



...children, their world, their education

Cambridge Primary Review Trust
Research Briefing 3
(new series)

CHILDREN'S COGNITIVE DEVELOPMENT AND LEARNING

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This briefing draws on the report *Children's Cognitive Development and Learning*, commissioned from Usha Goswami by the Cambridge Primary Review Trust. It is one of a series of surveys of published research designed to update and supplement those published, as was the earlier version of this report, in *The Cambridge Primary Review Research Surveys* (Routledge, 2010).

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.cprtrust.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. Consequently, the quality of the learning environments created by families, schools and the wider culture is critical for children's development. 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. The young child's brain has basically the *same* structures as the adult brain, and these structures carry out the same *functions* via the same *mechanisms*. 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.
- Genetic differences between children also influence development. However, the fact that genes influence development makes it even more important to provide optimal early learning environments for all children, so that environmental differences and genetic differences are not additive in their effects.

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. General cognitive skills such as visuo-spatial working memory, attention and inhibition also play important roles in the development of facility with number.

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. (2015) *Children's Cognitive Development and Learning* (CPRT Research Survey 3), York: Cambridge Primary Review Trust. ISBN 978-0-9931032-2-3.

The report is available at www.cprtrust.org.uk. The website also contains information about other surveys in this series, and those related to the Cambridge Primary Review.

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The Trust has eight priorities (equity, voice, community, sustainability, aims, curriculum, pedagogy and assessment) and four programmes (policy, research, schools, professional networking and development).

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