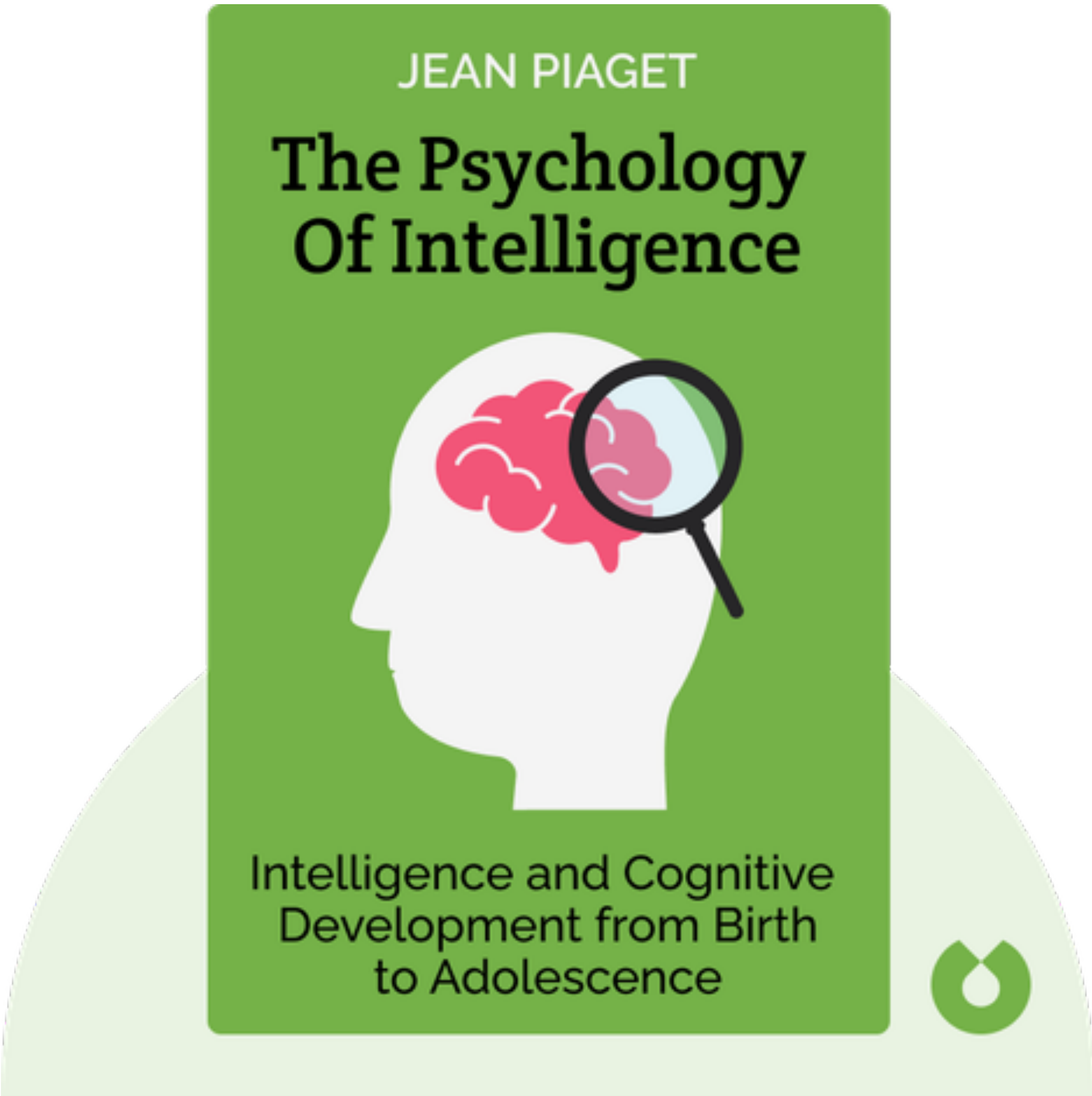

The Psychology of Intelligence

A theory of intelligence and cognitive development between birth and adolescence

By Jean Piaget

16-minute read

Synopsis

The Psychology of Intelligence (1947) outlines the pioneering psychologist Jean Piaget's theory of intelligence and cognitive development between birth and adolescence. Originally delivered as a series of lectures in Paris, Piaget's text provides a key to his highly influential research agenda and, by extension, to one of the twentieth century's most important bodies of work on children's psychology.

Who is it for?

- Parents fascinated by how their kids' minds work
- Teachers and educators
- Theorists and thinkers

About the author

Jean Piaget was a Swiss psychologist best known for his contributions to the study of child development. Born in 1896, he authored over 50 books on cognitive development before his death in 1980. His ideas continue to shape debate and guide the work of psychologists, sociologists, and educationalists.

What's in it for me? A new way of thinking about intelligence

What do children get wrong and how can we test their intellectual abilities? When the Swiss psychologist Piaget first entered the field of child psychology in the 1920s, these were the questions that guided research.

Piaget soon came to believe that this wasn't the best approach. Children of similar ages, he noticed, tended to make the same mistakes. *What* they got wrong didn't shed much light on intelligence. *How* they made mistakes, on the other hand, *did*.

Children, Piaget showed, aren't just more error-prone than adults – they reason in entirely different ways. This insight shaped his work over the next six decades and underpinned one of the most influential accounts of cognitive development ever to have been conceived.

In these blinks, you'll learn:

- what pond snails can teach us about intelligence;
- why it's sometimes perfectly logical to call a squirrel a dog; and
- how children develop through four stages of cognitive growth.

Intelligence is action.

When beginning a new investigation, one of the first things scientists do is define their research subject, in order to question what it is, *precisely*, that they're trying to analyze.

In 1942, Piaget found himself in exactly this position when he gave a series of lectures on the psychology of intelligence at the Collège de France in Paris.

At the time, psychology, or the science of the mind, was a relatively new discipline. Even newer was research into the nature of intelligence itself, which had only emerged two decades earlier in the 1920s.

Piaget's subject at the time was a question as simple to state as it was complex to solve: What *is* intelligence?

The key message here is: Intelligence is action.

To answer his question, Piaget first considered, then rejected, earlier theories.

One held that there's an objective reality "out there" in the world, and a subjective world inside our heads. We perceive the outer reality through our senses and the information we read or hear from others. These perceptive "recordings" create a copy of things existing in this world, and map the relationships between them.

Philosophers who take this view argue that intelligence is the acquisition and correction of this information. If the "copies" are faithful, we'll have a consistent mental system. To them, the content of intelligence – knowledge – is always acquired from the external world.

His experimental research with children in the 1930s, however, convinced Piaget that these philosophers were wrong. Children who performed his cognitive tests didn't appear to be accessing objective reality and copying information from it – they were actively *constructing* knowledge.

Toddlers, he observed, poke, prod, and pull at everything around them. Later on, children perform mental actions that have the same purpose: they rotate objects, put things in order, and compare different classes of things in their minds.

These actions, he came to believe, define intelligence. Even if we grant that "1 plus 1 equals 2" is an objective truth, a child can only arrive at this knowledge by actively reconstructing it for herself. She must add 1 and 1 rather than leaving these two units apart; and, having combined them, she can separate them again, and end up back where she started.

Intelligence, Piaget concluded, consists of these exploratory actions.

Adaptation governs all interactions between organisms and their environments.

What happens if you take a succulent from one of Switzerland's mild microclimates and place it on the cooler slopes of the Savoy Prealps? How do pond snails react if you pluck them out of the calm waters they favor and drop them into fast-flowing mountain streams? Piaget, a precocious child with an active intelligence, decided to find out.

The answer? The succulents grow lots of small, thick leaves to increase photosynthesis and boost their energy supply, while the snails develop tougher, rounder shells. In a word, both *adapt*.

Here's the key message: Adaptation governs all interactions between organisms and their environments.

While Piaget eventually became a renowned psychologist, as a young man in the early twentieth century, his great love was biology.

Adaptation, therefore, played a key role in Piaget's view of the world. If you want to understand the relationship between any living organism and its environment, he argued, look at how it adapts.

Consider humans. When we eat something, our digestive system reacts to this sudden intrusion of foreign matter into the body by releasing acids and triggering abdominal muscles to contract. For Piaget, this is an example of *accommodation* – a type of adaptation in which an organism changes its structure in response to an interaction with its environment.

Digestion, of course, occurs many times a day, and so these changes are relatively passive, but accommodation can also be deeply transformative – just think back to those succulents and snails.

There's another form of adaptation, too. Even digestion isn't just about passive accommodation; it is also active. When we eat an apple, our stomachs transform a part of the environment – the mass of fibre and vitamins we call apples – into a substance compatible with human life: energy.

This process is called *assimilation*. When an organism assimilates, it is actively imposing its own structure on the environment, just as our stomachs "restructure" the part of the environment made up of apples. Assimilation incorporates a part of the external world into ourselves.

So what does this have to do with intelligence? As we'll see, accommodation and assimilation don't just govern our physical interactions with the environment. They also shape our psychological or cognitive relationship with the world.

We organize knowledge to adapt cognitively to the world.

Earlier, we discussed the philosophical theory that assumes a complete separation between the mind and the world. Since our bodies belong to the world of objects, it follows that mind and body must also be separate entities.

Piaget rejected this idea, too. Adaptation, he claimed, is both physiological *and* cognitive. Our bodies and minds may be different, but they are engaged in the same task. The body has biological "structures" like the stomach; our minds have *mental structures*. Both regulate our interaction with the environment.

This is the key message: We organize knowledge to adapt cognitively to the world.

The world is full of information. Every second we're bombarded by massive amounts of perceptual and sensory stimuli. This constant flow of incoming data would be overwhelming if we weren't able to organize it somehow.

As it's clear that we are able to cope, there must be a system doing this organizing. Piaget posited the existence of *schemata* to explain how we do it.

Schemata – the plural of schema, a plan or blueprint – are organized units of knowledge about the world or how to behave in it. These are stored in a kind of cognitive filing cabinet. When we interact with our environment, we consult this cabinet to see if there's anything in there that can help us make sense of what's in front of us.

Imagine a child encountering a thorn for the first time. She doesn't know what this object is, so she touches it and promptly pricks her finger. Because she didn't have a "thorn schema," she resorted to a different one – call it the "find out what things are by grabbing them" schema.

This new experience is stored away as a visual representation of a thorn linked to a specific memory. This schema combines several ideas to create a behavioral script. Sharp spikes growing on plant stems, it says, cause pain and injury – ouch! – so it's a good idea not to grab them.

We should note, though, that this is already a complex schema that assumes the existence of other schemata – thorny plants, for example, are a subset of all plants – as well as an awareness of cause and effect. Such a schema is only possible after a great deal of cognitive development.

Intellectual assimilation and accommodation drive cognitive development.

Imagine a young child going for a walk with his mother. They stop at a tree and she points to an animal that adults call squirrels.

"What is that animal?" she asks. He thinks for a moment before answering, "It's a dog!"

We can say a couple of things about the boy's answer. First, it's wrong. For Piaget, this isn't a particularly interesting observation. Secondly, it's perfectly *logical*. This boy hasn't seen a squirrel before, but he has seen a dog. Presented with a new stimulus, he consulted his filing cabinet and pulled up the "dog schema." Dogs, it says, are four-legged animals with fur and tails. When you put it like that, squirrels *do* resemble dogs.

And that, Piaget thought, *is* interesting.

The key message here is: Intellectual assimilation and accommodation drive cognitive development.

What's going on when a child misidentifies a squirrel as a dog? Piaget believed that it was an example of assimilation.

As we've seen, assimilation occurs when an organism imposes its own structure on the environment. Earlier, we looked at physiological assimilation – digestion. Cognitive assimilation works the same way. The squirrel met all the criteria of the dog schema – it had four legs, fur, and a tail. The boy then imposed this schema on this new stimulus, charting it onto his mental map of the world.

Assimilation is a quantitative process. As we assimilate more and more stimuli, our schemata cover more and more of our environment, thus allowing us to respond appropriately in an ever-larger number of situations. This is one driver of cognitive development.

It can't, however, be the only one. If we assimilated every four-legged animal to the dog schema, after all, our organization of knowledge wouldn't be very useful.

That's where accommodation comes in. Recall how Piaget's succulents and snails changed their physical structure in response to their environment. Cognitive accommodation is similarly qualitative in nature.

Sometimes new stimuli don't fit our existing schemata. On first sight, squirrels look like dogs; octopuses, however, do not. Assimilating squirrels into a dog schema won't work either if the boy's mother tells him that dogs are pets that live indoors and squirrels are wild animals that live outdoors.

There are two ways of accommodating new stimuli. One is to create new schemata – pets and wild animals, say, or mammals and molluscs. The other is to modify existing schemata – the boy could, for example, reorganize the dog schema as a mammal schema which includes both dogs and squirrels as subcategories. This is the second driver of cognitive development.

The search for equilibrium propels us through discrete stages of cognitive development.

There are two ways in which we respond to our environments. The first is an act directed outwards toward the world; the second is an act internalized as a thought.

These acts, according to Piaget, are responses to needs. The feeling that something is missing determines the goal of behaviour. When you feel cold, for example, you seek what is missing – warmth. This is an example of the first kind of act. What form does this seeking take, though? This is where cognition, the second kind of act, enters the picture. Cognition "structures" or guides this behavior– for example, by providing schemata to locate a blanket or thermostat.

Both acts have the same goal: to create a state of balance or *equilibrium* between the individual and her environment.

Here's the key message: The search for equilibrium propels us through discrete stages of cognitive development.

Equilibrium is a state of harmonious balance between the individual and her environment. In this state, she can assimilate the stimuli she encounters into existing schemata.

Disequilibrium, on the other hand, occurs when schemata cannot assimilate the stimuli contained in a person's environment. This is a frustrating and disorienting state. The individual's mental map no longer charts the world around her. Something is missing.

The drive to restore equilibrium is called *equilibration*. When assimilation fails, the individual must accommodate. In children, genuine intellectual breakthroughs are the fruit of accommodations.

By creating new schemata capable of making sense of her environment, the individual restores equilibrium *at a higher level*. Now she can not only assimilate more information – she can also develop more complex behavioral responses. This state lasts as long as these new schemata continue to make sense of the world. Once they stop doing this, the process begins anew.

Every state of equilibrium is qualitatively different from the last. In Piaget's terms, the individual develops an entirely novel psychological structure that provides new tools to solve new and increasingly complicated problems. Slowly but surely, she advances toward the use of logic we associate with adult intelligence.

Piaget's experimental research led him to the conclusion that these breakthroughs could be divided into a series of milestones corresponding to discrete age brackets. It was on this basis that he formulated a theory of the various *stages of cognitive development*. In the next couple of blinks, we'll take a closer look at these advances.

In the first stage of development, infants discover the existence of independent objects.

During the first 24 months of their lives, infants embark on a remarkable journey of discovery.

The newborn's physical structure gives her ready-made *sensorimotor functions* to explore her world. She can perceive sights and smells and coordinate these perceptions with movements, or motor responses.

Thanks to these functions, she's far from helpless. Take innate skills like the sucking reflex. When a newborn's lips are stimulated, she'll reflexively respond by making sucking movements. She also quickly learns from experience to distinguish between various stimuli. If she's hungry, she'll reject the skin around her mother's nipple and only suck at the nipple itself, suggesting an early form of recognition.

But these advances are only the start of the journey.

The key message is this: In the first stage of development, infants discover the existence of independent objects.

Despite their increasing complexity, sensorimotor functions are limited by one crucial factor: the infant only accepts the reality of what she can perceive. For instance, if her mother's face appears in her visual field, she looks at it; if it disappears, she stops looking.

According to Piaget, infants lack a *concept of the object*, meaning that they do not understand that objects exist independently of actions such as looking, touching, and sucking. The acquisition of this concept is, for him, the most important breakthrough of the *sensorimotor stage of development*

When an adult places her keys in a drawer, she knows that they will still be there several hours later even though she hasn't seen or touched them. This is called *decentering*. Because she understands that objects exist independently of her own self, she also grasps higher-order concepts like cause and effect, and reasons appropriately. If the keys *aren't* in the drawer, for example, they still exist, and someone must have taken them. Since only her husband had access to the drawer, he must have them. Such reasoning allows us to navigate the world effectively.

Piaget's research led him to believe that infants develop this independent object concept at around eight months. Before this point, if you show an infant a toy she desires, she'll grab at it. Drape a cloth over that toy, though, and she'll make no attempt to retrieve the hidden object. From her perspective, it has ceased to exist. After eight months, by contrast, infants become much more assured hunters of hidden objects. Piaget took this as evidence that they had accommodated the independent existence of objects – a first leap toward the decentered reason that defines adult intelligence.

Children are egocentric in the preoperational stage of development.

Think back to the woman reasoning about how her keys might have disappeared. Piaget refers to cognitive acts like her deductions about cause and effect as *operations*. Logic, as we'll see later on, is at the heart of operational thought.

During the second stage of development, which lasts from the ages of roughly two to seven, children possess a concept of the object and begin exploring the relationships between things in their environment. This exploration, however, is *preoperational* – the term Piaget used for this stage.

While children *do* attempt to analyze how objects or ideas fit together, they approach this task intuitively and don't yet display an ability to combine, separate, compare, or transform ideas logically.

Why? Well, they still haven't fully decentered their sense of self.

This is the key message: Children are egocentric in the preoperational stage of development.

Take a well-known experiment Piaget conducted with children in this age range.

A cardboard mountain is placed on a square table. The child first walks around the table and then watches as a doll is moved around the table. At certain points, the doll stops and "looks" at the mountain. The child is then shown a series of drawings representing different views of the mountain and asked to pick the drawing which best matches what the doll is seeing.

Preoperational children almost always pick drawings that correspond with *their* view of the mountain. Piaget attributed this to the fact that they were still *egocentric* – that is, they struggled to see the world from any perspective other than their own. Seven- or eight-year-olds, by contrast, complete this task fairly easily. Their spatial schema is decentered and differentiated.

Experiments investigating preoperational children's sense of time revealed a similarly undifferentiated temporal schema. When four- and five-year-old children watch two objects depart simultaneously from point A and arrive at two different places, points B and C, they struggle to reconstruct this sequence of events. While recognizing that one object came to a halt when the other one did, children this age still refuse to accept that both stopped "at the same time" – simply because they stopped at different places.

For preoperational children, Piaget concluded, time is subjective. The idea that the same concept applies to different objects traveling in different directions, or at different speeds, is as alien as the concept of outside perspectives.

Mastering the principles of conservation, reversibility, and classification mark children's third stage of development.

The third stage of cognitive development is a milestone in a child's life.

Between the ages of seven and eleven, she becomes capable of *operational thought* – the application of logical rules to objects. This is a major breakthrough, but it does have one important caveat. At this stage, logical operations are restricted to physical objects rather than abstract ideas, which is why Piaget termed this the *concrete operational stage*.

Here's the key message: Mastering the principles of conservation, reversibility, and classification mark children's third stage of development.

What kind of logic do children use in this stage of development? Let's start with *conservation*.

Conservation refers to the idea that something retains its identity – that is, it remains the same – even when its outward appearance changes. One ton of feathers, for example, weighs as much as one ton of marble. Weight is conserved, whatever form it takes. Grasping this concept is one of the most transformative changes a child undergoes as she moves into the concrete operational stage.

Piaget devised several experiments to demonstrate this theory. A preoperational child of six has little trouble counting out five marbles laid out in a neat row. But if the marbles are then randomly spread out across the table, he'll usually tell you that there are now more marbles. He cannot *conserve number*. Similarly, if you pour water from a tall, thin glass into a short, wide glass, preoperational children believe the amount of water has changed. This is because they also fail to *conserve volume*. Children between the ages of seven and eleven, by contrast, readily grasp this concept.

Conservation is foundational to another important concept: *reversibility*. A child in the concrete operational stage can understand that a ball of dough retains its identity whether you roll into a sphere, a long log, or ten small spheres. Having learned to conserve substance, he also grasps the idea that you can take a sphere, roll it into a log, and then return it to its original state.

Then there's *classification*. When Piaget showed preoperational children a collection of white and brown beads made from wood, they were unable to determine whether there were more wooden beads or more white beads. In the concrete operational stage, this problem becomes simple to solve. Why? Well, children now understand that white beads are a subcategory of a larger class – wooden beads – and are able to apply this principle of classification more broadly.

Thought becomes increasingly abstract as it reaches maturity.

If the black cat is larger than the white cat and the white cat is larger than the brown cat, which is the largest cat?

According to Piaget's theory of cognitive development, the ability to solve this kind of problem marks the advent of mature, or adult, intelligence. This stage is defined by *formal operations*, and it begins around age twelve.

Unlike concrete operations, formal operations are not restricted to solving tangible problems like counting marbles on a tabletop – they can also be applied to abstract problems like the relative sizes of hypothetical cats. Put differently, thought now begins to treat thoughts as objects that can be manipulated by the mind.

The key message in this blink is: Thought becomes increasingly abstract as it reaches maturity.

Let's return to the question about cat size that we posed at the beginning of this blink. How is it solved? In a word, by deduction. Deductive reasoning begins by stating premises. If these are true, it follows that the conclusion must also be true.

We can see how this works by restating the cat problem using symbols. A is bigger than B. That's our first premise. Here's the second: B is bigger than C. Deduction and conclusion: A is bigger than B *and* C. Because this form of reasoning applies to abstract problems, Piaget termed it *hypothetical-deductive reasoning*. When she reaches this stage of development, a child does not need to compare three cats physically to determine which is the largest.

Deduction isn't perfect, of course. If the premises are faulty, the conclusion is likely to be, too. Piaget, however, wasn't really interested in *correct* reasoning. His point was that if a child reaches an erroneous conclusion by employing hypothetical-deductive reasoning, this structure of thinking will still be *logical*.

Working with false ideas, in fact, is another characteristic of this stage of development. Say you present a preoperational child with a problem that assumes that coal is white. Usually, the child will claim that coal isn't actually white but black, and will not be able to progress beyond this to solve the problem. Older children, by contrast, delight in formal operations that assume a hypothesis they don't believe to be true. For Piaget, the ability to think *as if* something were true is precisely the kind of reasoning critical to the work of philosophers and scientists.

Final summary

The key message in these blinks:

Intelligence is active. To figure out how the world works, we have to prod and poke at it – literally and metaphorically. Some things we encounter can be understood in terms of the things we already know; others can't. In the former case, we assimilate; in the latter, we accommodate. These processes are examples of intellectual adaptation to our environment. Both expand our cognitive horizons, driving us through four stages of cognitive development until we reach maturity in early adolescence.

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What to read next: *Ungifted: Intelligence Redefined*, by Scott Barry Kaufman

Like the work of all groundbreaking thinkers, Piaget's theories continue to shape the way psychologists discuss and think about intelligence. But that doesn't mean his is the last word on the subject.

Over the years, new experimental research has expanded, qualified, and challenged his account of cognitive development. What, then, is the current state of play in the field?

Who better to ask than American cognitive psychologist Scott Barry Kaufman, the author of a wide-ranging exploration of different theories of intelligence and how they can make us happy or unhappy? To find out more, check out our blinks to *Intelligence Redefined*!