Using digital technologies to support special needs

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Roles of technology enhanced learning

To provide more productive learning experiences for SEN learners

Adaptive programs

To engage teachers in exploring new pedagogies to exploit findings of neuroscience

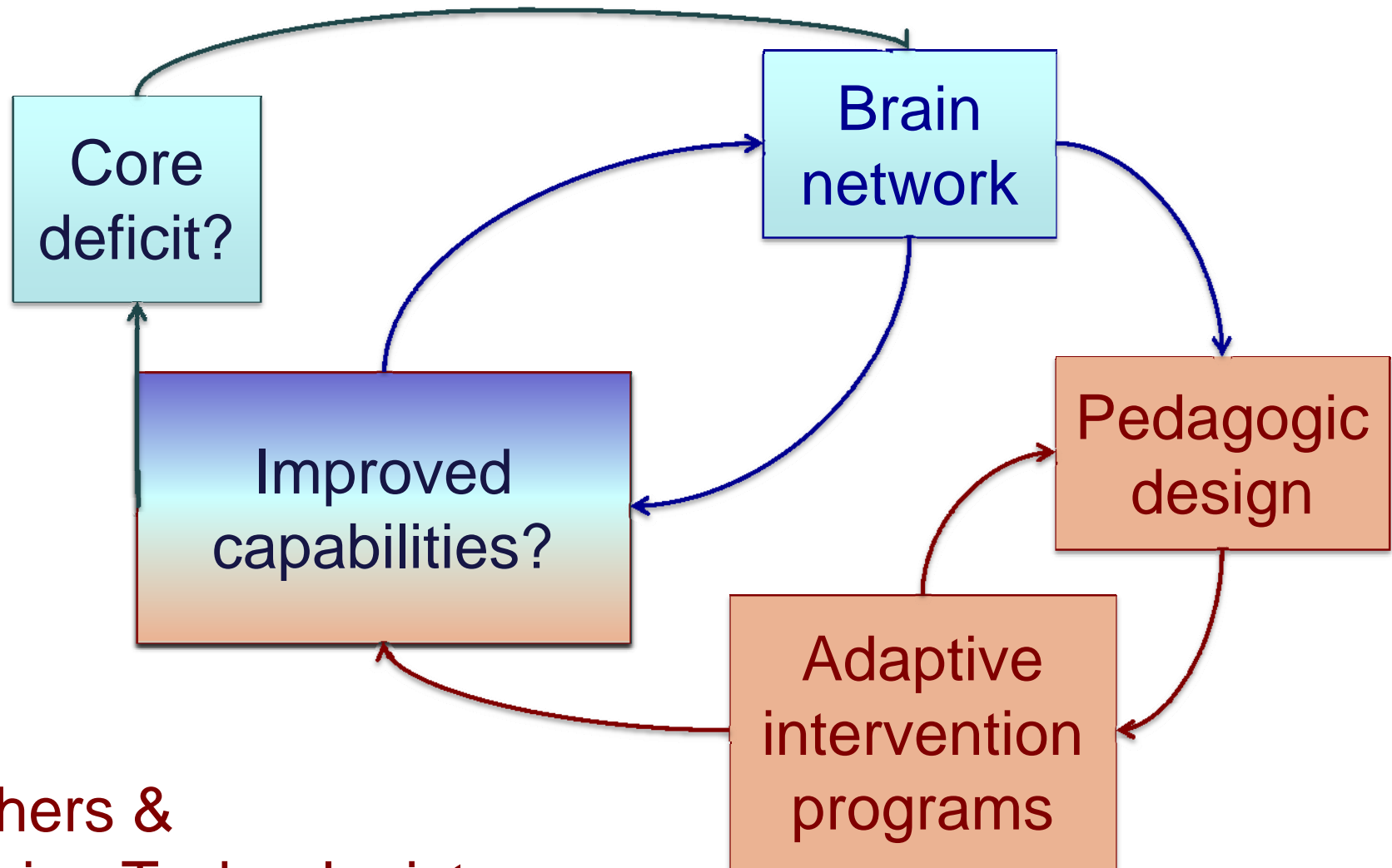Shareable, editable pedagogic programs

To give parents an active role in assisting their children who have special needs

Personalised home-based learning, online

From neuroscience to education…

Neuroscientists & Educational psychologists

Core deficit?

Brain network

Pedagogic design

Improved capabilities?

Adaptive intervention programs

Teachers & Learning Technologists

Neuroscience and cognitive deficits

Dyslexia can be specific deficit in phonology

→ interventions in phonology

→ improvements in performance

→ changes in brain activity

McCandliss example??

Dummy slide

- Demo of McCandliss example of technology for dyslexia

Neuroscience and cognitive deficits

Dyslexia and dyscalculia often occur together

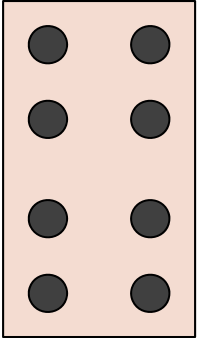Dyscalculia can be specific deficit in numerosity – "lack of number sense"

→ interventions on numerosity tasks

→ improvements in performance

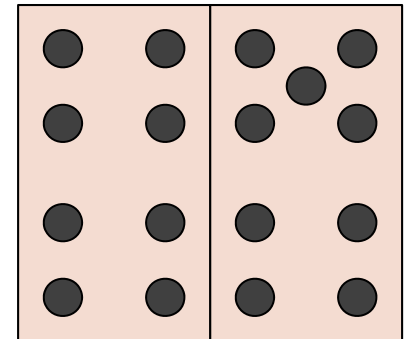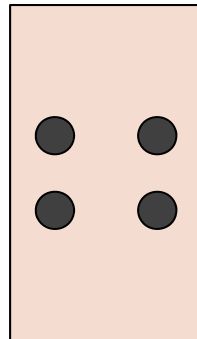But little work so far, and few teachers
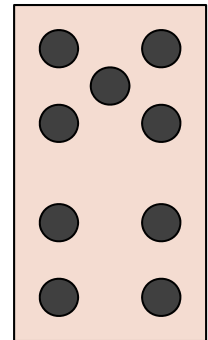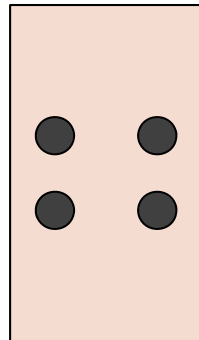
What is dyscalculia?

Where does 8 go?

Normal response

What is dyscalculia?

Dyscalculic response
(points and counts)

↖1   ↖2   ↖3   ↖4   ↖5   ↖6   ↖7   ↖8   ↖9   "Start again"

What is dyscalculia?

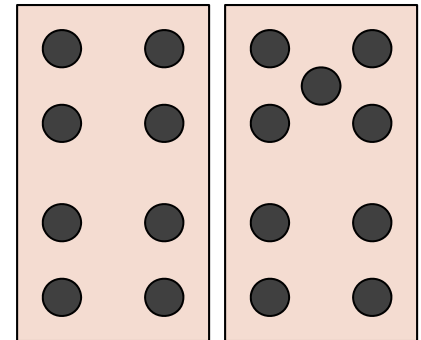*Where does 8 go?*

Dyscalculic response
(points and counts)

Twin study in progress (UCL)
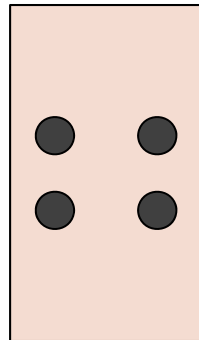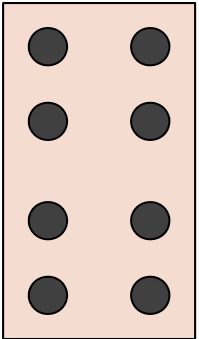
Evidence of dyscalculia:
Significant difference between numeracy tests and IQ tests for ~7% of sample

Dyscalculics are significantly worse on Dot enumeration, but not on IQ or Vocabulary.
(Landerl et al, 2004; Butterworth, 2005)

The neuroscience of dyscalculia

A core deficit of numerosity processing

Appears to be heritable

Affects ~3-6% of the population

Can be diagnosed, e.g. test dot enumeration

How many are there?
Which is more?

From neuroscience to education

From diagnosis to educational remedy?

No clear logical pathway

→ use established pedagogical principles

→ use ideas from best practitioners

→ use technology to capture and test ideas

Pedagogy in use

- SEN methods use 1-1 teacher-pupil interactions

- Other pupils given individual and paired tasks

- Manipulation of special materials (Cuisenaire, dot pattern cards, dice, number lines, beads, counters, etc)

- Talk plays a key role – pupil has to describe the task, the goal, the action, and the repair

- Games help to align teacher-pupil task goals

Pedagogic principles

Constructionism (Papert & Harel): a task environment that affords learning:

  makes task goal meaningful to the learner

  lets them act to achieve that goal

  feeds back the result in relation to the goal

  motivates revisions to improve

Good SEN teachers set up these kinds of tasks

Some success, but limited, and local

Clear task goal

Intrinsic feedback on actions

Enables revision of actions using feedback

Adaptive to learner performance

Self-paced learning

Simple interface

Customizable so teachers can design tasks

Numeracy software often confusing
Learning to recognise dot patterns
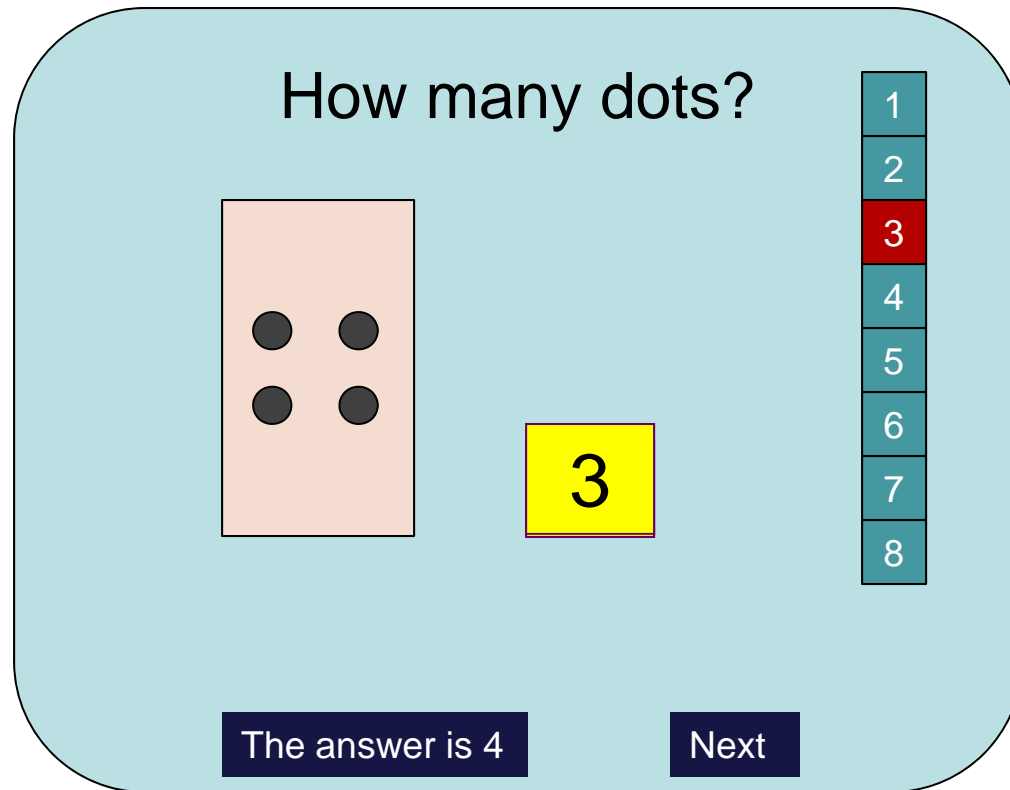

How many dots?

3

| 1 |
| 2 |
| 3 |
| 4 |
| 5 |
| 6 |
| 7 |
| 8 |

0 1 2 3 4 5 6 7 8 9

Done

Confusing interface
Random generation of level of task

Numeracy software often confusing
Learning to recognise dot patterns

How many dots?

1
2
3
4
5
6
7
8

3

The answer is 4

Next

Answer conflicts with learner action
Extrinsic feedback, not meaningful
No action revision: so does not elicit reflection

Intervention study in progress

SEN groups (3 inYr 3, 4 in Yr 4)

Identified by teacher tests

Normal groups (8 in Yr 1, 10 in Yr 2)

Dot enumeration task:

Recognise, not *count* how many dots

Card patterns and random patterns

Self-paced and time-limited

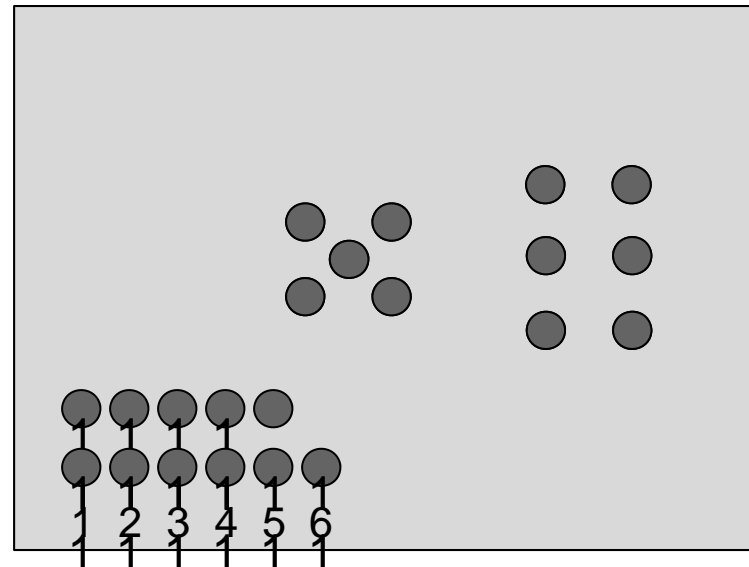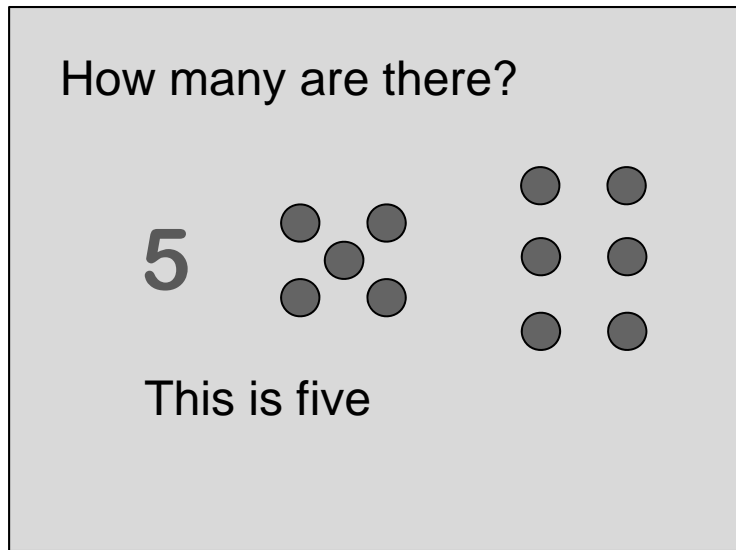Feedback shows match to number line

Asked to construct repair if wrong

Demo program

Live link to program running on laptop

Dummy slide – represents program

How many are there?

5

This is five

Shows result of learner's input
Shows meaning of patterns in relation to number line
Program tracks accuracy and speed of response
Selects next task within ZPD

Evaluation (of learner)

One SEN pupil, Year 4
Time on task – 18 minutes over 5 trials

- Few errors on self-paced trials, because *counting*
- Time limited to 1sec increases errors
- Next trials limit time to 3secs, then 2 secs
→ Errors gradually reduce till they can do it in 1 sec

As the program adapts the time of display to learner performance they can gradually learn to *recognise*, rather than *count* the dots
But is this a change at the neural level?

Engaging teachers

Technology for SEN interventions

Learners

    Opportunity for unsupervised repeated practice

    Easier manipulation than physical objects
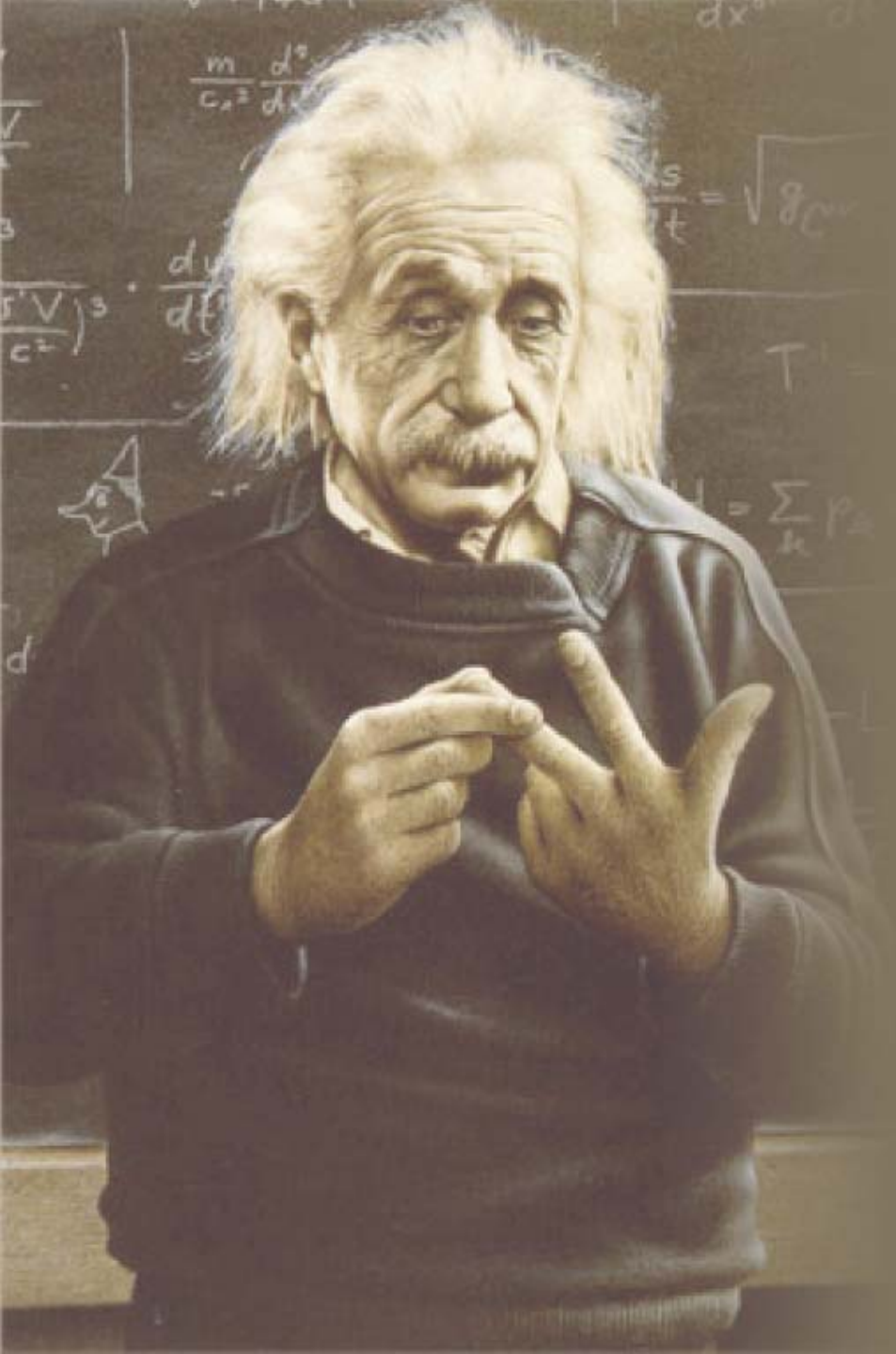
    Virtual environments link physical to abstract

Teachers

    Captures pedagogic principles for revision

    Enables customisation of tasks by teacher

    Teachers can share effective pedagogic practice

The End