

Note: This was published in French, with the title *La compétence cognitive des enfants: données récoltées en laboratoire et sur le terrain*, In Plavis, M., Milovanovic, D., & Bideaux, V. (Eds.) *Qu'est-ce que l'agisme?* (pp 135-146). Editions Le Hetre Myriadis. 2019. Here is the original manuscript, in English.

Children's Cognitive Competence: Evidence from Lab and Field

We adults, in Western and Westernized societies, often act as if children are mentally incompetent. We talk down to them, as if they can't understand our normal speech. We more or less continuously tell them what to do, and how, on the assumption that they are incapable of figuring things out and making rational decisions. We overprotect them from dangers, including imagined dangers, as if they have no ability to judge risks for themselves. We require them to attend schools where their own wishes and natural ways of learning are suppressed and they are forced through lessons, by reward and punishment, much as animals are trained for circuses. All this seems natural and even necessary to most of us, because this is how children have been treated in our culture for several generations. We grew up being treated as if we were incompetent, and so we raise our children that way too.

I don't want to suggest that children are just like adults, nor that they can in all ways be treated as adults. They are smaller, have much less (or no) economic power, and generally know less about the world than do we who have been in the world longer. Indeed, we have an obligation to provide for children what they can't provide for themselves—food, shelter, information about real dangers, an interesting and safe-enough environment in which to explore and play, and a moral and loving community within which to grow and learn in their own natural ways.

But children are remarkably good at figuring out what they need to know and using what they know to make rational decisions. Once they have consolidated and internalized their understanding of language (typically by age 4), they generally have no difficulty understanding normal adult conversations. It seems likely that children learn much more from overhearing adults talking with one another than they do from the watered-down conversations that adults often try to carry on with them, as children everywhere eavesdrop on adults (Lancy, Bock & Gaskins, 2010). Moreover, research has shown that when young children talk with one another, as they negotiate with their peers in play, they use far more sophisticated and complex language than occurs in conversations between adults and children (Fekonja, Marjanovic-Umek, & Kranjc, 2005).

Piaget's Error, and Corrective Research Since His Time

One of the primary sources of misinformation about children's abilities, coming from academia, is the uncritical passing along of Jean Piaget's stage theory of cognitive development. In his long career at the University of Geneva (from the 1920s until his death in 1980), Piaget wrote dozens of books and hundreds of articles on children's reasoning. He is correctly considered the founder of the academic field of cognitive developmental psychology, the study of how mental abilities change from infancy onward. Some of his ideas continue to be valuable today. For instance, he presented evidence that children learn about the physical world through their free

play, and he contended that children don't just learn isolated bits and pieces of information through such play, but develop mental schemes that can then be applied to new information.

Unfortunately, however, Piaget also developed a stage theory of cognitive growth in which he contended that children's ways of thinking are fundamentally different from those of adults. This theory is a major contributor to the adultist view that children are mentally incompetent, unable to make rational decisions for themselves. In fact, most people who know of Piaget today know him primarily for his stage theory, which is still often taught to undergraduates in psychology and education as if it were established fact.

Very briefly, Piaget proposed that children's reasoning abilities progress through four stages (Inhelder & Piaget, 1958). During the first stage, the *sensorimotor stage* (birth to roughly age 2), children are incapable of any thought that is separate from action; thought and action are one. During the second stage, the *preoperational stage* (roughly age 2 to 7), the child can symbolize the world mentally and thereby think of things previously experienced, but cannot mentally represent ways of operating on the world or relationships among different objects or events. Therefore, the child can't understand cause and effect relationships or reason by analogy. Children at this stage are also *egocentric*, meaning that they do not understand that other people may see things differently than they do or hold beliefs that they do not hold. During the third stage, the *concrete operational stage* (roughly age 7 to 12), children understand much about the world, but that understanding is still limited to concrete experiences. They are still not capable of hypothetical reasoning, that is, reasoning about events that have never occurred in their experience. For example, they are incapable of solving what are called *counterfactual syllogisms*, that is, syllogisms in which one of the premises violates what is known to be true about the world in which the he or she lives. With the fourth and final stage, the *formal operational stage* (beginning around age 12), hypothetical thinking emerges.

This, admittedly, is an oversimplified description of Piaget's stages, and I should add that Piaget was clear that the transitions from stage to stage are gradual, not sharp. However, it portrays the essence of the theory as passed along in textbooks. The point to be made now is that the great majority of researchers in cognitive development today give little or no credence to this theory. Research since Piaget's time has consistently shown that children are far more sophisticated thinkers than Piaget believed. Here, as illustration, are a few examples of research on reasoning abilities of young children that contradict Piaget's stage theory.

Evidence that young children understand cause-effect relationships.

Piaget realized that young children act on objects in order to understand them, but he did not recognize how sophisticated they are in the ways they act. As an illustration of that sophistication, consider this experiment on cause-effect reasoning (Schulz & Bonawitz, 2007). The researchers presented four-year-olds with a box that had two levers sticking out of it. Pressing one lever caused a toy duck to pop up through a slit on top of the box, and pressing the other caused a puppet made of drinking straws to pop up. The box was demonstrated to different children in two different ways. In one demonstration condition, the experimenter pressed each lever separately, so the child could see the effect that each lever produced when pressed. In the other condition, the experimenter always pressed the two levers simultaneously, so the child

could not know which lever controlled which object. Then, each child was allowed to play with the two-lever box or with a different toy. The result was that children who had only seen the two levers operated simultaneously chose to play much more with the demonstrated box than with the new toy, while the opposite was true for the other children.

The logical explanation for this finding is this: The children who were shown what each lever did were no longer much interested in the box because they had little to learn from it. They knew which lever caused which object to pop up. In contrast, those who had only seen the two levers pressed simultaneously wanted to explore the box so they could try each lever separately and discover whether it moved the duck, the puppet, or both. In other words, they were motivated to discover the cause-effect relationships between the levers and the objects that popped up from the box. The experiment showed that the four-year-olds were capable of rather sophisticated cause-effect reasoning. They realized that to know fully how the box worked, they had to see what each lever did separately, not just what the two levers did when operated together.

Evidence that young children are not egocentric.

Numerous experiments have shown, contrary to Piaget's stage theory, that children as young as four are capable of understanding others' viewpoints and understanding that other people may have beliefs contrary to their own (Wellman, Cross, & Watson, 2001). In a typical experiment, a child watches the experimenter dump the candy out of a Skittles package and put a pencil inside. Then the experimenter asks what is in the package and the child says "a pencil." After that the experimenter asks what someone who has been out of the room will think is in the package when she returns to the room, and the child says "Skittles," demonstrating the child's knowledge that someone else can believe something that the child knows to be false.

Evidence that young children can think about counterfactual possibilities.

Contrary to Piaget's claim, much research has shown that children much younger than age 12 are capable of counterfactual reasoning (e.g. Nyhout, Henke, & Ganea, 2019). In one of the earliest such studies, M. G. Dias and Paul Harris (Ref) showed that even four-year-olds could solve counterfactual syllogisms if the problem were put in a playful manner. Here is an example of a syllogism that the researchers used:

All cats bark (counterfactual major premise).

Muffins is a cat (minor premise).

Does Muffins bark?

When the researchers put syllogisms like this to young children in a serious tone of voice, the children answered as Piaget would expect. They said things like, "No, cats go *meow*, they don't bark." They acted as if they were unable to think about a premise that did not fit with their concrete, real-world experiences. But, when the researchers presented the same problems in a playful tone of voice, which made it clear that they were talking about a *pretend* world, children as young as 4 years old regularly solved the problems. They said, "Yes, Muffins barks."

Here is a likely explanation of the difference between four-year-olds and 12-year-olds in Piaget's tests. When the question is asked in a serious tone of voice, four-year-olds seem to assume that

the experimenter wants a serious answer about the real world; the bit about all cats barking is just an attempt to trick them. Twelve-year-olds, in contrast, understand from prior experience that this is a logic game dealing with an imaginary world. Four-year-olds are perfectly capable of thinking about an imaginary world different from the real one; they just need to be cued in that this is what the experimenter wants.

Still other research shows that, contrary to Piaget's theory, young children are capable of reasoning by analogy as long as the problems are not too complex and are presented in a way that makes clear what they are supposed to do (e.g. Walker, Hubachek, & Vendetti, 2018). The evidence, all in all, is that what changes with age during childhood is not basic reasoning ability, but knowledge about the world that allows the child to understand what the researcher is looking for. What a researcher considers to be the right answer in a laboratory test of logic is not the same as what the children's parents might consider to be the right answer in normal conversation at home, where a claim that cats bark might be seen as a lie or a sign of delusion.

The Age Four Transition to Verbal Reasoning

The reasoning abilities that I have just described, along with many others, are generally present in four-year-olds but not in three-year-olds. The research suggests that, from about age four on, children think in fundamentally the same ways as adults, but prior to that they do not. What causes this transition? In the 1930s, the Russian psychologist Lev Vygotsky (1934/1962) noted an age-four transition in reasoning and developed the theory that it has to do with the internalization of language, such that language becomes a means of thought as well as communication. Verbal thought is the kind of thought that most distinguishes human thinking from that of other animals, and Vygotsky suggested that it underlies the kinds of reasoning abilities that seem to appear at around age four. A great deal of research since Vygotsky's time has borne out this theory (see Alderson-Day & Fernyhough, 2015; Winsler, Diaz, & de Madrid, 1997).

So, research to date supports the view that, instead of four stages of cognitive development spanning all of childhood, we have just two stages. The first stage, prior to age four, is that of preverbal thought, and the second stage, from about age four to the end of life, is the stage of verbal thought. As children grow older, beyond age four and into adulthood, their ability to solve certain kinds of problems improves because they have learned more about the world, not because of any further shifts in their fundamental way of thinking.

Evidence from Hunter-Gatherers

One powerful line of evidence for children's mental capacities and the age four transition comes from studies of hunter-gatherer societies. Until roughly 10,000 years ago—a speck of time considering the millions of years of our evolutionary history—we humans were all hunter-gatherers. Some groups of hunter-gatherers managed to survive into modern times, in remote parts of Africa, Asia, South America and elsewhere, and have been studied by anthropologists. Such work has revealed certain similarities among such groups of people, wherever they have been found (see Gray, 2009, 2014).

They live in small bands, of about 20 to 50 people (including children) per band, which move regularly from place to place within large but relatively circumscribed areas. Their societies are the most egalitarian societies that have ever been found, and, in fact, another term used for such band societies is *egalitarian societies*. They have no hierarchical structure of governance, make group decisions by consensus, have little property (no more than they can easily carry as they move from place to place), and readily share what they do own. Because they share food nobody goes hungry when some people are lucky and others are not in a given day or week of hunting and gathering. As part and parcel of their egalitarian ethos they have an extraordinary degree of respect for individual autonomy. To a degree that seems almost unimaginable to most Westerners, they refrain from telling one another what to do or offering unsolicited advice.

Some years ago I delved into the lives of children in hunter-gatherer bands by reading all I could find on the topic and, to supplement that, conducting a survey of ten anthropologists who had, among them, studied seven different hunter-gatherer societies on three different continents (Gray, 2009; 2012). One thing I learned is that hunter-gatherers typically view children as “infants” up to the age of about four. Children under that age are often still nursed by their mothers, and, although they are free to engage in many adventures around the campsite and to accompany adults on trips, they are not allowed to—and apparently have little desire to—venture out of sight and hearing of adults or older-child caregivers. Four-year-olds, in contrast, are generally free to run with other kids, or even alone, away from caregivers. Millennia of experience have taught hunter-gatherers that by age four (of course it varies somewhat from child to child) children not only begin to seek independence from adults but are capable of it. They now “have sense” and can be trusted, just as adults can be trusted, to make reasonable decisions and avoid serious dangers. I also learned that hunter-gatherer adults refrain from telling children what to do, just as they refrain from telling adults what to do. As illustration, here are quotations from two different observers of different hunter-gatherer groups:

- “Hunter-gatherers do not give orders to their children; for example, no adult announces bedtime. At night, children remain around adults until they feel tired and fall asleep. Adults do not interfere with their children's lives. They never beat, scold, or behave aggressively with them, physically or verbally, nor do they offer praise or keep track of their development.” (Gosso et al., 2005)
- “The idea that this is ‘my child’ or ‘your child’ does not exist. Deciding what another person should do, no matter what his age, is outside the Yequana vocabulary of behaviors. There is great interest in what everyone does, but no impulse to influence—let alone coerce—anyone. The child's will is his motive force.” (Liedloff, 1985).

I also learned that in all of these societies children, from age four on into their teenage years, are free essentially all day, every day, from dawn to dusk to play and explore in their own self-chosen ways (Gray, 2012). Without anyone requiring them to do so, or even suggesting it, they play at all of the kinds of skills that are important to their society and in that way educate themselves. They play, for example, at hunting, gathering, building huts, cooking, negotiating differences, navigating their terrain, and at the music, dance, and art of their culture. Coercion or coaxing is never necessary. They learn how to do things by watching, and they practice by incorporating what they have observed into their play.

Evidence from the Sudbury Valley School

Even more years ago, I became interested in the Sudbury Valley School, where children are free to play, explore, and in other ways pursue their own interests all day, without intervention or evaluation by adults. I found that children at this school educated themselves very well—and went on to successful, happy adulthood—just as was true for hunter-gatherer children (Gray, 2017; Gray & Chanoff, 1986). They played at skills important to our culture, including skills involving reading, writing, and math as well as many others. In their play many of them developed passionate special interests and went on to careers that fulfilled those interests. This school, along with many other schools modeled after Sudbury Valley, has proven that children are just as capable of taking charge of their own education and doing it well in our culture as they are in hunter-gatherer cultures if provided with an appropriate context.

Consistent with all I have said about the age-four transition, the youngest students that Sudbury Valley will accept are four years old. At this school, all students, regardless of age, are free to roam anywhere on the school's 10 acre campus, which is not fenced off from its surrounds. Adults do not follow the students around. Students, regardless of age (from 4 to late teens), are expected to take responsibility for their own safety. The campus includes a millpond with a dam and is bordered on one side by a road with traffic and on another side by a state forest where someone could get lost. It also has huge rocks and trees to climb and one of those old-fashioned "dangerous" high slides in the playground. The judgment of the school has always been that most four-year-olds are capable of being responsible for their own safety in this environment, but most three-year-olds are not. (I should add that the school requires a visiting week of all prospective students, regardless of age, in which they must prove their ability to be responsible; so not all four-year-olds are accepted.) This policy has turned out to be wise; over its 50-year history, with many hundreds of students, no students have died or even been seriously injured. The policy has since been adopted by most of the schools throughout the world that are modeled after Sudbury Valley.

Conclusion

I have described here converging evidence—from laboratory studies of children's cognition, from studies of hunter-gatherers, and from the experiences of democratic schools such as Sudbury Valley—that children age four and older are mentally competent to make reasonable decisions and control their own daily activities. They shine best when they are trusted and are free to make their own decisions, just as is the case for adults. It is a mistake to treat children age four or older as if they are infants or somehow mentally defective.

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