When we were butterflies

Stunning discoveries about how babies and children develop can help answer questions about such deeply human concepts as morality, identity, imagination and consciousness, says **Alison Gopnik**

WHILE childhood has always been a profound part of human life, public discussion of it is almost always confined to the personal and the practical – both in memoirs and novels, and in the ubiquitous parenting books.

Yet in the past 30 years, a scientific revolution has completely transformed our understanding of babies and young children. Babies both know more and learn more than we would ever have thought possible, and we have recently begun to grasp the mechanisms by which they do this. I wrote *The Philosophical Baby* to try to show that thinking about childhood can help us answer deep questions about truth, imagination, love, consciousness, identity and morality. Without exaggeration, I believe it can tell us how we came to be human.

We share almost all of our genes with our closest primate relatives, so where does our distinctively human intelligence come from? The traditional answers stress the pressures that led adult humans to contrive and cooperate in new ways. Think of the classic natural history museum diorama of the hunters pursuing the mastodon – hunters who need to construct both spears and alliances.

But the real key may lie with the observant youngsters tucked into a corner of that vignette. The long, protected immaturity we call childhood may be at the heart of our distinctly human capacity for learning and imagination, our capacity to change what we do to fit the world and to change the world to fit what we do.

Speculations about the evolutionary origins of human nature are dogged by a fundamental problem: comparisons across species usually underpin evolutionary arguments, yet there is only one species that does what we do. Much of the time it is easy to make up just-so stories about why our distinctive features evolved, and much more difficult to find evidence to support them.

However, the fundamental link between childhood and intelligence can be found across a striking variety of species. The classic examples come from birds. "Altricial" species, where the young require intensive nourishing, such as crows, are immature for an extended period and have learning abilities that rival those of the great apes. "Precocial" species like chickens, which mature much more quickly, have much less flexible behaviour and less impressive learning abilities – and they are more likely to end up in the soup pot than on the cover of *Science*. Chickens seem to rely on very specific inborn capacities adapted to one particular environmental niche. Crows, on the other hand, have a more flexible strategy: they can learn how to turn an unprecedented new object, such as a piece of wire, into a novel tool.

Why is there this apparently paradoxical correlation between developmental immaturity and intellectual sophistication?

PROFILE

Alison Gopnik is professor of psychology at the University of California, Berkeley, and mother of three. This essay draws on her new book, *The Philosophical Baby: What children's minds tell us about truth, love, and the meaning of life* (Farrar, Straus and Giroux/The Bodley Head, 2009)

A learning strategy has many advantages because it lets an animal survive in many more environments, and even modify those environments. But it has one big disadvantage: until learning takes place, such animals are helpless. You don't want to consider and assess all the different ways you could handle that mastodon when it's charging towards you. Extended immaturity is evolution's way of solving this problem. There is a division of labour between the young, who get the protected time to learn and imagine, and the adults, who take care of them while they do so.

Human babies are useless on purpose. Because they don't have to do the adult work of predating and mating, fighting and fleeing, they can discover how the world works and explore the possibilities it offers. Moreover, just as small genetic mutations in the physical developmental programme can lead to big changes in the shape of the adult organism, so small changes in our developmental timetable would be just the sort of thing to make our

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Who will they be today? Trying out different personalities teaches kids how people work

behaviour so startlingly different from our genetically similar primate relatives.

Human beings are the most extreme example of the strategy of extended childhood. We have a longer period of immaturity than any other species and we invest especially heavily in our young. Recently, primatologist and anthropologist Sarah Blaffer Hrdy has suggested that our investment in caregiving may be responsible for our distinctively human hearts, our capacities for altruism, empathy and cooperation. But childhood may also be responsible for our distinctively human heads, too, for reason as much as for passion.

The evolutionary correlation between immaturity and intelligence may help explain another startling set of discoveries. Traditionally, psychologists and philosophers thought that babies and young children were basically defective adults, that they were irrational, amoral and egocentric. But in the past three decades that picture has been completely overturned. For example, babies seem to be born knowing that other people are like them, and that some objects are physically closer than others. We have also discovered how much they learn about the physical and biological world and, most significantly, about the other people around them.

One of the fundamental ideas of cognitive science is that our brains are in some senses like computers, created through evolution.

"Babies are the research and development department of the human species"

Very recently, we have even started to uncover the underlying computational mechanisms and brain changes that allow all this learning to take place.

It turns out that babies and young children have remarkably sophisticated abilities to infer statistical patterns, use probabilistic logic and to reason inductively about how people, objects and language work. They use some of the same techniques that underpin important recent work in machine learning. These techniques involve a form of Bayesian inference. Children seem to update the probability that their hypotheses about the world are correct as new evidence comes in, and this allows them to change their theories about how the world works.

Neurologically, we know that children's brains are more flexible and plastic than adult brains. Babies actually have more neural connections than adults. They begin by making many weak connections between neurons, and proceed by pruning out the unused connections and strengthening the useful ones. The distinctively human prefrontal cortex takes a particularly long time to mature: the wiring of this part of the brain may not be complete until the mid-twenties. The adult capacities for focus, planning and action that are governed by this part of the brain depend on the long learning that takes place in childhood.

These remarkable learning abilities don't just show up in the lab but are reflected in children's everyday activities. We work, they play. Play is the hallmark of the paradoxically useful uselessness of extended immaturity. Recent studies show exploratory play – the restless, unstoppable drive to push every button and pull every string – helps them discover how the physical world works. Their equally unstoppable "pretend" play – the parade of alternate identities, imaginary friends and wild fantasies – helps them work out all the possible ways that people could be.

The picture that emerges from this research is that babies and young children are not so much defective as different from adults. They have equally complex and powerful, but very different minds, brains and lives, suited to their distinctive evolutionary role. Babies are brilliant learners but terrible planners, with fantastically creative and visionary imaginations but absolutely no executive capacity. They are the R&D department of the human species, the blue-sky guys, while we adults are production and marketing.

Human development is more like reverse metamorphosis than simple growth, with babies as exploratory, bright butterflies while the adults are caterpillars, inching along their narrower paths. Science won't tell us how to make babies smarter – they are already as smart as they could be – but it can tell us that taking care of them is not a badly paid chore but a crucial part of the human adventure. ■