



... children, their world, their education

PRIMARY REVIEW
RESEARCH BRIEFINGS
2/1a

CHILDREN'S COGNITIVE DEVELOPMENT AND LEARNING

Usha Goswami, University of Cambridge
Peter Bryant, University of Oxford

This briefing draws on Primary Review Research Report 2/1a *Children's Cognitive Development and Learning* by Usha Goswami and Peter Bryant. The report provides a substantial but necessarily selective survey of the enormous quantity of empirical research on children's cognitive development since 1967, focussing on the early years (0 – 10). The survey considers central aspects of child development, thinking and learning in the primary years, and identifies areas of consensus about the development of children's learning, thinking and reasoning. It also highlights current controversies in the field. For example, it contradicts the Plowden Report's conclusion, based on Piaget's theory, that there are developmental stages in learning to think, but it emphasises the crucial parts played by social and motivational factors in children's learning. The full report lists all sources consulted and is available at www.primaryreview.org.uk.

Young children's learning

- Children possess and demonstrate all the main types of learning (statistical learning, learning by imitation, learning by analogy and causal learning) even as babies. This includes learning the relationships between the sounds that underpin language acquisition, or the visual features that specify natural categories or concepts such as *bird*, *tree*, *car*.
- Learning in young children is socially mediated. Families, carers, peers and teachers are all important. Even basic perceptual learning mechanisms require social interaction to be effective. This limits the applicability of educational approaches such as e-learning in the early years.
- Recent neuroscience research shows that learning depends on the development of multi-sensory networks of neurons distributed across the entire brain. For example, a concept in science may depend on neurons being simultaneously active in visual, spatial, memory, deductive and kinaesthetic regions, in both brain hemispheres. Ideas such as left-brain/right-brain learning, or unisensory 'learning styles' (visual, auditory *or* kinaesthetic) are *not* supported by the brain science of learning.

Children's knowledge, reasoning and cognitive development

- Children think and reason largely in the same ways as adults, but they lack experience, and are still developing the ability to think about their own thinking and learning (meta-cognition) and to regulate their own behaviour and interactions. They need diverse experiences in the classroom to help them develop these self-reflective and self-regulatory skills.
- Children construct causal frameworks to make sense of their experiences in the biological, physical and psychological realms, in order to explain, for example why other people behave as they are observed to do (having a 'theory of mind'), or why objects or events follow observed patterns. Knowledge gained through active experience, language, pretend play and teaching are all important for the development of children's causal explanatory systems. The biases in children's explanations, which reflect a general human tendency to seek information that appears to confirm one's theories, should be recognised and worked with by teachers.

- Language is crucial for development but there is huge individual variation in language skills from an early age. Typically young children learn new words at an exponential rate, acquiring 10+ words daily. The median vocabulary is 55 words at 16 months, 225 words at 23 months and over 6000 words by age six, but the developmental range stretches from a vocabulary of 0 words to over 500 words at age two. Children who enter school with impoverished language skills require immediate support.
- Incremental experience is crucial for learning and knowledge construction. The brain learns from every experienced event, but because cognitive representations are distributed across networks of neurons, cumulative learning is crucial. There is stronger representation of what is common across learning experiences, and there are multiple representations of experience (e.g. motor and visual representations). This supports the value of multi-sensory approaches to teaching.
- Differential exposure (for example to spoken or written language) will lead to differential learning. As an example, one of the most important determinants of reading fluency is how much text the child actually reads, including outside the classroom.

Children's learning in school

- Pretend play and the imagination are important for cognitive development in the early years of education, helping children to reflect upon and regulate their own cognitive behaviour, and to reflect upon and gain a deeper understanding of the mind. Pretending is more effective when carried out with other children and when scaffolded by adults.
- The central role of learning from others is highlighted by Vygotsky's 'zone of proximal development', which indicates how much further a child can go when learning with the support of a teacher, parent, carer or peer.
- Learning in classrooms can be enhanced by developing metacognitive strategies, self-reflection and inhibitory control in children. These skills can be taught.
- The ways in which teachers talk to children can influence learning, memory, understanding and the motivation to learn. Learning and memory benefit when the teacher adopts an elaborative conversational style, amplifying and evaluating what the child says. This elaboration helps children to make sense of temporal and causal aspects of their experiences.
- Teachers should praise effort rather than performance. Children's self-theories of intelligence influence their response to schooling and their motivation to learn. As Dweck has shown, children who believe that their intelligence is fixed are less likely to make an effort to learn, whereas those who believe that their intelligence can grow, will try harder when faced with a learning challenge. If teachers praise effort rather than performance, children's intrinsic theories can be altered and children's motivation to learn can increase.
- Individual differences in the ability to benefit from instruction, identified by Vygotsky as the 'zone of proximal development', are large in the primary years. Any class of children must be treated as individuals, whilst remembering, as noted above, that learning by children is primarily a social activity requiring common goals and shared activities.
- Symbol systems like the alphabet and the number system require direct teaching, but for both reading and number certain *cognitive prerequisites* facilitate learning.
- The cognitive prerequisites for reading and number depend on language development, perceptual development and spatial development, and can be enhanced by direct teaching (for example, using linguistic rhyme and rhythm games).
- For **reading**, the key cognitive prerequisite is *phonological awareness*, the child's ability to reflect upon the sound patterns of words in her mental lexicon at different 'grain sizes' (e.g., syllable, rhyme). Teaching through rhyming games, for example, aids the development of phonological awareness. It is more difficult to learn to read fluently in languages with inconsistent spelling

systems (such as English), with many phonemes (English has around 44 but Finnish has only 21), and where syllable structure is complex (English has relatively few consonant-vowel syllables).

- For **number**, the main cognitive prerequisite appears to be *recognition of numbers as approximations of quantity*. Comparisons of quantity thus become important for discriminating between quantities, hence children are worse at comparing 8 with 12 (ratio 2:3) than 8 with 16 (ratio 1:2). For very small numbers (1 – 4), infants and young children rely on automatic perceptual processes called 'subitizing'. A critical factor for building a number system from these basic spatial/perceptual representations is learning the count sequence.

Further research

Cognitive developmental research can benefit enormously from new technologies in neural imaging and genetics. These techniques are uncovering links between brain development and child development that are likely to be hugely important for education. Research in typical neuro-cognitive development is most needed, as current funding focuses on developmental *disorders*. Metacognition, reading and number are also important areas where educational research needs to discover more about the optimal ways of enhancing normative developmental profiles.

FURTHER INFORMATION

The report on which this briefing is based: Goswami, U. and Bryant, P. (2007) *Children's Cognitive Development and Learning* (Primary Review Research Survey 2/1a), Cambridge: University of Cambridge Faculty of Education. ISBN 978-1-906478-08-7.

The report is available at www.primaryreview.org.uk and is one of 32 Primary Review interim reports. Two of these deal with the opinion-gathering strands of the Review's evidence base. The remainder report on the thirty surveys of published research which the Review has commissioned from its 70 academic consultants. The reports are being published now both to increase public understanding of primary education and to stimulate debate during the period leading up to the publication of the Review's final report in late 2008.

The Primary Review was launched in October 2006 as a wide-ranging independent enquiry into the condition and future of primary education in England. Supported by Esmée Fairbairn Foundation, it is based at the University of Cambridge Faculty of Education and directed by Professor Robin Alexander.

The Review has ten themes and four strands of evidence (submissions, community and national soundings, surveys of published research, and searches of official data). The report summarised in this briefing relates to the **Research Survey** strand and the theme **Learning and Teaching**.

Enquiries: The Administrator, The Primary Review, Faculty of Education, 184 Hills Road, Cambridge, CB2 8PQ. Phone: 01223 767523.

Email: enquiries@primaryreview.org.uk . Website: www.primaryreview.org.uk.

Press enquiries: richard@margrave.co.uk (Richard Margrave, Communications Director).

Note: the views expressed in the Primary Review Research Reports are those of their authors. They do not necessarily reflect the opinions of the Primary Review, Esmée Fairbairn Foundation or the University of Cambridge.