contents

chapter 1 studying human development

You and I are members of an extraordinary species: a species that has a capacity far beyond any other to create and use tools and technologies, to think in abstract and hypothetical ways, to analyse and communicate our thoughts, to plot and plan, fall in and out of love and reflect on our experience in music, painting, poetry.

And yet like every other species, we are biological organisms. Like every other creature, we began life as a single cell: a fertilized ovum. How is it possible for all the complexity of the human mind to develop from such a humble beginning? What unique biological endowment does the human conception carry, that our young develop so differently from those of other species? What human experience is necessary, to bring that biological promise to fruition? And how can it be that a process that universally generates the characteristic intelligence that marks us as human also creates the rich diversity of ability and personality we see across individuals? Questions such as these are at the heart of developmental psychology. They are what this book is about.

Why study human development?

For me, unraveling the puzzle of human development is the most intriguing and exciting challenge that science can possibly tackle. We take the changes that occur through childhood for granted. Actually, these changes are as remarkable as anything else in nature! Where else can we see the rise of intelligence and individuality before our very eyes, as we do in watching a newborn baby grow into a toddler, a child, an adolescent, an adult?

The phenomena of childhood are intrinsically interesting. But developmental psychology has a far greater significance: it enriches our understanding of human nature as a whole. If you follow a sequence of events through, as we do in studying childhood development, you end up with a far richer understanding of a given state of affairs than you would had you only seen that one state. **Figure 1.1** illustrates the point. If you saw only picture C, you would probably infer that the big dog had stolen pie from the plate, while the small dog innocently slept. But if you had seen the sequence of events leading up to picture C (pictures A and B) you would realize that the big dog is innocent, where the small dog was not only the thief, but also sneaky and deceptive! Understanding how events unfold can radically change your interpretation of the end state.

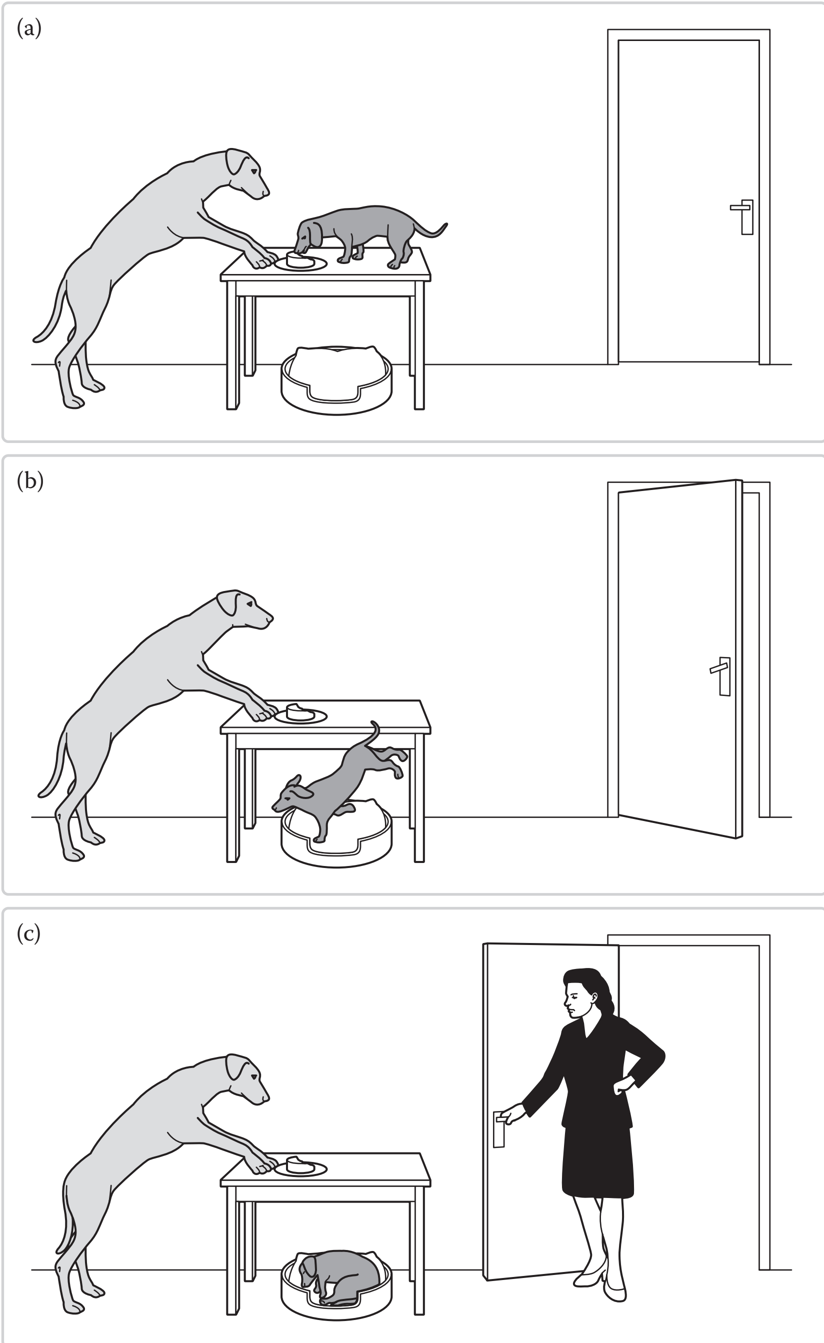


figure 1.1

Seeing the bigger picture

Understanding how children develop into adults can radically alter our understanding of human nature, and this is an important goal in itself. For instance: are we, as a species, *inevitably* doomed to all the bigotry, paranoia, racism, murderous intent and thoughtlessness that presently blight lives and despoil our planet? Are we born biologically predisposed to such things, or are they by-products of the contexts in which children develop, the ways that children are treated? Could deeper understanding of human development open up ways to change things for the better?

Developmental psychology has a strong and continuing commitment to child welfare, and to fostering the full potential of individual development. In fact, our discipline has already changed children's lives in many ways, both through altering our understanding of childhood, and through influencing social policy (some examples of this are listed in **Table 1.1**). For example, disorders such as ADHD (attention deficit hyperactivity disorder) have only recently been recognized. A child with such a disorder (illustrated in **Box 1.1**) is difficult to cope with, and would, a generation ago, have been dismissed as unteachable, unintelligent, naughty. He (it is usually a boy) would probably have been punished and excluded from ordinary education. Today, he would be diagnosed, treated, supported: the outlook for his future is much better.

A second example is the change in policy for dealing with child witnesses: young children are easily intimidated and confused in courts, so that their experience of being witnesses used often to be very distressing,

table 1.1

Some ways developmental psychology has changed children's lives

Intelligence tests	Have replaced subjective and sometimes prejudiced opinions about a child's potential and thus opened up access to education
Studies of intelligence over time	Have shown that individual IQ scores vary far more over time than is popularly thought and thus reduced 'once for all' labelling of children's abilities
The discovery of developmental problems such as dyslexia, ADHD, autism	Have created tolerance and support for children who were once dismissed as irredeemably stupid or naughty
The discovery that reward works far better than punishment	Has shifted education and parenting away from *'spare the rod and spoil the child'* toward more constructive emphasis on encouraging the child's confidence and self-esteem
Studies of sex differences in development	Have changed our perception of both girls and boys, the ways we treat them and what we allow or expect girls and boys to be like
Research on how children's minds and skills develop	Has changed how we view learning and education: less rote learning, more activity-based learning

and their testimony disregarded. Research showed that children are easily led to remember things that didn't happen – even very bizarre things – especially if they are asked the same questions over and over, or the questioner suggests things they might 'remember' (Ceci, Leichman and White, 1999). But questioned less aggressively and without leading questions, even the very young can recall things quite well, and do not usually invent or embroider stories (Howe and Courage, 1997). Such discoveries have changed how child witnesses are handled during enquiries and in courts, making it possible to secure better justice both for child victims (of abuse, say) and for adults who might have been wrongly accused.

box 1.1

An example of attention deficit hyperactivity disorder

Source: Wallis (1994).

> Seven-year-old Dusty awoke at 5.00 one recent morning in his Chicago home. Every muscle in his 50 lb body flew in furious motion as he headed downstairs for breakfast. After pulling a box of cereal from the cupboard, Dusty started grabbing cereal with his hands and kicking the box, scattering the cereal across the room. Next he began peeling the decorative paper covering off the TV table. Then he started stomping the spilled cereal to bits. After dismantling the plastic dustpan he had gotten to clean up the cereal, he moved onto his next project: grabbing three rolls of toilet paper from the bathroom and unravelling them around the house.

A short history of developmental psychology

People have been interested in child development for a very long time. Both Plato and Aristotle, for example, had theories about child development and child rearing, and many subsequent philosophers, including Locke and Rousseau, put forward theories on these topics. But their work was based on intelligent speculation rather than evidence or scientific test. Developmental psychology as a separate discipline began only about 150 years ago. Three crucial things made developmental psychology possible in the middle of the 19th century:

- The industrial revolution created a need for a new, urban workforce with skills (such as literacy and numeracy) that required mass education. Thus there was a new economic need to understand the process of learning and the development of the mind.
- Social reformers became concerned at the brutalizing effects of sending small children to work long hours (7-year-olds doing shifts of 10 hours a day were common) in coalmines and factories. This created a new interest in understanding the effects of childhood experience on individual disposition and behaviour.
- Darwin's book *The Origin of Species by Means of Natural Selection* (1859/2003) changed our perception of human beings from almost celestial beings 'made in the image of God' to biological beings shaped by natural selection just like every other living creature. In so doing it changed where

we would look to understand human nature and development: to biology and science rather than to theology and religion. For the first time, Darwin's theory moved human beings into the realm of phenomena that might be studied and understood through science as part of the natural world.

Darwin's book was published in 1859, creating a level of excitement (and outrage) that is almost impossible to imagine today. It triggered the birth of developmental psychology as a scientific discipline. By 1888 there were about 50 published empirical studies of child development across Europe and America. In the 1890s specialist academic journals began to be published, and institutes for research in child development began to appear. By the early years of the 20th century developmental psychology was a going concern.

Although developmental psychology has a single overall focus (understanding human development) it's a mistake to think of it as a single, monolithic enterprise. There are a number of things on which almost all developmental psychologists would agree. But different researchers have focused on different issues, or come to different conclusions on the same issue. This has been true since the earliest days of research: it's how science works, and is just as true in any other science (not all medical researchers agree that HIV causes AIDS, for example). One thing that all developmental psychologists share, however, is history: a familiarity with the ideas that have gone before. Knowing this history enriches our understanding of modern research (just as knowing the sequence of events in Figure 1.1 enriches our understanding of the canine characters involved). So let's briefly review that history before reviewing modern psychology.

Darwin and the theory of evolution

It would be impossible to exaggerate the importance of Darwin's work for psychology and for biology as a whole. Nothing has ever revolutionized our understanding of human nature and development so much. Almost all work in developmental psychology is influenced by Darwin in one way or another.

The heart of Darwin's insight was that the physical features of living organisms have been selected, over many generations, because they are particularly successful (*adaptive*) in ensuring survival in the environment the creature inhabits. For instance, in environments where a long thin beak is best suited for getting food, the individual birds within a species who have longer thinner beaks will survive better than those with shorter stubbier ones. Because they survive better, the thin-beaked individuals will be more likely to mate and rear young successfully. They pass on their thin-beak genes, and so gradually the species shifts towards thin-beakedness.

Of course, this process of *natural selection* applies just as much to behaviour as to body shapes. Behaviours associated with survival and reproductive success will be selected for, just as body types associated with success are selected for. In fact, evolution must work first at the level of behaviour rather than body shape: after all, thin-beakedness is only adaptive if you're already trying to suck food from long thin apertures. Shifting from gills to lungs is only adaptive if you're already trying to leave the water and live on the land.

Darwin's work posed fundamental questions about the origins of human behaviour. What role has evolution played in shaping our minds and how we behave? What role does it play in shaping our individual development? How much of who we are, how we develop, is innate, set by our biological history? Darwin began the work on these questions. For example, in 1877 he published 'A biographical sketch of an infant': a detailed diary recording his baby son Doddy's emotional expressions, to explore whether these were innate or not. This 'baby diary' was a milestone for developmental psychology. It was the first attempt to make rigorous and systematic observations of child development. Baby diaries became an important early methodology, and are still in use for some kinds of research today.

Comparative psychology and ethology

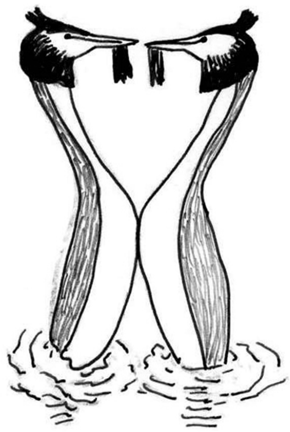


figure 1.2

The grebe courtship ritual

Source: A. Manning: *An Introduction to Animal Behavior.* (Edward Arnold). © 1972. Reproduced with permission from Hodder Education.

One consequence of Darwin's work was that researchers began to ask: can we understand human behaviour and development in the same terms as we explain animal behaviour and development? What can we discover about human development by comparison with other species?

Quite a lot of key animal behaviours are rigid, ritualized or stereotyped, and very typical of a particular species. Well-known examples are the courtship dances of birds (**Figure 1.2**), and the kill behaviours of lions or crocodiles. Ethologists such as Niko Timbergen argued that these rigidly stereotyped *species typical* patterns of behaviour (which he called *fixed action patterns*, or FAPs) are instinctive: that is to say, these behaviours are innate, programmed into the animal rather than learned. Each FAP is triggered by a *sign stimulus* in the environment, to which the animal is innately programmed to respond. For example, a certain silhouette is a sign stimulus triggering fighting in the male stickleback fish. The silhouette is that of a rival – but in fact, a piece of cardboard of the right shape will also trigger or *release* FAPs protecting territorial rights.

Some instinctive behaviours identified by Timbergen and others seem to be present from birth: for example, the tendency of young birds to gape at the sight of a parent (or a parent-shaped piece of cardboard), thus making it easy to be fed. Other FAPs seem to emerge later, as the animal matures: sexual or courtship FAPs, for example, might occur only as the animal reaches sexual maturity. Just as animals' bodies are programmed to change at adolescence, so their behaviour may be pre-programmed to change as they mature. Like FAPs present from birth, these later occurring behaviours were thought to be largely independent of the environment, and to reflect a process of *maturation* rather than learning.

figure 1.3

An universal gesture, the open-palm wave

Source: I. Eibl-Eibesfeldt, *Love and Hate* (Methuen). © 1971. Reproduced with permission from Methuen.

Innate behaviours such as fixed action patterns exist, according to ethology, because they are adaptive and enhance the chances of survival for the individual and hence for the species. Such patterns of behaviour have been shaped up by the process of natural selection identified by Darwin, through the evolutionary history of the species. Individual development then reflects the unfolding of these innate behaviours through a process of maturation.

Do human beings also have instinctive behaviours, FAPs? Is our development characterized by maturation? Ethologists such as Timbergen and Irenaus Eibl-Eibesfeldt argued that some human behaviour, too, can be understood in these terms. Indeed, it would be surprising if we alone of all the species were not pre-programmed to develop in certain ways. But the concepts of fixed action patterns and sign stimuli have not been very helpful in understanding human behaviour or development. Human behaviour is extremely flexible and variable. Almost no human behaviours have the universal, rigid, ritualized characteristics of a fixed action pattern. In fact, the only instances of human behaviour that look at all like a fixed action pattern are quite minor: for example, certain social gestures that seem to be universal to all human beings (Eibl-Eibesfeldt, 1971), such as the open palm wave when we greet someone (Figure 1.3).

Nor does there seem to be much evidence for the idea of maturation as a key factor in human development, although at one time this idea was advocated by some researchers. For example, Arnold Gesell studied children's developing physical coordination and control over their bodies (*motor development*), and found that the sequence of development did not vary between children. Motor control develops from the head down (head first, then the trunk, last the legs) and from the central to the peripheral elements (head and trunk first, then a progressive mastery of the limbs from elbow to wrist to fingers, and from knee to ankle to toes). Furthermore, children achieve milestones (such as head control, sitting, crawling) at very similar ages. On the basis of such data, Gesell concluded that motor development is importantly controlled by maturation, in other words by the unfolding of a biological programme (Gesell and Ames, 1940).

However, the evidence is that Gesell was wrong. For instance, the speed of a child's mastery of motor control can be increased by training (McGraw, 1945). This should not be the case, if motor development reflects the maturation of a pre-set biological programme. Furthermore, modern work shows that the consistent order of events which Gesell noticed need not reflect a biological programme maturing so much as the basic dynamics of the situation. It would be hard, for example, to learn to walk before you had learned to stand up! Standing up comes first because it is a necessary subskill of walking, not because it is 'programmed' to mature first. If even so basic a thing as motor development is not controlled by maturation, it seems most unlikely that more complex human behaviours could develop in this way. Maturation is not now regarded as important in understanding human development.

In fact, the concepts of maturation and of instinctive behaviours of the kind described as FAPs have been problematic as a whole, even in describing animal behaviour: more is learned, more is affected by the environment than these concepts allow. Nonetheless, the basic idea that evolution may prime us to behave or to develop in certain ways remains a plausible hypothesis, and other conceptualizations of how this may work have had interesting implications for developmental psychology.

Imprinting and attachment

For instance, Konrad Lorenz (1981) argued that the young of many species are biologically programmed to *imprint* on (in other words, to become attached to) their parent. According to Lorenz, a gosling is programmed to imprint on the first moving object it sees, during a *critical period* a few hours after hatching. Normally this is the mother, and the result has huge advantages for survival: the 'imprinted' gosling stays close to the object of its attachment (the mother) and is therefore to hand for feeding and protection. Furthermore, this early imprinting sets the gosling's later orientation when it comes to mating: it will mate with something reminiscent of the mother – another goose, rather than, say, a chicken or a dog. But if the mother is absent at the crucial time, then either the gosling does not imprint at all, or it may imprint on some other creature or object. Lorenz demonstrated that goslings would imprint on him, would attach themselves to him as they would to their mother: they would follow him as they followed their mother, and in later life would even try to mate with him rather than with another goose.

Lorenz's idea of imprinting very much impressed the psychologist John Bowlby. Bowlby suggested that human babies are born with an innate drive to become attached to the mother, just as a gosling is (Bowlby, 1953, 1969). At the time, this was a revolutionary idea. The general assumption had been that babies became attached to people for entirely instrumental reasons: because they were fed, for instance. Bowlby's suggestion was that we become attached to our mothers because we are biologically programmed to need attachment and love every bit as much as we need food.

Bowlby's conclusion was supported by experiments by Harry Harlow (Harlow and Zimmerman, 1959), who reared baby monkeys with two surrogate 'mothers', one made of wire, cold and uncuddly but with a nipple through which the baby monkey was fed, and the other made of soft, cuddly cloth but with no nipple. The baby monkeys preferred the soft cuddly 'mother', choosing to run to 'her' when frightened, rather than to the cold food-giver. If monkeys attach for comfort rather than food, surely humans do too?

Bowlby's theories about infant attachment have been hugely influential, and are of lasting importance. His conclusions were not right in every respect, as we shall see later in this book: babies do not necessarily attach to just one person as he thought, and do not necessarily prefer the mother. But the basic idea that human development and feeling might reflect biological need is a continuing theme for research.

Sociobiology and evolutionary psychology

Today, probably the best-known supporters of the idea that human behaviour and development can be understood by reference to our evolutionary history are the adherents of sociobiology and evolutionary psychology. Both of these disciplines argue that many human behaviours are importantly shaped by innate tendencies which have evolved to enhance our survival and reproductive success, even if we don't inherit instinctive fixed action patterns.

A key area where this sort of idea has been explored is social interaction. For example: why do individuals sometimes behave altruistically? Darwin's theory as originally conceptualized seemed to imply that organisms should be selfishly focused on their own survival, or on the survival of their own direct offspring. If they helped others, it should only be for direct mutual advantage. But in fact people aren't like that – and nor are other creatures.

Take the bee: one individual, the queen, breeds. Hundreds of others serve her, never breeding themselves, apparently sacrificing themselves for her offspring. How is this *altruism* adaptive for them? A British biologist suggested an explanation based on the concept of *kin selection* (Hamilton, 1964). In brief, male bees derive from unfertilized eggs, and therefore have only one set of chromosomes. Queen bees mate but once in a lifetime: so all their offspring share the chromosomes of the male mate, plus a melange of the chromosomes from the queen herself. The bees who serve the queen are her daughters. They share all their father's chromosomes, plus some percentage of the mother's. This means that they share more chromosomes with their sisters than they would share with their own offspring, were they to mate with a male other than their own father. By serving their mother's daughters, including the new queens she will create, they secure the best future for their own genes. Thus their 'altruistic' behaviour is in fact adaptive – *for their genes*. This is a natural extension of Darwin's theory. It offers an explanation of all sorts of behaviour in the animal world that seems otherwise to fly in the face of a simple view of natural selection.

Hamilton's ideas have been taken further by naturalists such as E. O. Wilson (1980), who proposed the new discipline of *sociobiology.* Sociobiologists assume that human behaviour has evolved to optimize the survival of what Richard Dawkins has famously called our 'selfish genes'. This theory predicts that, just like bees, human beings will show 'kin selection' – in other words, will be helpful and altruistic to the kinfolk who share their genes (offspring, siblings, cousins, in that order) rather than to unrelated strangers. There is much evidence to support this idea. But not all altruistic behaviour can be explained by kin selection. In fact, we are often altruistic to individuals unrelated to us.

Sociobiology has proposed the notion of *reciprocal altruism* (Trivers, 1971) to explain why we help those who don't share our genes: an individual will help another if the cost is not too great, and if he or she expects the other to reciprocate, in a sort of 'tit for tat' universe that helps everyone survive. Interestingly, this hypothesis suggests that there is important adaptive value in the ability to recognize one another, so that we can know the reputation of different individuals (who is reliably helpful and who is not). Does this explain the endless social fascination with gossip in our species?

Sociobiologists have identified many parallels between human behaviour and that of animals, particularly our nearest relations, the apes. Their claim that these behaviours must be adaptive and must have evolved because they have survival value is intriguing. However, this approach is very controversial. Critics object that, though the theories offered by sociobiologists may be plausible and seductive, they are not backed by convincing evidence. It may be true that the predictions of sociobiology fit the data, but this scarcely constitutes an independent test of the ideas, since the theory was developed to explain those data in the first place! For example, the fact that individuals help siblings and cousins as well as their offspring was the reason that Hamilton proposed his hypothesis about kin selection. So a new demonstration that individuals are altruistic to their kin is not an independent test of the theory of kin selection.

In fact, the theories of kin selection and reciprocal altruism don't fit the data very well, if you take a broader look. Altruism happens where it shouldn't, according to sociobiological accounts: people sacrifice time, effort, even their lives to help unrelated strangers who cannot possibly reciprocate (this is the basis not only of outstanding human lives such as that of Mother Theresa, or of heroic military acts, but of all voluntary work, and of career choices to pursue 'caring professions' rather than power or wealth). Equally, and depressingly often, altruism doesn't happen where it should, according to sociobiology, as the many children abused, abandoned or killed by their families testify.

Many critics argue that there is just too much variability in human behaviour to be captured by the precepts of sociobiology. Other factors must be involved, and may in fact provide a far better explanation for our behaviour. Many believe that sociobiology has not yet made a convincing case for its thesis. Some do not even accept that sociobiology amounts to science (Maddox, 1998).

Learning theory and behaviourism

A radically different application of Darwin's principles of natural selection comes from *learning theory* and *behaviourism*, which dominated psychology as a whole for the first half of the 20th century. Natural selection implies that things that are adaptive and successful in serving survival will tend to prosper and become more frequent, whereas things that are maladaptive will die out. Through evolutionary time, this principle will shape physiology and innate tendencies. But in an individual life, it will be a potent force for shaping specific behaviours, specific *learning.*

The Russian physiologist Ivan Pavlov (1927) observed that dogs can learn to associate a bell with the arrival of food. Dogs naturally salivate at the sight or smell of food, making ready to digest more easily. If a bell was rung systematically before the food was offered, the dog would begin to salivate whenever the bell was rung, even though there was no food present. This reaction was called a *conditioned response.* This sort of *learning by association* to respond to one stimulus (here, a bell) as if it were another (here, food) is called *classical conditioning,* and occurs in human beings just as it does in animals. You can probably think of examples of such associations in your own life (just as certain little cakes evoked particular feelings for the writer Marcel Proust).

A second principle of conditioning was articulated by Thorndike (1911) as the *law of effect.* This simply states that an action is more likely to be repeated if it leads to reward, and less likely to be repeated if it does not (or worse, leads to punishment). For example, a rat will learn to press a lever if doing that is associated with the arrival of food, but not if it isn't, and will learn to avoid the lever if pressing it is associated with getting an electric shock. Again, human beings are much the same!

This type of process was most powerfully explored by Burrhus Frederic (B. F.) Skinner, who pointed out that animals are not simply led passively into this or that behaviour by the presence or absence of stimuli for reward or punishment in their environment. Rather, they actively operate on the environment to create reward or punishment. For example, a dog that is rewarded with a biscuit for cute begging behaviour will do his party piece when he wants to get a biscuit. The dog thus controls the owner as much as the owner is controlling the dog (a thing many dog owners have long suspected!). This is *operant conditioning.* Skinner's account of operant conditioning extends the law of effect, providing a more dynamic interpretation of the relationship between behaviour and environmental stimuli. The effects of operant conditioning are, of course, as clearly visible in human beings as in animals.

Many psychologists saw these principles of learning as the basis for a new and more rigorous way of explaining human behaviour and development. At last, we could explain why an individual behaves as he or she does, not by inferring invisible thoughts in the mind or hypothetical innate tendencies, but by referring to external, highly visible stimuli and the equally visible overt responses associated with them. Like physicists or biologists, psychologists could study things in the external world, rather than introspections or speculations. Thus this *stimulus–response* or *S–R* approach seemed to provide an objective and scientific basis for psychology. This way of thinking was called *behaviourism*.

Some early behaviourists were so taken with the power of S–R explanations of behaviour that they saw no role at all for the mind or any other type of thought process in psychological theories. All behaviour, including verbal behaviour, could be explained in terms of chains of associations between stimuli and responses. That being the case, it seemed natural to further suppose that human behaviour was entirely learned, rather than having any innate component. So although the law of effect is very much in line with Darwin's theory of natural selection, behaviourism moved strongly away from the notion that behaviour is inherited after having been shaped through evolutionary history. Evolution and development might use the same *process* (natural selection) but were not continuous with one another, as those who believed in innate behaviours as an important factor in development (for example, ethologists, and later sociobiologists) thought. Instinct was 'out', and learning was 'in'. And this put new emphasis on child development.

Many prominent behaviourists focused on childhood. For example, John Watson, an early and very radical behaviourist, believed that behaviourism could explain everything about a child's development, and indeed could *control* that development, shaping a child to be whatever you wanted him or her to be. He famously wrote:

> *Give me a dozen healthy infants, well formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select – doctor, lawyer, artist, merchant-in-chief and yes, even beggar man and thief, regardless of his talents, penchants, tendencies, abilities, vocations and race of his ancestors.*
>
> *(Watson, 1930)*

Watson's most famous (or possibly infamous) studies involved demonstrating that babies' irrational fears can be explained by classical conditioning. For instance, after a baby known as 'Little Albert' had been frightened while playing with a furry toy he became frightened of the toy and of other similar-looking furry things, including beards (Watson and Rayner, 1920).

Skinner too believed that child development could be entirely explained in behaviourist S–R terms. He designed whole programmes of childrearing based on behaviourist principles, and wrote a novel advocating the principles of learning theory as a means of creating Utopia (*Walden Two*). Every aspect of development was covered by Skinner's behaviourism, including language (which Skinner saw as 'verbal behaviour' – Skinner, 1957) and thought (which Skinner believed was sub-vocal verbal behaviour).

It is fashionable today to decry behaviourism as a deeply misguided approach to psychology and development. Indeed, the approach ran into some very severe problems. One problem was that behaviourism supposed that, since there are no innate behaviours or tendencies, one can condition (in other words, train) any animal to associate any stimulus with any response. This is not the case. It's very easy, for example, to condition a dog to run away or to freeze to end a painful experience (such as an electric shock), but it's very nearly impossible to condition it to salivate or eat a biscuit to end the shock. It turns out that animals (including human beings) have innate predispositions to learn some S–R associations rather than others. Typically, animals confronted by something dangerous, painful or threatening will fight, flee or freeze, and are genetically 'prepared' to learn to associate these responses with escaping particular noxious events. Thus the concept of *preparedness to learn* reintroduced innate tendencies carried over from evolutionary history into S–R theories of how behaviour develops.

A worse problem for learning theory comes from the fact that S–R chains cannot in fact explain the creativity and diversity of behaviour – certainly not in human beings. The best example of this is human language. We are obviously capable of constructing new sentences, sentences that carry new ideas, or refer to non-existent fantasy things: sentences that cannot, therefore, be explained in terms of any simple S–R chain of events. Such phenomena suggest that in fact, something other than S–R chains (such as mental processes) must be involved in the generation of behaviour – a conclusion that radically undermines the power of behaviourism to explain human psychology.

Problems such as preparedness to learn and creativity showed that behaviourism and S–R theory could not provide a complete account of human behaviour or development. Nonetheless, it is quite clear that human behaviour is shaped by reward and punishment, just as S–R theory says. This fact is still widely used where we need to understand and to modify behaviour. For example: suppose you, as a child psychologist, are confronted by a 2-year-old child who is misbehaving wildly. The parents are at their wit's end. What to do? Often, in such situations, a trained observer will notice that in fact, the child's bad behaviour is 'attention seeking'. He or she desperately wants the parent's attention, but only gets it when misbehaving. Even the mother's criticism is more rewarding to the child than being ignored, so the child plays up more to get more attention, and the problem is made worse. The parent's behaviour (ignoring the child unless he or she is misbehaving) is creating the bad behaviour! The solution is straightforward; as Skinner puts it:

> *The remedy in such a case is simply for the mother to make sure that she responds with attention and affection to most if not all of the responses of the child which are … acceptable and that she never (rewards) the annoying forms of behaviour.*
> *(Skinner, 1961)*

Behaviour modification, in other words the identification of the rewards and punishments that are controlling existing behaviour and altering these to create more satisfactory behaviours – just as described by Skinner – remains a powerful tool for psychologists dealing with problem behaviour today, particularly in dealing with children.

Social learning theory

Social learning theory (Bandura, 1973) provides one way of preserving the important insights of S–R theory as to how reward and punishment shape behaviour, while beginning to allow for the action of mental processes. Bandura studied aggressiveness in children, and found that children who watched a film where another person behaved aggressively toward a doll were more likely to behave aggressively when allowed to play with that doll themselves than was the case for children who had not watched anyone else being aggressive. This is hard to explain in purely S–R terms: where is the reward that is eliciting the aggressive behaviour in the child? Bandura suggested that the children are *learning by observation*. In effect, the observing child mentally identifies with the person he or she is watching, and so notices and is affected by any reward or punishment that person's behaviour attracts. If aggression is rewarded in the person the child watches, then aggressive behaviour is implicitly rewarded in the observing child too, and so becomes more likely.

Observational learning is an important factor in development. Children learn a great deal from watching others and then imitating them, both in their social behaviour and in the acquisition of skills. In fact, so important is observational learning and imitation in development that it now seems strange that psychology took so little notice of it until the 1960s! That social factors were ignored for so long is a tribute to the dominance of behaviourism in Western psychology. But in other cultures, such factors were recognized as important long before this.

Vygotsky and social interactions in development

The first to recognize the importance of social interactions in development was the Russian psychologist Lev Vygotsky. According to Vygotsky (1962), at any one time a child has a certain level of ability and is able to perform, alone and unaided, tasks up to that level of ability. Just beyond this level are new ideas and new skills that are too difficult for the child to manage alone, but that he or she can manage in collaboration with an adult or a more skilled older child. These new ideas and skills are the next thing to be mastered. Vygotsky called them the *zone of proximal development*. The support of a more skilled collaborator allows the child to enter and explore this zone, and so to learn, and to raise his or her mastery to a new level. This new level too will have a zone of proximal development, another step beyond – and so development proceeds.

For example, a baby learning to use a spoon to feed herself may be helped by an adult, who guides the spoon to the child's mouth more accurately than the child can manage alone, or who deals with the tricky problem of loading the spoon (and so on). The adult's help not only allows the child to achieve a performance beyond his or her own independent level of skill, but also provides the experience and practice to let skill develop.

For Vygotsky, such supportive social interactions are the key to human development. And in fact, the suggestion that practical skills and knowledge can be passed on in this way makes obvious sense. But Vygotsky's theory goes much further, suggesting that social interactions of this type not only foster the development of practical skills but also play a key role in creating mental processes.

For example, children's earliest efforts to communicate are supported by adults (or older siblings) in just the same way as their early efforts to feed themselves. The baby makes an effort to communicate (a noise of some sort), and the more skilled partner supports that effort by interpreting what the child means, saying the right words for the child, behaving as if there is a reciprocal conversation. In effect, the adult partner is 'shaping up' the child's language, just as his or her help shapes up the use of a spoon. At first the child's language depends on this help from the adult world: the child's language skills exist only in the social interaction between the child and skilled others. Gradually the child's independent skill as a speaker develops further, until the child can produce and structure language for him or herself. Now the child can begin to internalize language, to be able to reflect on it and with it, and thus become able to use it for private thought processes. Thus thought processes, according to Vygotsky, have their origins in social interactions.

Vygotsky's work does not provide a complete account of development. However, his insight into the role of social processes in fostering development has had a vast and continuing influence in developmental psychology. For example, followers of Vygotsky such as Luria (1976) extended his work to explore how the development of mental processes is structured by the surrounding culture as well as by individual social interactions, a powerful idea with increasing influence over developmental research.

Piaget and cognitive development

Piaget is, beyond any doubt, the most influential developmental psychologist of the 20th century. Only Darwin has had as great an impact as Piaget. Like Darwin, Piaget was originally a biologist. Like Darwin, his ideas have irrevocably changed how we think about human development.

Where ethologists, sociobiologists, learning theorists and behaviourists focused on the development of behaviour, and social learning theorists and Vygotsky focused on social processes in development, Piaget focused on the development of the mind. Specifically, he was puzzled by the development of knowledge, or *cognition*. The general assumption before Piaget was that babies are born without knowledge of the world, their minds empty, 'blank slates' waiting to be filled up through learning and experience. It was assumed that information from the world or from other people could provide this waiting mind with knowledge. Piaget realized that this cannot be right. Knowledge involves understanding and insight rather than blind rote learning. To achieve insight, there must already be structures in the mind able to capture and make sense of the information received. For if there are no structures capable of receiving it, the information will no more stick in the mind than a whispered word stays in an empty room. And if there are no structures capable of making sense of the information received, it will remain meaningless even if it can be recorded. (A tape-recorder, for instance, can record human speech. But it has no processes capable of interpreting the meaning of that speech, nor processes capable of learning how to interpret speech.) An infant, therefore, could learn nothing, could develop no knowledge or insight, unless the structures needed for doing those things were already there. This opens up entirely new problems for research: what structures does the infant mind contain, and where do they come from?

Piaget argued that the mental structures necessary for human knowledge and insight must be rooted within the organism, because they cannot (as we have just seen) be provided from outside. They must therefore develop from biological mechanisms. His theory was that the basic mechanisms of adaptation that serve evolution as a whole must be sufficient to explain the origins of intelligence, both in individuals and across evolutionary history.

For Piaget, human intelligence is continuous with that of all other living organisms. He argued that, through evolutionary history, intelligence arose through the development of the senses. With no senses at all, an organism cannot even detect that it has suffered damage, let alone keep out of harm's way. A first tiny step toward awareness and intelligence is the ability to detect the presence of other creatures or objects impinging on one's body, through the two proximate senses of touch and taste. Touch allows an organism to pull back at the first prick of a thorn rather than impaling itself, for instance. Taste gives an organism the basis for a choice between swallowing or spitting, a first small step toward anticipating consequences. The senses of smell, sight and hearing greatly extend the organism's ability to anticipate events: to smell food, a potential mate, a poison or a predator before you taste or touch it, to hear it coming or see it in the distance greatly increase the organism's scope for adaptive action. These three 'anticipatory' senses already imply some degree of ability to draw inferences and predict events (there is no advantage in being able to detect a lion in the distance unless this suggests danger and the wisdom of taking evasive action). The ability to reason and predict the future comes to fruition in the 'sixth sense': intelligence proper. With this sixth sense, an organism can not only draw inferences and make predictions on the basis of concrete present events ('I see a lion'), but can make predictions about the future, conceptualizing possibilities ('This looks like lion country, there *might* be a lion here').

Many species have begun to develop this sixth sense, this ability to anticipate (predict) events that have not yet happened (my dog, for example, predicts the viability of successful scrounging from strangers on a beach very well). Human beings have gone a step further, developing a powerful abstract intelligence capable of imagining hypothetical situations and possibilities way beyond concrete experience (only we worry about the danger of being abducted by alien spacecraft we have not yet detected, and so on).

Piaget's account of why intelligence evolved is intriguing and compelling. It is also extraordinarily universal: the adaptive value of senses, and the consequent steady progression toward abstract, predictive intelligence apply equally to a Martian, a human and a bird (or any other living thing), although species differ in terms of how far they progress through the process. His view of individual development is equally intriguing.

Human babies are born, according to Piaget, with nothing but a few reflexes (such as sucking, orienting to the breast and the like). They have no conception of the world or of themselves (nor any idea that there is a distinction between these things). Through very basic mechanisms of adaptation, each child must build on the simple reflexes to construct for him or herself all the mental structures necessary for the development of knowledge. This takes many years: it is completed at about 12 years of age. The process follows the same pattern and sequence of events in every child. This is not because it is 'pre-programmed' in any way. Rather, the universal sequence of events through development reflects the fact that knowledge itself has a certain structure, and the growing mind must reflect this. The sequence of cognitive development is therefore not specific to human beings – Martians would have to develop in the same way.

Piaget identified four stages in the process of cognitive development. Each stage is more powerful and sophisticated than the one that came before. Each produces a qualitatively different character of thinking. And each stage creates the conditions for the next stage to develop, until an adult form of reasoning has been reached. We shall study these stages in detail in later chapters. Briefly, they are:

- *The sensori-motor stage*, which occurs between birth and about 18 months. This period is spent constructing the basic mental structures for memory and perception. Gradually, the baby becomes able to recognize that the world is separate from the self. He or she becomes aware that the world has its own properties, and becomes able to represent and remember those properties.

- *The pre-operational stage* occurs between 18 months and about 7 years of age. Initially, the child's thinking is very bound to specific physical actions in the world, so that thinking is tied to *doing*. The child becomes progressively more competent in *imagining* rather than actually doing as a basis for thinking. But his or her ability to connect one thing to another, or to bear two aspects of a situation in mind at the same time is still very limited. This means that the ability to draw inferences (for instance) is still very limited.
- *The concrete operational period*, which begins around 8 years of age, is a great breakthrough. The child becomes able to connect one thing with another, because it is now not only possible to do a thing in the imagination, it is possible to mentally *reverse* that action as well. For the first time, the child understands the logical connection between the situation before an event and afterwards, because he or she now knows what that relationship is. The difference this makes to reasoning is illustrated in **Box 1.2**.
- *The formal operational stage*, which begins from about 12 years of age, is adult reasoning. The concrete operational child can reason logically, but is very literal minded, very tied to concrete physical events. Gradually, the child's thinking is freed from concrete fact, and can handle the abstract and the hypothetical.

Piaget's theory has dominated psychology for half a century. The questions he asked and the data he collected pose a lasting challenge for developmental psychology. Perhaps most importantly, his idea that children must play an active part in constructing their own minds rather than being the passive products of biology or learning has revolutionized how we think about development.

Piaget's theory has difficulties (as we shall see in later chapters). Like behaviourism, for example, it underestimates the extent to which the newborn are innately primed to learn certain things. It underestimates the role of social processes in supporting development. Nor is logic as good a model of human reasoning as Piaget supposed. Nevertheless, it would be hard to overestimate the importance of Piaget's work.

Information processing and cognitive development

One legacy of Piaget's work is that developmental psychology is now very aware of the need to understand what knowledge a child may have at any given point, and what cognitive processes the child has for handling that knowledge. These issues have been explored in research that draws analogies between human minds and computers.

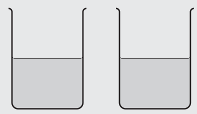
A computer is, basically, a device that performs *operations* on *information*. It can be programmed to behave like a calculator, performing simple logical or numerical operations. With more complex programming, it can solve much more complex problems. Just what problems a computer program can solve and how successfully it does that depends

box 1.2

Conservation of liquids: the effect of being able to mentally 'undo' actions

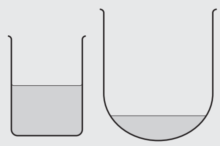
Imagine you are asked to say, is there the same amount of liquid in each container in Figure (a)?

(a)

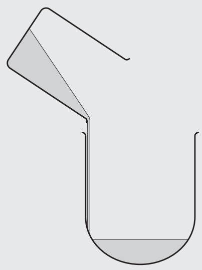


Now how about Figure (b)? Do these two containers hold the same amount of liquid?

(b)

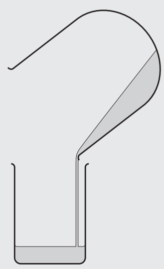


You probably answered 'Yes' to Figure (a), and 'Don't know, doesn't look like it' to Figure (b). From these two 'still snapshots' there's no way of knowing. This is just how Piaget says the world looks to the pre-operational child. But suppose you could connect the two snapshots?



Suppose you could remember that situation (b) was created by pouring liquid from one of the two containers in (a) into the new container, which is now standing next to the other one from situation (a) ...

and you were also able to mentally reverse that act of pouring, and so 'see' where the liquid in the new container came from.



Now you would realize that the amount of liquid must be the same in both containers in (b), since it's the same liquid as shown in the two containers in (a). This is the position of the child with reversible concrete operations.

on the exact information the program has and on the specific operations it can perform on that information. So a program with a few very simple rules might be very successful in solving easier problems in some area, but produce poor answers or no answer at all to harder problems. Add more information or more rules, and the program might 'develop' the ability to solve more of the harder problems.

Various theorists have suggested that this may provide a good model of what is happening in childhood cognitive development. Like a computer, the human mind can be thought of as an information-processing device, one whose programming, and therefore performance, changes as it develops.

For example, Robert Siegler suggested that developmental changes in the solutions children offer when solving balance problems might reflect different states of knowledge, and therefore different rules children of different ages use in thinking about how things balance (Siegler, 1976). A 5-year-old uses a very simple rule, an 8-year-old a more complex one, and a 14-year-old uses a more complex rule still. Siegler showed that a computer program armed with the 5-year-old's rule produces the same answers across a set of problems as would a 5-year-old child, whereas a program armed with the 8-year-old's rule solves the problems in the same way as does a real 8-year-old, and so on. Furthermore, if you teach an 8-year-old the rule typical of a 14-year-old, the child's performance changes to be the same as a 14-year-old's, just as changing the computer's rule from the 8-year-old to the 14-year-old rule changes the program's performance.

Such *computer simulations* of the effects of different information or sets of rules for using that information, have helped to clarify what may be changing as children develop, across a range of different kinds of task. This approach has often been used to explore qualitative changes of the kind described by Piaget in the way children think (Klahr and Wallace, 1976): quite small changes in the rules a program uses can create a qualitative change in the factors it takes into account and the kind of solutions it produces, effects that can parallel the changes Piaget saw between one stage of cognitive development and another.

Other factors too can be explored through computer simulations of children's thinking. For instance, what would be the effect on reasoning if there were developmental changes in the sheer amount of information that the mind can use at one time? In other words, could it be that younger children's weaker reasoning reflects a smaller *memory capacity*, and that developmental change in reasoning occurs as this memory capacity increases? Advocates of this theory (Case, 1985; Pascual-Leone, 1970) argue that many of the changes we see in children's cognitive abilities through childhood can be predicted and simulated by assuming a developmental increase in the memory capacity available, as we shall discuss in Chapter 7.

Some researchers (Klahr, 1984) suggest that even the very process through which developmental change occurs can be explored through computer simulations, by creating programs that modify themselves. Various different ways of doing this have been tried: for example, by building an extra layer into programs using rules for solving problems: this extra layer of program ('a meta-program') monitors the problem-solving layer below, looking for patterns and modifying the lower program to reflect these patterns (cutting out redundant steps, for example, or chunking into one procedure elements that started out as separate steps but that turn out always to go together). Programs like this can be set up to modify themselves, turning themselves from a rule-set that behaves like a 5-year-old to one that behaves like an 8-year-old, for example. But the way they do this does not look very much like the way this process happens in children. For a start, the program achieves in minutes what children take years to learn. Obviously, the human process must be importantly different from what is happening in the computer.

Responding to this (and other) problems, some researchers have argued that human minds are not set up in the way a rule-following program is structured. Human brains create *neural networks* as they learn. That is to say, human learning involves the gradual creation of patterns of connection between many neurons, where many neurons within the pattern may be active at the same time, or may switch on and off in complex interaction with one another. Computer systems can be set up to simulate this sort of process (Plunkett, 2000). Such systems are called *connectionist systems*, and can indeed learn from experiences. But even this line of approach has yet to produce any system that convincingly mimics human development.

The possibility of simulating children's cognitive processes on computers opened up whole new ways of understanding cognitive development, and of testing theories about children's thinking (Klahr and MacWhinney, 1998). Of course, computer programs cannot fully simulate a child's mind: children are flesh and blood, and may have a dozen thoughts in their mind that have nothing to do with the problem-solving task itself ('I'm bored, is it lunch time, am I doing this task well enough or do I look stupid?' and so on) that the computer cannot share. Children develop in complex, multi-faceted environments, where computer programs exist in simple, abstract worlds. And children have insight and understanding, where computer programs don't. Nevertheless, simulations allow us to test the idea that developmental changes in specific states of knowledge or in the memory space available for using that knowledge might play a key role in qualitative changes in children's reasoning through childhood.

Sigmund Freud

Where Piaget and information processing approaches emphasize the universal aspects of the development of human thought and reasoning, other theorists have focused more on the development of individuality. The first and most famous of these was Sigmund Freud.

Freud's initial interest was in the peculiarities of the human mind. It would be easy, reading only the theories reviewed so far, to imagine the human mind as straightforwardly adapted to circumstances and rational. As Freud pointed out, this is not the case. We human beings can suffer great angst and confusion apparently over trivia, and like a character in Lewis Carroll's book *Alice's Adventures in Wonderland* we are perfectly capable of believing any number of impossible things. We harbour delusions, concoct fantasies, and sometimes these play a more important role in our lives than 'reality'.

Freud's explanation for all this was that human behaviour is as much a product of desires and motives as of learning or reasoning. According to Freud (e.g. 1933, 1940), the *ego*, which is the rational, conscious mind, is only one of three elements controlling our behaviour. Far more powerful in generating behaviour is the *id*, our unconscious mind, where our desires and motives bubble and boil. These are restrained by the ego, and by the *superego*, which is our moral conscience.

According to Freud, many of the desires of the unconscious mind (id) are unacceptable to the ego or the superego. These desires are rooted in our biology: in the core motivations of our sexuality, and in basic fears and needs. The ego and superego try to *repress* these unacceptable thoughts and feelings, but the drive of these desires is too great to simply turn off. This leads to the development of a number of *defence mechanisms* which work to disguise the unacceptable desires as something else, and so sneak them past the superego to influence behaviour.

The activity of our busy unconscious minds can best be seen in dreams, when unacceptable thoughts are symbolically transformed into more acceptable images (dreaming of a train going into a tunnel had an obvious sexual symbolism for Freud, for instance). They are also visible in the slips of the tongue we commonly make (such as saying 'Give me a hug' when we meant to say 'Give me a mug') which Freud argued were not innocent mistakes but reflect the real desires of the unconscious mind seeping through our ego defence mechanisms (hence this kind of mistake is called a 'Freudian slip'). The power and character of unacceptable unconscious thoughts is also evident in neurotic behaviour and fantasies.

By analysing the dreams, fears and fantasies of his neurotic patients through a process of *psychoanalysis*, Freud came up with a theory of the development of personality through childhood. Like Piaget, he believed that development passes through a number of stages; but Freud's stages are *psychosexual* rather than cognitive. That is to say, for Freud, the key to each stage of development is the biological drive that dominates the unconscious mind:

- *The oral stage* runs from birth to about the first birthday. The baby's chief desires relate to food, and to his or her mouth. Sucking is the greatest of pleasures. A child whose desire to suckle is fully satisfied during this stage may become, in later life, a sunny *oral optimist*, whereas one who is deprived may become a sour *oral pessimist*.

- *The anal stage* runs from the first birthday to about the third birthday, and coincides with the period of potty training. Now the child's pleasure centres on the anus, and the process of retaining or eliminating faeces. Freud suggested that children may become fixated at this stage, as a reflection of whether they are frustrated in their anal desires or not. He suggested that artistic activity, for example, is an extension of *anal expressiveness*: a symbolic revelling in the expression (smearing) of faeces, where miserliness is an extension of anal retentiveness, a symbolic hanging on to what is yours.
- *The phallic stage*, from 3 to 6 years of age, is when pleasure shifts from the anus to the genitals. The child fantasizes sexual pleasure with the opposite-sex parent, and suffers turbulent passions of lust (for that parent) and fear (of reprisals from the rival, the other parent). This is the period of the *Oedipus complex* in little boys, and the *Electra complex* in little girls.
- *The latency stage*, from 6 years to adolescence, reflects the resolution of all this turbulence. Defence mechanisms act to suppress and disguise the child's dangerous lust and so escape the fear of reprisal. The boy 'escapes' castration at the hands of his rival (father) by 'becoming' the father: adopting the father's ideals and values, and thus is formed the superego. According to Freud, little girls, with less to lose (no phallus), form weaker superegos than boys.
- *The genital stage*, which begins at adolescence, is the start of true, adult sexuality, bringing its own challenges for the superego.

Freud's theory has always been very controversial. The consensus of opinion is that many of Freud's specific claims either have not been supported by scientific work, or cannot even be scientifically tested. For instance, there is little evidence for the Oedipus complex. How could you test the claim that the superego develops through fear of castration? Psychoanalysis itself tends have a circular, rather than a scientific orientation to evidence. For example, if you refuse to believe a psychoanalyst's interpretation of your behaviour you may well be told that this is *proof* that it is correct – your defence system has obviously been alerted, you are clearly in denial! However, Freud's identification of the power of unconscious impulses, and of the role of motivations and desires in forming our minds and personalities, has had a lasting impact on psychology as a whole, as has the notion of defence mechanisms.

Freud's youngest daughter Anna Freud developed a more explicitly developmental application of Freud's psychoanalytic ideas, placing more emphasis on development in adolescence than Freud had done. Erik Erikson too applied and extended Freud's idea of development as shaped by the resolution of inner conflicts, though he viewed these conflicts as passing through a series of psychosocial stages rather than psychosexual ones, reflecting more general social processes rather than purely biological desires. We shall return to these ideas in a later chapter.

table 1.2 Key theories in the history of developmental psychology

	Key idea	Samples of key works
CHARLES DARWIN (1809–1982)	Theory of evolution: all living creatures have been shaped by the biological process of natural selection	Charles Darwin: *The origin of species by means of natural selection* (1859) Charles Darwin: 'A biographical sketch of an infant' (1877)
BEHAVIOURISM (20th century)	That all behaviour is learned, either as an anticipatory response made to a stimulus associated with reward or punishment, or as an operant response aimed at achieving reward or ending punishment.	Ivan Pavlov: *Conditioned Reflexes* (1927) John Watson: *Psychological Care of Infant and Child* (1928) Burrhus Frederic Skinner: *About Behaviourism* (1974)
ETHOLOGY (mid 20th century)	That much animal behaviour reflects innate responses or tendencies, and that basic human behaviours may be explained in the same way	Niko Timbergen: *The Study of Instinct* (1951) Konrad Lorenz: *On Aggression* (1966) Irenaus Eibl-Eibesfeldt: *Love and Hate* (1971)
JOHN BOWLBY (1907–1990)	Influenced by ethological accounts, Bowlby suggested that human babies attach to their mothers through the operation of instinctive drives important to development and quite separate from the child's material needs	John Bowlby: *Child Care and the Growth of Love* (1953) John Bowlby: *Attachment and Loss* (1969)
SOCIOBIOLOGY	The idea that animal behaviour (including human behaviour) is shaped by the need to secure the survival of genes, rather than individuals. Thus we will sacrifice our individual interests to give our genes a better chance of survival.	Richard Dawkins: *The Selfish Gene* (1976) E. O. Wilson: *Sociobiology: The new synthesis* (1980)
LEV VYGOTSKY (1896–1934)	Skills and intelligence are developed through social interactions	Lev Vygotsky: *Thought and Language* (1962)
JEAN PIAGET (1896–1980)	Intelligence must be constructed from basic adaptive processes; the organism is an active contributor to this construction, building intelligence up through a series of stages each more sophisticated and powerful than the one before	Jean Piaget: *Genetic Epistemology* (1968)
INFORMATION PROCESSING	The human mind can be understood by analogy to a computer, wherein both the programming and the memory space may vary. Development may reflect increases in the 'programs' the child has available for processing information or in the memory space available to the program, or both.	Robert Case: *Intellectual Development: Birth to adulthood* (1985) Robert Siegler and Erik Jenkins: *How Children Discover New Strategies* (1989) Klahr and MacWhinney: 'Information processing' (1998) Kim Plunkett: 'Development in a connectionist framework: rethinking the nature-nurture debate' (2000)
PSYCHOANALYSIS	Our behaviour is controlled as much by unconscious, instinctive drives (especially sexual drives) as by our conscious minds. To understand childhood development we must understand the process whereby children gain control over raw instinctive drives to become civilized (and neurotic).	Sigmund Freud: *The Pathology of Everyday Life* (1904) Anna Freud: *Beyond the Best Interests of the Child* (1973)

The full details of each of these references are listed in the references at the back of this book.

Current research and the legacy of the 20th century

The influential theories of the 20th century (**Table 1.2**) can seem bafflingly diverse and contradictory. Sometimes they asked different questions. Sometimes they proposed radically different answers to the same questions. No consensus about development emerges across these different theories. Nevertheless, there are common themes in the history of developmental research, common questions that different theories tried to address in one way or another. These questions form the backdrop for the modern research we shall review in the remainder of this book:

- To what extent (and how) does our biological inheritance shape our human development and individuality? What are the roles of 'nature and nurture' in shaping who we are?
- What kinds of experience (reward and punishment, mental reflection, social interaction) shape development? How do these things interact with one another, and with biology?
- Is the child a passive passenger in this process, or an active influence on his or her own development?
- Where do individual differences come from?
- Is human development continuous (in the way the growth of an oak tree is continuous: its structure stays the same, it just gets bigger) or discontinuous (in the way spawn is different in structure from a tadpole, or from the frog it will become)? Could discontinuities in development reflect the action of a single developmental process, or do they imply that the process itself changes?
- What drives development? Why does it happen at all? Are there evolutionary constraints on how far development can go?

Studying development scientifically

In studying developmental psychology, you are studying a science, and learning to think and to do research scientifically. The core feature of science is that its theories depend on *empirical evidence*. Rather than simply speculating about things as philosophers and others do, scientists go out there and collect things, measure things, do experiments and record what happens. In many ways, this commitment to evidence is, and always has been, the defining characteristic of science. But our understanding of the status of empirical evidence ('facts'), and our understanding of theories has changed radically over the past 50 years. We have become much more sophisticated in our view of what it means to be a scientist.

table 1.3

Some differences between scientific and unscientific thinking

Scientific thinking	Unscientific thinking
Is driven by the evidence: a theory must fit the evidence or be rejected.	Gives far less importance to evidence. A belief may be held without looking for evidence to support it, or despite the existence of evidence that refutes it.
Uses formal and systematic methods for collecting and testing evidentiary data.	Anecdotes, personal opinions, commonly held beliefs may be treated as self-evidently true, without any test.
Understands that all data are potentially biased, affected by the methods used to collect them. Different methods might produce different results.	Assumes that facts are facts.
Strives to create explicit, internally consistent and empirically testable theories to explain data.	Theories may be implicit, internally inconsistent and untestable.
Understands that we cannot 'prove' any theory to be the truth: theories are our best explanation in the light of what we know at the moment. Any theory may turn out to be wrong, or be replaced by a better one.	Believes certain things to be true beyond any question.
Is progressive, always open to new data and better theories.	May be rigidly committed to a particular theory.

The problem with 'facts' (and the nature of data)

In Darwin's day, the general view was that knowledge (theories, understanding) derived from 'facts' – that is, from empirical observations and measurements. Collect enough facts and the truth would eventually emerge. (This theory of science is described by philosophers as '*inductivism*'. It is still pretty much the layperson's view of science today.)

One problem with this view is that it assumes that human beings can perceive reality ('the facts') in some absolute, objective way. We now know that this is impossible. Every measurement we take is made with tools that have limitations which affect what we see. Every observation we make is made by a mind that is constrained by pre-existing theories which affect the 'facts' we find. Every measurement is made in a particular context.

For instance, imagine a new species of flying rodent. Does it communicate vocally? In 1877, a rigorous researcher makes a 2-year study and hears not a sound. For him, the 'fact' is that the rodents are not vocal. In 1977, a new researcher, armed with new equipment able to 'hear' signals way beyond the range of human hearing, discovers a plethora of communications in these rodents. For her, the 'fact' is that the rodents are vocal. In 2077, a researcher not yet born, armed with equipment we can no more now imagine than the researcher of 1877 could have anticipated the equipment of 1977, may make discoveries that will change our understanding of these rodents' communications again. The data we collect are always constrained by the tools we use to collect them. This is inevitable. At any moment, a new tool may come along and radically alter our view of 'the facts'. This has happened many times in developmental research, as we shall see through the course of this book.

Furthermore, however good our measurement tools and techniques, we can only make discoveries about the things we choose to look at, which are normally influenced by what we already know and expect to find. Suppose a researcher is studying the effect of particular elements in the diet on undesirable behaviour in children. Already, he is biased to expect a correlation between those behaviours and certain foods. So he will measure the correlation between behaviour and the specifics of the child's diet; he probably won't measure the correlation between (say) the child's behaviour and his or her popularity. Now, it may be that he finds a correlation of the type he is expecting: perhaps children who prefer junk foods show more undesirable behaviour? He is likely to see this as vindicating his theory that diets of that kind are damaging, and publish reports condemning the nutritional content of junk foods. But it is possible that there is nothing intrinsically wrong with eating junk food in itself (compared with the average diet, which is actually pretty much as deficient in fruit and vegetables and also includes too much salt, fat, sugar, etc.). It may be that quantity, not quality, is relevant here: junk food portions are simply larger and hence more fattening, and obese children are less popular. Unpopular children are less happy, and this is reflected in their behaviour. Our researcher will never see this: his preconceptions determined what he measured, and they shape how he interprets the results he gets. Another researcher with a different theory will make slightly different measurements – and come up with slightly different results.

Our theories always determine what we measure and how we measure it, and so our preconceptions bias the 'facts' we find. This too is inescapable: you cannot measure absolutely everything, you always have to be selective. Inevitably, your theories shape your choice of what to measure and what to ignore. As our theories grow to encompass more factors, our view of what is or is not relevant changes.

And however good our measurement tools, however good our initial theory may be, the results we observe can depend on who is doing the measuring and where that measurement takes place. For example, a doctor measuring your blood pressure in a clinic will get a higher reading than you would if you measured it yourself at home. This effect of context is so well known that doctors label it 'white coat syndrome' and make allowances for it in diagnosing high blood pressure. Any doctor's clinic causes white coat syndrome, but the effect is greater if the doctor happens to be sexually attractive (or repulsively ugly). Who does the measuring and where they collect these observations greatly affects the results in many contexts in developmental research.

So the truth is that there are no absolute, objective hard and fast 'facts'. There are only *data* measured in a certain place, using certain methods, by certain people who chose where and how and what to measure in the light of their pre-existing theories and expectations. This is why research papers have such detailed introduction and method sections. When two researchers come up with different results, we can look at precisely what they did and why, and try to work out what affected their data. We can form hypotheses that would explain the difference, and do new research to test those hypotheses. In the process, we may well make new discoveries that extend our understanding of both theories and methods.

The trouble with truth (and the nature of theory)

If there are no absolute, hard and fast facts, can we say that any theory is true? The answer is obviously, no. However well a theory may fit all the data we have today, new data may always come along that it cannot explain. This point is more important for science than may appear at a casual glance. The philosopher Karl Popper was the first to draw out the key implication: *no amount of data that fits a theory can ever prove that it is true, whereas one datum that contradicts the theory can prove it false.* Popper used the example of the very simple theory: 'all swans are white'. Now, millions of swans *are* white. For long periods of history, a researcher testing this theory in Europe would have made endless observations confirming it, but he would have been foolish to conclude that it was true. The discovery of one black swan in the southern hemisphere discredited it.

Popper argued that *falsification* is more pertinent to science than the search for truth, since we can never know that a theory is true (it's always possible that new data will falsify it). According to Popper, science progresses by proposing theories and testing the predictions these theories make against the data until a prediction proves wrong and the theory must be altered, or discarded in favour of another.

Every theory we have, then, is provisional: it is not the absolute truth, merely a useful way of explaining what we presently know. But that does not mean that any theory is as good as any other. A theory that doesn't fit the data we have now would obviously be less useful than one that does. And even where two theories both more or less fit the data, one may be better than the other because it predicts and explains a wider range of phenomena, or gives a simpler explanation. For instance, a theory that explains the development of both rational and irrational reasoning is better (more complete) than one that explains only rational reasoning, or only irrational reasoning. Equally, a theory that explains both rational and irrational reasoning as different facets of the same kind of process is better than one that explains these two things in terms of two entirely different processes: it is simpler, and simpler explanations tend to be more useful (the principle of always choosing the simpler of two equally good explanations of the same phenomena is called *Occam's razor*). In many ways, the ideal goal of science would be to find a complete theory that accurately explained all the phenomena of the universe in terms of a few simple principles: the elusive 'theory of everything'.

Data, theories and progress in science

Our theories do not arise out of 'objective facts' as inductivism supposed, and are not 'true', but merely useful (or otherwise) in predicting data. These insights suggest that the relationship between data and theory is far more complex than was supposed in Darwin's day.

Where do theories come from? What role does data play in the creation of a theory, or in its development? Popper gives only a partial answer. His principle of falsification is now generally accepted as an account of how science discards ideas. But it does not explain where new theories come from, nor why it is that some falsifications lead us to abandon a whole complex theory, and others don't.

The philosopher Thomas Kuhn (1970) has proposed that science develops in stages. In the first stage (which he called *pre-paradigmatic*) there are many different, often rather poorly specified theories about the phenomenon in question, theories that differ on very fundamental issues (whether behaviour is instinctive or learned, for example). Data is collected rather haphazardly (and in partisan ways) to bear on these controversies. The conflict over the nature of development between sociobiology, behaviourism and psychoanalysis is typical of pre-paradigmatic science.

Gradually, conflicting theories begin to find common ground: a set of assumptions that all can share evolves and comes to dominate research. (For example, in the last quarter of the 20th century it was widely agreed that all behaviour, whether biologically pre-programmed, learned or psychodynamically driven, reflects underlying information processing, and that theories should be expressed at this level.) Kuhn calls these shared assumptions a *paradigm*. Now research moves away from old controversies and focuses on applying these shared assumptions to more and more phenomena. According to Kuhn, this is *normal science*. At this stage, although individual hypotheses (that this particular behaviour reflects that particular set of information, for instance) are still falsified and rejected, the basic assumptions of the overall paradigm (that behaviour always reflects information processing of some sort, for example) are retained and defended.

'Normal science' continues until either there have been just too many failures and falsifications in the theories the underlying paradigm suggests, or someone comes up with an alternative, even more powerful new paradigm. In either case, scientists begin to challenge the old dominant paradigm and develop an alternative view. Kuhn calls this stage of competition between paradigms *revolutionary science*. It continues until one paradigm or another comes to dominate and 'normal science' resumes. Many think that developmental psychology is in the throes of a new period of revolutionary science, as we shall see through the course of this book.

Is developmental psychology a science like physics?

Even 30 years ago, it was common to hear it said that psychology was not a 'hard' science like physics. Physics was said to study phenomena where firm deterministic laws could be discovered, whereas psychology studied messier, more ephemeral phenomena where laws could only be probabilistic, where phenomena behaved in curious non-linear ways, data must be relative to some context and the very presence of an observer could unsettle the phenomenon to be observed and distort the data. Psychology was thus dismissed as an inferior branch of science, or even scarcely scientific at all.

For decades, the pressure seemed to be on psychology to find ways round this, to find a 'more scientific' (i.e. more strictly regular and deterministic) explanation of human development and behaviour: in other words, to be more like physics or to accept that psychological research is not 'real' science. As a consequence, psychology tended to shy away from tackling obviously 'messy' problems (such as intentions, consciousness and so on) and focused on the more tangible things (perception, overt behaviour and the like).

Ironically, the tables have turned in an unexpected way. It turns out that physics itself is not at all what we thought it was. In fact, it is much like psychology... For example, as Einstein's theory makes clear, measurements in physics are as relative to context as are measurements in psychology. (If you throw me a book in a train travelling at 100 miles an hour, on a rotating planet, how fast is the book travelling? There's no one absolute answer. The question is: relative to what?) Heisenberg has shown that, even in physics, the act of observing something (photons, say) changes the behaviour of what you are observing. And chaos theory shows that the relationship between cause and effect is not necessarily linear in the physical world either.

In sum, the physical universe is less deterministic and more probabilistic than old concepts of 'hard' science supposed, and psychology and physics are more similar than we thought. In fact, as we shall see in later chapters, the same principles that physicists use to describe the genesis of the infinite diversity of snowflakes or the origin of a star system can also be applied to explain developmental changes in human beings.

Methods for studying human development

Every science shares a number of methodological problems: for example, we want measuring instruments that are reliable and valid; we want our data and theories to have a degree of generality; and we want to be able to distinguish mere correlations from causal relationships. In addition, every branch of science studies a different set of phenomena, and each has its own particular problems in doing so, reflecting the nature of the phenomena studied.

Common methodological issues in science

Reliability and validity

Every science wants the tools it uses in collecting data to be reliable (in other words, to measure or record things accurately) and valid (in other words, to measure what we intend them to measure). Sometimes, establishing that our methods of collecting data are reliable and valid is fairly straightforward. For instance, I can compare what I weigh on my bathroom scales with the weight other scales produce on the same morning, and so see how reliable they are. Or I can check that my questionnaire is a valid measure of people's tendency to buy organic goods in the supermarket (rather than, say, their desire to impress a researcher with their 'green' credentials) by comparing the results it obtains against a film of what they actually bought.

But few measuring tools are perfectly reliable, and few are perfectly valid. Errors in reliability and validity are collectively known as *error variance*. Error variance is often regarded as no more than a nuisance, a weakness in our measurement tool. Sometimes this is true: some problems are purely technical (a bathroom scale that gives two different readings for the same naked person seconds apart, for example). But sometimes error variance is more interesting than this. It can point to the existence of 'real' factors that we have not yet understood (for instance, that a young child's popularity reflects his or her possessions – which we have not measured – as much as the personality traits that our test assesses). As we identify new variables that our original theory did not realize were relevant and begin to take these into account, we convert variance we did not understand (and so called 'error') into variance we do now understand – and so drive our theories forward.

Generality

There would be very little interest in the theories of science, if those theories applied only in the special circumstances of the laboratories in which the research took place. What use would a careful measure of the temperature at which water boils be, for instance, if it applied *only* in the particular laboratory where it was measured?

Generality is an issue for every science. As we all know, the boiling point of water varies with atmospheric pressure: it's different at sea level and up a mountain. The effect of a cancer drug may be very different in a mouse and a human being. A child's ability to solve logical problems may be different when the problem is couched in the concrete terms of a familiar situation and when it is posed abstractly, as we shall see later in this book. In sum, a great many phenomena in the physical, biological and psychological world are strongly affected by context. If things vary from one context to another, how can theories ever be general?

We can never *assume* that a theory will generalize. Some things do, some don't. The trick is to bear both possibilities in mind, and to test the issue directly. But it is also worth noticing that by understanding just how a given phenomenon varies from one context to another, we come to understand more about the processes at work across contexts. For example, by understanding *why* a given drug works in mice but not people (or understanding how logical reasoning relates to context), our overall understanding of how drugs work (or how reasoning develops) increases, taking in more and more contexts – and so becoming more general.

Correlations and cause and effect

Many things correlate; that is to say, changes in one factor are systematically related to (*co-vary* with) changes in another. For example, certain illnesses are correlated with high levels of anxiety. Such correlations are interesting, but they do not tell us much. Is the anxiety causing the illness? Or is the illness causing the anxiety? Or are both being caused by some third factor, so that there is no causal association between the illness and anxiety in either direction? Merely establishing that there is a correlation between factors cannot answer these questions.

Experiments provide science with a systematic way of exploring cause–effect relationships. The basic principle of an experiment is that, if there is a causal relationship such that factor A causes factor B, then intervening to change factor A should change factor B. So, for example, if anxiety is causing a given disease, then treating and reducing the anxiety should reduce the symptoms of the disease. If, on the other hand, anxiety is not causing the disease, treating the anxiety will have no effect on the disease. To test this causal connection, a sample of patients with the illness are divided into two groups. One group is the *experimental group*, and receives treatment ('an intervention') to reduce anxiety. The other is the *control group*, and receives no treatment for anxiety. This control group provides a check on the extent to which the disease would have abated in any case during the course of the experiment, rather than as a result of the experimental intervention. If, at the end of the experiment, the experimental group shows much better recovery than the control group, it can be inferred that the difference had been caused by the intervention, and hence that anxiety was playing a role in causing the illness. (Of course, the control procedures in a real experiment would be rather more elaborate than in this simple illustration!)

Special issues for research on human development

Studying change

Our primary aim is to understand the process of change through human development. But development takes a long time. At any one moment it is hard to detect much changing in an individual child. What we have is a snapshot of that child as he or she is now, a 'still' photo, when what we want to understand is the movie that runs from conception to adulthood. So our first problem is: how can we study developmental change or the processes that produce it? A number of research strategies (*research designs*) have been developed to help us study change through childhood. Each has strengths, and each has weaknesses.

The quickest and easiest of such strategies is the *cross-sectional* research design. Here, age-related changes in performance on some task or activity are explored by comparing groups of children of different ages. So, for example, a study might compare a group of 5-year-olds, a group of 8-year olds and a group of 12-year-olds. The vast majority of developmental research uses this strategy. It can produce rich data about different age groups.

This approach needs care: if the different age groups are not matched on all the factors besides age that might affect their behaviour in the task concerned (such as social background), then the results might reflect these other factors rather than age. Even if all the normally relevant factors are matched across the groups, it may still be possible that one age group has happened to have some extreme unusual experience that distorts the age effect. For example, 5-year-olds tested in October 2000 may be different in the kinds of anxiety they report from those tested in October 2001, reflecting the media coverage of the 9/11 attacks on the World Trade Center. This is known as a *cohort effect.* These two problems can be handled by alert awareness of the possibilities, and by careful choice of samples (in other words, the children studied) across both populations and time.

But the cross-sectional approach has another limitation that cannot be so readily handled: it creates a picture of each age group by averaging across children. There is no way to know what individual development between one age and another would look like. This problem of following individual development can be handled by a *longitudinal study*, in which the same children are followed for a period of time (weeks, months or years), and are repeatedly tested through that period on the measures of interest. Individual case studies and baby diaries fall into this category of research, though longitudinal studies generally follow a group of children rather than just one individual.

Longitudinal studies are rich sources of information both about age-related developmental change and about the pattern of change within individuals. They are rarer than cross-sectional studies because they are harder to do: the research inevitably takes a great deal longer, and over a period of months or years, a number of participants will drop out as families move away or children change schools (and so on). The drop-out rate can be a real problem: it may be that those who leave the study are systematically different from those who don't, making the results hard to interpret. For instance, what if the more entrepreneurial or imaginative families move more often? Then a longitudinal study of creativity might systematically lose those individuals most likely to have a background that fosters creativity. Furthermore, the repeated testing itself may distort the results, as children become sophisticated (or self-conscious, or bored) about testing.

Although longitudinal studies come closer than cross-sectional studies to tracking actual developmental change, it's still the case that they take snapshots, albeit in sequence, rather than directly observing change as it happens. This is inevitable: it takes time, often years, for a child to show clear developmental change. It would be impossible (and probably unethically intrusive) to record the child's behaviour in any detail over such a duration.

A comparatively recent solution to this problem is the *microgenetic study*. Here, a child's behaviour is recorded (often filmed) in very great detail for relatively short periods of time as the child engages in some activity that is likely to stimulate change in understanding or behaviour. For example, a child might be filmed for 20 minutes while trying to solve a building task that requires the discovery of counterbalance. Here, some participants will make new discoveries and adopt new strategies on camera (some won't). By very detailed frame by frame analysis of exactly what the child did and what feedback he or she received from the task, it is possible to develop hypotheses about the mechanisms of new discovery operating in childhood (see Chapter 7). Microgenetic studies are extremely labour-intensive and slow to do. They offer the best way we yet know of actually observing development as it happens. But how does what we observe relate to development as a whole, and to changes occurring over long periods of time?

Making mental processes visible

Much of what we want to understand in studying development is not visible: we cannot see a child's intentions, thoughts or feelings. All we have to go on is what we can see and hear: what the individual says and does, and what we can infer from this.

There are many ways of gaining insights into children's minds from what they say. Quite a few such insights have come from simply listening to *what children say spontaneously* to adults, to themselves or to one another, as they go about their everyday lives. For instance, it was only when I listened to my 3-year-old son's muttered dirge that I realized that he thought his chicken-pox was a life sentence, condemning him to a life of lonely itchiness forever. His concept of chickenpox was utterly different from my adult view. Maybe all 3-year-olds have the same confused ideas? On the basis of many such observations in casual conversation with her children, Susan Carey (1985) proposed a new theory of how children's conceptual understanding develops, as we shall see later in the book.

Open-ended interviews, where the researcher sets out to discuss a particular topic but lets the child lead the direction the conversation takes, give a slightly more formal way of collecting these useful data. Like a child's spontaneous remarks, such conversations tend to be idiosyncratic so that it can be difficult to gauge whether the insights they provide relate to all children of that age, or just to this individual. This issue can be more systematically explored in *structured interviews*, where the researcher asks a series of children exactly the same questions.

We can also gain insights about children's mental processes by asking them to 'think aloud' and explain their actions as they tackle a given task. Transcripts of such running commentaries are called *verbal protocols*. Of course, very young children cannot tell us what they are thinking. And in fact, even adults may have a surprisingly limited insight into their own mental processes (I do not always know, for example, exactly why I am irritable, or how I solved a particular crossword clue), and what they say is sometimes mistaken, and sometimes less than completely candid. For these reasons, what children *do* is often a more important source of data than what they *say*.

Like their speech, children's behaviour can be observed in a wide range of contexts. Their *spontaneous behaviour* in everyday life, out shopping, at school, playing alone or with others, interacting with their families, is a rich source of insight. Like spontaneous conversations, observations of individual children can be hard to compare: they may have been doing entirely different things, or have been influenced by different factors in the richly complex world which every child inhabits. It can be hard to know whether insight gained from spontaneous behaviour applies just to that individual child, or to children of that age at large. Again, this issue can be explored by observing children in more *controlled situations*, where the researcher puts a series of children in the same situation, or asks each of them to *complete a particular task*.

The level of detail that can be taken from observations of children's behaviour in such situations can vary enormously, from recording only whether the child *succeeds or fails* in a given task, right down to *recording every action* or even *every eye movement*. Either type of data can be used to test hypotheses about the child's mental processing. 'Pass/fail' data can provide a quick and easy way to test many types of well-formulated hypothesis. More detailed data are more useful for testing hypotheses about mechanisms of change, and for gaining new insights, and new hypotheses about mental processes (see Table 1.4).

table 1.4 Experiments, observations and data

	Natural contexts where the child's behaviour is free and spontaneous	Experimentally controlled tasks/ situations
Only specific responses, or pass/fail data are recorded	*Example:* Counting how many times children fight or cooperate in a nursery playground *Plusses:* Natural behaviour in a natural context *Minuses:* Lack of control of the situation may mean the relevant behaviours don't occur Narrow data focus may miss relevant factors/unexpected effects	*Example:* Recording children's success and failure in an experimental problem-solving task *Plusses:* Good for testing hypotheses *Minuses:* Narrow data focus may miss relevant factors/unexpected effects Experimental situation may distort child's responses
A full record is made of the child's behaviour	*Example:* Film of children playing together in a playground *Plusses:* Natural behaviour in a natural context Full record allows new factors and hypotheses to emerge *Minuses:* Labour-intensive analysis Lack of control of the situation may mean that little relevant behaviour occurs	Example: Microgenetic analysis of film of a child solving a problem *Plusses:* Good for testing hypotheses Detailed record allows behavioural change to be tracked, and new factors and hypotheses to be discovered *Minuses:* Labour-intensive analysis

No matter what data we collect, we still cannot see a child's mental processes, his or her thoughts or feelings. All we can do is draw inferences about those things from the data available to us. We can test those inferences by drawing new predictions from them, and testing those in new, more extensive data, or by constructing interventions and experiments designed to clarify what mental processes underlie a child's behaviour. But like every other theory in any science, our inferences about children's mental processes may be wrong. New data or new insight may change our understanding at any moment. So like any other theory, inferences about children's mental processes must be treated with care: they are our best understanding in the light of what we know now, not 'truth.'

Studying development ethically

Developmental psychology studies living creatures, the young of our own species, rather than inanimate matter or forces. This imposes an ethical responsibility on developmental researchers that exceeds that of other branches of science. There are things a physicist, say, may do to the material that he or she investigates (such as decomposing it into its constituent elements, or depriving a process of factors believed to be essential to its progress to check that theory) that we may not (and would not want to) do to a human child. How can we study development in an ethical way? Do ethical standards impose limitations on how far developmental research can progress?

Ethics has become an increasingly prominent part of research and practice in developmental psychology over the last century. Many studies done in the past would be regarded as inappropriate and unethical today (a prime example would be Watson's studies involving the induction of a conditioned fear in a baby). In the early days of research, ethical issues were left entirely to the individual researcher – not always with wholly edifying results. Today, there are strict, formal codes of ethics by which all psychologists are bound. Full statements of this ethical code are available from organizations such as the British Psychological Society, or the Society for Research in Child Development in the United States. In brief, as a developmental psychologist you must:

- Think about the consequences of your research or intervention for the participants and for those to whom the results may apply. You are responsible for those consequences.
- Do no harm. Don't expose participants in research to risks they would not have run ordinarily in the course of everyday life.
- If at all possible, explain the research and its potential consequences to the participants before you start, and get their informed consent for their participation.
- Where participants are too young or otherwise unable to give their consent, seek the consent of others who have some investment in the participant's best interests. This might include a child's parents, or a formal committee designed to uphold ethical standards (ethics committee).
- Give participants, however young, a real choice to refuse to participate.
- Don't deceive participants about research or interventions unless there is an overwhelming reason to do so that has also been endorsed by independent opinion (an ethics committee).
- Debrief participants after research or interventions: tell them what it was about and what you discovered in terms they can understand. Correct any false impression the participant may have gathered.
- Respect participants' privacy. All the information obtained about an individual must be absolutely confidential.

This code of ethics makes certain kinds of research impossible. For example, PET scans (positron emission tomography) can build up complex pictures of the structure and activity in a living brain, offering the possibility of new and more detailed information about developmental changes in the brain. But PET scans require the injection of a radioactive marker. This is too invasive to be ethical, if it is done solely for the purposes of developmental research. Equally, it would be shockingly unethical to deprive a child of nutrition, ordinary stimulation or love for the purposes of research, or to induce genetic or other physiological damage, however informative the results might be.

However, data are sometimes available because some situation has occurred completely independently of research, creating a *natural experiment*: the opportunity to study a phenomenon that it would have been unethical to arrange. Children are born with genetic damage; they suffer illnesses and accidents, and endure medical tests for diagnosis or treatment of these things. These natural events can provide us with information that would otherwise be outside all possibility of ethical research.

More extreme natural experiments occur in parts of the world where children are victims of famine, war, poverty, unchecked disease, often enduring brutalization and deprivation almost beyond our comprehension. The primary aim of research with such children is, of course, to find ways of mending the damage they have suffered. But in identifying what that damage has been, and what 'works' to put it right, we may gain information about the process of child development as a whole.

About this book

This chapter has introduced the basic questions that drive developmental research, and the basic methods that we use in trying to answer those questions. It has put this material in its historical context. This sets the scene for the remainder of the book, which surveys what we now know, and what we still don't know about development.

The nature of science means that in studying developmental psychology you aren't going to be discovering 'the truth' or learning lists of 'facts'. As we have seen, it is much more complicated than that. What you will be doing is developing an educated or 'critical' opinion about human development: that is to say, you will be learning how to evaluate theories and data about development in a rigorous and scientific way. How well does this theory explain the phenomena we are interested in? How valid and reliable are the data we have about this?

Each chapter of this book reviews research in a given area of developmental psychology. At the end of the chapter there is a synopsis of key material covered, for revision. The book can be read from cover to cover, but the chapters can also be used in any order you like. Where material in another chapter would provide useful background, a brief summary is included and cross-references in the text indicate where more detailed material can be found. Each chapter aims to cover its topic comprehensively. If you master the material in the text, you will have a sound grounding in developmental research. To take this knowledge to a deeper level, you can read the original work that this book reviews, following up on references in the text. There is also a short list of suggested reading to take you more deeply into key issues, at the end of each chapter.

At the end of each chapter you will find exercises designed to help you gain a critical grasp of the material that has been covered. Each has been chosen both to revise key themes from the chapter and to stretch your understanding of core issues. These exercises are intended to be completed first by you working as an individual. But having completed them, you might find it useful and illuminating to discuss your ideas with other people.

Exercises

1. In many ways, the cognitive developmental approach of Piaget and information-processing theories became a dominating paradigm in developmental psychology. What are the key features of this paradigm? In what ways does this cognitive approach differ from other approaches such as sociobiology, behaviourism, psychoanalysis? What assumptions does it share with these other approaches?
2. How would you design a study, and what kind of data would you collect, to test the hypothesis that 3-year-olds are less likely than 8-year-olds to remember what they had for lunch yesterday? Why would you use this approach, and what problems would you need to think about in setting up the study?
3. On a small island, children are suffering horribly from malnutrition. Many are dying. The island is rich in food, but the islanders' religion forbids them from eating most of the available things. Elders enforce the religious rules. You are hired as a psychologist to work on this problem. What practical and ethical issues should concern you?

Suggested further reading

For an overview of the history of developmental psychology read:

- R. B. Cairns (1998) The making of developmental psychology. In R. Lerner (ed.), *Handbook of Child Psychology, Vol 1: Theoretical models of human development*. New York: Wiley.

For discussions of how history has influenced the work of various key modern researchers, read:

- R. Parke, P. Ornstein, J. Reiser and C. Zahn-Waxler (eds) (1994) *A Century of Developmental Psychology*. Washington, DC: American Psychological Association.

For the key ideas of the major theorists in the 20th century, there is no substitute for reading their own words.

- Box 1.4 suggests specific readings for each theory. The full references for these readings are listed in the bibliography at the back of this book. Many of the older classics have been reprinted, and where this is the case, the details are for the reprint.

For an excellent and very readable introduction to the nature of science, read:

- A. F. Chalmers (1999) *What is This Thing Called Science?* 3rd edn. Buckingham: Open University Press.

For discussions of research methodologies in developmental psychology read:

- D. Teti (2004) *Handbook of Research Methods In Developmental Psychology*. Oxford: Blackwell.
- C. Robson (1993) *Real World Research: A resource for social scientists and practitioner-researchers*. Oxford: Blackwell.

For ethical issues read:

- M. Bulmer (ed.) (1982) *Social Research Ethics*. London: Macmillan.

- British Psychological Society (1991) *Code of Conduct, Ethical Principles and Guidelines*. Leicester: BPS.
- Society for Research in Child Development (2000) *Directory of Members SRCD*, pp. 283–4.

Revision summary

What is developmental psychology?

- Developmental psychology is the scientific study of how individuals develop from conception through infancy, childhood, adolescence and into adult life.
- From its beginning, developmental psychology has influenced childrearing practice and policy, influencing children's lives as well as contributing to a deeper understanding of human nature.

A short history of key ideas in developmental psychology

- The beginning of developmental research was profoundly influenced by Darwin's theory of evolution through natural selection, and is still very much influenced by biological issues.
- Ethologists and sociobiologists sought for innate or instinctive behaviours or tendencies in human development. There is little evidence for instincts, and explanations of behaviour in terms of survival advantage have been heavily criticized: they are plausible, but critics say they lack credible supporting evidence. Nevertheless, work exploring human behaviour in its evolutionary context has raised intriguing possibilities for important topics (such as attachment and altruism).
- Learning theorists and behaviourists claimed that all behaviour develops through learning processes that parallel natural selection in the individual's life: rewarded behaviour survives, punished behaviour doesn't. Reward and punishment certainly do shape human behaviour. But such processes cannot explain the creative nature of human behaviour: this implies a vital role for mental processes. Nevertheless, this approach has given us useful tools for interpreting and modifying children's behaviour.
- Vygotsky suggested that the development of children's skills, and even their mental processes, occurs in interactions with more skilled individuals, who support the child's efforts as he or she tackles the next area of challenge. Important aspects of human development may be carried by the culture, rather than constructed by the individual. These ideas have a powerful continuing influence on research.
- Piaget argued that children must construct mental processes for themselves, starting from a few basic reflexes and using only very simple biological processes for adaptation. The nature of knowledge means that every child would go through the same stages during this process, each stage being qualitatively different in its thinking from the one before. Piaget's work was the greatest single influence on developmental research in the 20th century.
- Information-processing theory drew an analogy between human minds and computers, arguing that computer programs can simulate the effects of

different states of knowledge or processing power, and so throw light on changes in children's thinking and the mechanisms of developmental change.

- Psychoanalytic theories suggested that human development is as much affected by unconscious processes deriving from basic biological drives as by rational knowledge or conscious reasoning. Successive stages of development reflect the changing focus of the child's biological drives, and the resolution the child has achieved between expressing and repressing these drives.

Continuing questions for research

- How do biology (nature) and experience (nurture) interact to produce development?
- What kinds of individual or social experience are critical for development?
- How are babies active in constructing their own development?
- Is development continuous (more of the same, as an oak tree simply gets larger) or discontinuous (change from one thing to something qualitatively different, as a tadpole changes into a frog)? Could discontinuities in development reflect the action of a single developmental process, or do they imply that the process itself changes?
- Where do individual differences come from?
- Why does developmental change happen at all? How does it happen? What kinds of mechanism produce developmental change?
- Are there evolutionary constraints on how far human development can go?

Studying development scientifically

- Starts from an understanding of what science is and what it isn't.
- There are no hard and fast facts in science. There are only data measured in a certain place, in a certain way, by certain people who chose where, how and what to measure in the light of their pre-existing theories or expectations. Different tools, measures or expectations might change our understanding.
- The theories or expectations that we start out with determine the 'facts' we discover every bit as much as those 'facts' influence our theories about the world.
- There is no way to 'prove' any theory is true: we can only prove that it isn't true. Science is sceptical, always looking for things that might falsify a theory. It is, therefore, also progressive: ever open to the possibility of a new and better theory.
- The key to studying development scientifically is to develop a critical appreciation of the strengths and weaknesses of different studies and the data and theories they have produced.

Methods for studying development

- All sciences strive to find methods for collecting data that are reliable (i.e. measure things in a consistent way) and valid (i.e. measure what we intend them to measure).

- Developmental studies use three basic research designs to study change through childhood: cross-sectional studies that examine the differences between groups of children of different ages; longitudinal studies that track developmental progress in the same group of children over long periods of time; microgenetic studies that make very intensive analyses of changes in children's behaviour during short periods of time.
- Our focus is often on understanding mental processes, which we cannot directly see or hear. We study such things by collecting data about what children say and do (spontaneously in everyday life, or in structured tasks or situations) and drawing inferences about mental processes from these data. Like any theory, such inferences may be wrong. We test our inferences by drawing predictions and testing these in experiments or in new observations.
- Many factors correlate with one another. A correlation can be hard to interpret: does A cause B, or is B causing A? Or perhaps there is no causal relationship between A and B at all, and the apparent correlation reflects the action of a third variable we have not measured? Experiments provide a systematic way of exploring cause–effect relationships: if factor A causes factor B, then experimentally manipulating factor A should produce an effect on factor B that does not occur in a control group which does not receive the manipulation.

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