was to assess whether deaf mothers were better at presenting a sign while the child was looking at the object and at the sign at the same time.
Simultaneous presentation of sign and context (Harris, JDSDE, 2001)
Summary so far

• Intelligence starts to develop before language.

• Babies solve problems in action (detour, use of tools) and communicate through gestures before they start to speak.

• They develop knowledge about the world through their own actions and through observational learning.

• This forms the basis for further developments both in intelligence and in language.

• Deaf mothers seem to know (from experience?) that \textit{simultaneous} presentation of information visually is important for their deaf babies learning to sign.
• Three examples of the use of observational learning and thinking in action in early mathematics
  – number representation
  – problem solving
  – learning about multiplicative reasoning

• One example of promoting the development of attention and working memory
Observational learning before school: number representation

• We (Zarfaty, Nunes, & Bryant, 2004) assessed pre-school children’s numerical representation skills using a visual demonstration.

• The children saw a puppet demonstrating the number of objects to be placed in a box.

• Because the objects disappeared before the children were given the go ahead to copy the number, this required a mental representation of the number.
• Deaf (n=10) and hearing (n=10) children (31 to 54 months) were asked to copy the number of objects put into a box by a model.

• The number of bricks varied between 2 and 4; this means that it could be perceived and the children did not have to count.

• The number of bricks (2, 3 or 4) did not influence the results.

• The model either took all the bricks at the same time (simultaneous) or one at a time (successive).
Deaf children were more accurate than hearing children when the presentation was simultaneous. They performed as well as hearing children when the presentation was successive.
Deaf and hearing 1st Graders also do better in simultaneous presentation tasks when counting was required because the numbers were larger (3 to 6).

When the presentation was simultaneous, deaf children did as well as hearing children under successive presentation.
Conclusions

• Both deaf and hearing children did better when the presentation was simultaneous than when it was successive.

• The use of observational learning and simultaneous presentation improves deaf children’s performance in number representation tasks.

• It is possible that simultaneous presentation facilitates the encoding of information visually.
Modelling and thinking in action

- Problem solving in mathematics involves two abilities
  - Reasoning about relations between quantities
  - Using numerical symbols to represent the quantities
- Reasoning about quantities develops before learning arithmetic for hearing as well as deaf children
- Children can model or be guided to model relations between quantities in story problems through teaching
A boy had 6 marbles. He put them in his pocket and went out. But he had a hole in his pocket and some fell out. When he got home, he only had 4 marbles. How many did he lose? Without the materials, the girl answered: Four.
What is involved in solving mathematical problems?

• Numbers and quantities are not the same thing: we can reason about quantities without representing them numerically (Marc is taller than Paul; Paul is taller than Fred; therefore ....)

• Numbers are used to represent quantities

• Reasoning about quantities starts before arithmetic (i.e. before the language for talking about quantities) and forms the basis for learning about arithmetic
Reasoning about quantities before arithmetic

- **Two studies**
  - **Additive reasoning**: making use of thinking in action (not a teaching study, just comparing performance in the different conditions)
  - **Multiplicative reasoning**: a short-term teaching study (guided modelling of problem solving)
Deaf (n=28; moderate: 4; severe – 4; profound: 20; 12 had CIs) and hearing children (n=78) aged 6 years were presented with addition and subtraction story problems. The story was illustrated by pictures presented either **simultaneously** or **successively**. The children either had bricks to represent the numerical information or had no bricks.
Simultaneous vs successive presentation
With vs without blocks

The difference between hearing and deaf children was not significant when the presentation was simultaneous and the children could use blocks as symbols. The deaf children solved fewer problems correctly than the hearing children in all other conditions.
Conclusions

• Deaf children did better when the presentation was simultaneous than when it was successive.

• Deaf children did better when they could use blocks as symbols for representing the numerical information and could act on these symbols.

• Deaf children did as well as hearing children when they solved problems in the most favourable condition (simultaneous presentation with use of blocks).

• Their additive reasoning can continue to develop with the support of visual symbols and does not have to be hindered if they have not yet learned arithmetic.
• The children were also asked to solve multiplication problems.

• Simultaneous or successive presentation was also used.

• The children always had blocks that they could use when solving multiplication problems.
Simultaneous presentation
We will put 3 apples in each basket. How many apples do we need altogether?
Successive presentation
We will put 3 apples in each basket. How many apples do we need altogether?
Deaf children’s performance improved in the simultaneous condition but their performance under the best condition was still lower than the hearing children’s performance.

This result suggested the need to develop a teaching study by modelling and guided action.
One-to-many correspondences and multiplicative reasoning

• Multiplicative reasoning is not the same thing as additive reasoning
  – Additive reasoning is about putting together or separating things of the same type
  – Multiplicative reasoning is about two quantities in a fixed correspondence (ratio) to one another (3 apples in 3 baskets)

• Young children can solve multiplicative reasoning problems correspondences before they are taught about multiplication in school
Our teaching study with 1st Graders (JDSDE, 2008)

• 27 deaf children from 6 schools (7 schools for the deaf and mainstream schools with units); mean age=6y6m; SD=0.66 years
  – 12 profoundly deaf; 8 had CIs; no documented learning disability

• 33 hearing children (2 schools); mean age=5y7m; SD=0.31 years
Design of the teaching study

• Pre-test
• Two sessions of teaching
• Immediate post-test
• Delayed post-test (about 2 weeks later)
• Assessment: multiplication and division problems
Design of Study

• Two groups
  – One group received teaching on one-to-many correspondences and sharing
  – One group received teaching on visual analysis

• Each group works as a comparison group for the other because both groups work on reasoning tasks with an experimenter on a one-to-one basis
We are buying goldfish and will put 3 goldfish in each bowl. We have 4 bowls. How many goldfish do we need to buy?
I have 8 stickers. I will give 2 stickers to the children who do good maths work. How many children will get stickers?
Teaching Tasks

• A series of tasks graded in difficulty was created
• The tasks were presented with the help of materials
• When the children did not immediately solve the problem, we prompted them
• 20 problems were used in the intervention; two sessions on subsequent school days
Three types of problem
Multiplication
• Materials needed:
• Pile of cut out plates and pile of same colour unifix blocks
• The teacher is putting biscuits on plates for the children. There are 8 children in her group. Each one is going to get 2 biscuits. How many biscuits does she need? (if child doesn’t take the right number of plates, T prompts)
Partitive division

- Materials needed:
  - Pile of same colour unifix blocks
  - Pile of cut-out rectangles to represent the classes

The mayor of this city went to visit the children in a school. She brought 20 story books with her for the 1\textsuperscript{st} Grade classes. There are five 1\textsuperscript{st} Grade classes. How many books can she give to each class?
Quotative division

• Materials needed:
  12 Cut out balloons

A boy was going to have a party. He had 12 balloons. He wants to give 2 balloons to each friend that comes to the party. How many friends can he invite?

* This is difficult because each pair of balloons will mean that you can invite one boy. If the children cannot solve the problem just with the cut-out balloons, suggest that they use something to represent the boys.
The intervention effect was significant. In the immediate post-test, the deaf children in the intervention group did not differ from the hearing children. In the delayed post-test, the deaf children did better than the control group of hearing children but not as well as the hearing children in the intervention group.
Summary

• The intervention was effective in improving the deaf children’s multiplicative reasoning.

• Their performance was lower at delayed post test than in the immediate post-test.

• Perhaps it is necessary to increase the amount of teaching for the gains to remain at the same level in the delayed post-test.

• In short, it is possible to improve deaf children’s mathematical performance by teaching to their strengths.

• Can similar methods be used to improve deaf children’s basic cognitive skills?
Attention, working memory (WM) and learning

• Information is kept in the perceptual system only briefly

• When someone perceives something in the environment, the information has to be encoded to be remembered

• In order to do well in many tasks, people need to encode information, keep it in mind and work on it at the same time (e.g. reading, problem solving)

• The ability to do this is called working memory

• Make on your note pad a series of circles following the same pattern as the squares on the next slide then put your pens down
• What did you do to try to recall which squares had lit up?

• Memorizing strategy: repeat the pattern visually or with almost imperceptible gestures to recall the pattern
Attention, WM and learning

• When WM tasks are visual, deaf people do better than hearing people who do not sign

• When encoding requires language, deaf people do not perform as well as hearing people

• The window of opportunity to encode the information is limited

• Deaf people who use oral language encode information more slowly than hearing people

• Encoding in sign language is slower than in oral language
Attention, WM and learning

- WM depends on attention and strategies to remember
- Deaf children’s performance in tasks that require paying attention to two things at the same time is weaker than that of hearing children
- This could be due to lack of practice: hearing children often have to listen and look at the same time
- Deaf children use recall strategies less often; this could be due to lack of practice
- Attention and recall strategies can be improved through observational learning and guided practice
Nunes et al. (2014): improving deaf children’s WM

• 73 children in the taught group and 80 children in the comparison group

• Comparison group attended the same schools and belonged to the cohort in the previous year

• Teachers were taught to use the programme and implemented it with the children

• The taught group was assessed on WM before and after the program; the comparison group was assessed twice with a similar interval between the testing sessions

• The assessments were standardised WM tests developed independently of the researchers
The teaching program

• Two types of games
  – teacher led games, used for the teacher to model the strategies and guide the children’s rehearsal
  – on-line games that gave the children independent practice in dual tasks
The teacher led games

• Word recall
• Color recall
• Missing digit recall

• Teachers kept a record of the children’s progress
  – After the child succeeded in one level of the game, the child moved to the next level; the teacher tells the child how good he/she is and invites him/her to play a more difficult level
  – If the child did not succeed, the child played the same level again once before moving on
The on-line games

• Animals
• Digits backward
• Letters recall

• Teachers kept a record of the children’s progress
  – If the child had 100% correct, the child was moved to the bonus games; after 3 minutes, the child returned to the next level of WM games
  – If the child did not succeed, the child played the same level again once before moving on
You will need to remember two numbers.

The Animals Game

How many ducks? How many monkeys?
Results

Mean score on the WM measure for each group on the second assessment
(Maximum score: 3)
Summary

• Deaf children are at a disadvantage in WM tasks

• This is probably due to lower levels of selective attention and less practice with dual tasks

• Adults can model rehearsal strategies (observational learning) and also guide children’s rehearsal

• Adults can also show children ways of using visual resources in rehearsal

• Deaf children can improve their performance in WM tasks through training
Overall summary

• Intelligence starts to develop before language. Babies’ and toddlers’ solving problem is ahead of language.

• Young children learn much through observational learning and thinking in action.

• Reasoning about quantities develops before arithmetic (the language for reasoning) and forms the basis for mathematics learning.

• Deaf children can improve their quantitative reasoning through observational learning and guided thinking in action.

• These approaches to teaching can support the development of deaf children’s reasoning and working memory.
http://www.education.ox.ac.uk/research/child-learning/resources-2/