

How We **Become** Who We Are

*When does personality develop? Are children who can already draw letters in preschool destined to be the best in their class later on? Will a child who exhibits behavior problems early on have problems integrating into society? At a conference held at the Munich branch of the **MAX PLANCK INSTITUTE FOR HUMAN COGNITIVE AND BRAIN SCIENCES** and titled "How we become who we are," scientists presented key findings from LOGIC, a longitudinal study launched more than 20 years ago on the development of individual differences.*

In October 1984, Franz E. Weinert, then Director of the Max Planck Institute for Psychological Research that was founded in 1982, and his team recruited a group of 210 four-year-olds who had just started preschool. The aim of the study was to observe the development of these young children as comprehensively as possible over a long period of time. The German and international researchers who were involved in the project were particularly interested in the development of cognitive, social and motor skills and individual personality traits. They called their research project the LOGIC study: Longitudinal Study on the Genesis of Individual Competencies.

From 1984 to 1993, the research plan was intensive; each child was assessed individually three times a year for around eight hours each time. After 1993 there were subsequent assessments in 1998 and 2003/2004 under the direction of Wolfgang Schneider, who moved from the Max Planck institute in Munich to the University of Würzburg in 1991 and took over responsibility for the study after the retirement of Franz Weinert in 1998. Schneider directed the last assessment period of the study, which was then funded by the Volkswagen Foundation from 2001 until its completion in 2005. The original research team, by then with positions at a number of other academic and scientific institutions, also remained involved until the end. ▶

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At the Munich conference in July this year, titled “How we become who we are”, the first day was devoted to presentations of findings on intelligence, memory processes, moral motivation, personality development and social development. On the second day, the researchers presented their findings on motor abilities, performance motivation, scientific thinking, mathematical competency and spelling competency.

Intelligence, as Jan Stefanek of the University of Würzburg’s Institute for Psychology summarizes, “is pretty stable from relatively early years.” In the LOGIC study, intelligence tests were administered to provide data that would help determine how important intellectual abilities are in the development of various other functional areas, such as memory, motor skills, moral reasoning and personality.

Intelligence was measured in several ways that included psychometric intelligence as measured in traditional IQ tests, and nonverbal intelligence as measured in more “culture-fair” tests. Overall, the researchers found that the intelligence test scores of LOGIC participants were slightly above average, and scores rose with repeated testing – a common phenomenon with longitudinal studies.

Stefanek (together with Schneider) reported reasonably high two-year stabilities for both verbal and non-verbal intelligence, which also increase as the children get older. “The differences in intelligence scores that were determined when the children were four years old remained more or less stable two years later,” said Stefanek. In fact, he pointed out, this stability increased with increasing age.

Intelligence can be predicted at an early age

If their children are clever in kindergarten, can parents expect great achievements from them at school and at work? According to Jan Stefanek, “There is an above-average success rate in predicting a child’s intelligence at the age of six based on the scores they achieved at the age of four. And the scores of a six-year-old or a ten-year-old are actually an extremely good basis for accurately predicting intelligence later in life.” Research into the relationship between psychometric intelligence and tests of cognitive level showed that, although IQ was relatively independent at an early age, they converged later. That is, there was no significant correlation between cognitive level and intelligence at preschool age, but the correlations of IQ as measured by psychometric intelligence tests and tests of children’s ability to think logically increased during school age.

The absolute level of intelligence – both verbal and nonverbal – continued to increase into the adolescent years, and nonverbal intelligence continued to increase

into early adulthood. Individual differences in these general trends were dependent on the school. The verbal intelligence of children who attended Gymnasium (a more academically oriented high school) increased more than that of children who attended Hauptschule (a more trade-oriented secondary school). “This was something that was not at all the case as far as non-verbal intelligence was concerned,” noted Stefanek.

Another area studied through LOGIC from preschool to early adulthood was memory. The memory research group, including Wolfgang Schneider, Monika Knopf from the Institute for Psychology at J.W. Goethe University in Frankfurt, and Beate Sodian from the Department



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of Psychology at Ludwig Maximilians University in Munich, asked whether verbal, language-based memory was a homogeneous content area such that individual components – verbal short-term memory capacity, strategic memory and memory for stories and texts – were strongly interlinked.

“We began with the assumption that there would be particularly close links between these components at preschool age,” says Monika Knopf, “and that the correlation would decrease as individual differences in strategy use and in subject-specific knowledge came into play. To look at the relation among memory components over the course of memory development, the researchers assessed memory capacity, strategy use, and text memory.

To determine verbal memory capacity, the researchers looked at children’s capacity for remembering words and sentences. In the word span task, lists of words were read to the child, who had to repeat them back in the same order. The number of words in a list was then increased until the child was no longer able to reproduce the order correctly (word-span task). The sentence-span task functioned in the same way, but with short sentences.

Memory strategy use was tested with a task in which the child had to remember picture cards that could be grouped into a number of semantic categories (such as

food, vehicles, animals, and so on). Children who grouped the pictures (a semantic organization strategy) could make the memory task easier and remember more. The child’s ability to commit texts to memory, retain them and repeat them was tested with simple picture stories for the younger children and then with narrative stories.

The investigations revealed different patterns for the different memory components. Verbal short-term memory improved slowly from preschool until age 17, but then did not increase any further. “We were unable to detect any significant increase between the ages of 18 and 23,” says Monika Knopf.

In contrast, the developmental curve for strategic memory was not linear: most children acquired learning strategies quickly and abruptly, and as these strategies were acquired, improved their performance in the semantic memory tasks. As expected, children showed a steady improvement in the ability to learn and remember texts, but the researchers were surprised to discover that early individual differences in the ability to reproduce texts remained relatively stable: children who could remember texts and stories better than others at an early age retained this advantage in adolescence and early adulthood. “It seems that a complex cognitive ability is developed surprisingly early,” says the research team.

Although individual differences on the memory tasks were related to later schooling – the verbal memory at the age of four for children who later attended Gymnasium was already significantly better than that of children who later attended Hauptschule – the degree of difference between the two groups did not change with different school experiences.

The scientists’ hypothesis that the three components of memory – verbal capacity, strategic remembering and text memory – would be strongly correlated at the start and not diverge until later was not confirmed. From the very beginning, the correlations were moderate and did not change significantly. The researchers thus concluded that “this surprising result suggests that our verbal memory actually has several different sub-components that can vary even in a single individual.”

Gertrud Nunner-Winkler of the Munich Max Planck Institute for Human Cognitive and Brain Sciences investigated the development of moral knowledge and moral motivation. She gave children aged four, six and eight picture stories in which a character breaks simple moral rules, for example stealing or lying. Answers to questions about the characters’ actions were used to determine the children’s moral knowledge – are the actions allowed, and why or why not? Nunner-Winkler found that children recognize and understand moral rules at a very early age: for example, 98 percent of the four-year-olds said that stealing candy is not allowed,

and is bad. This moral knowledge was not always reflected in children’s moral motivation, though. Moral motivation is someone’s willingness to do the right thing even though it may be to their own detriment. For example, when asked how the candy thief felt, 80 percent of the children answered “good” because, after all, he had the candy.

Does having your candy cause moral conflict?

Nunner-Winkler was able to show that this surprising result is stable. “The happy victimizer phenomenon was replicated many times,” she confirmed. Her conclusion: “On average, moral motivation increases continuously between the ages of 4 and 22,” but very few people remain “morally stable.” This means that “people’s moral motivation is different from their moral knowledge, and can still change into early adulthood.” In fact, a good 20 percent of 22-year-olds still saw morals as not all that significant.

From the age of eight, there were sex differences in moral motivation that became more pronounced with age – in favor of the girls. Nunner-Winkler believes this can be explained by increasing gender stereotypes that assign men characteristics that may be morally less favorable, such as assertiveness, and women morally more favorable characteristics, such as being “helpful.” Nunner found that moral motivation varied with gender role identification. “If boys have a strong gender identification, their moral motivation is lower, while the opposite is true for girls,” explains Nunner-Winkler.

Jens B. Asendorpf, now a professor of psychology at Humboldt University in Berlin, investigated the early development of aggression and shyness and their effects on personality later in life. His findings are sobering: three-year-olds who were noticeably aggressive at preschool age have more altercations with the police as young adults – in fact, they are 12 times more likely to get into trouble than the normally aggressive children in a comparison group.

When children were between the ages of four and six, they were assessed annually by their preschool teachers to determine how aggressive or timid they were. The teachers’ opinions were confirmed by trained observers. Aggression and timidity were found to be independent of each other: boys were judged to be more aggressive than girls, but there were no sex differences in timidity.

To determine the long-term effects of early aggression and early timidity, Asendorpf looked at extreme groups – one group comprised 15 percent of the most aggressive children and was compared with a group of children with below-average aggressive tendencies. Another group comprised 15 percent of the most timid chil-

dren, and this was compared with a group of children who demonstrated below-average timidity.

The comparisons revealed that aggression is extremely stable: at the age of 23, the aggressive children were judged by their parents – and also by themselves – to be considerably more aggressive than those in the comparison group.

The aggressive children were educational under-achievers, meaning they rarely obtained the qualifications that would have been expected of them based on their IQ scores. Aggressive children were also less likely to have a full-time job than would be expected given their educational qualifications. And “particularly worrying” was the fact that “between the ages of 18 and 23, the aggressive children had been charged by the police 0.5 times on average, or 12 times more often than the control group, who had been charged only 0.04 times,” said Asendorpf.

Asendorpf noted that, although aggressive persons who commit a crime are more likely to be noticed and brought to justice than those who commit the same crimes less conspicuously, these findings are still bad news. “Aggression at preschool age is a risk factor for aggression, underachievement and criminality in adulthood,” he explains.

writing tests two years later, and that 90 percent of the children who had been categorized as “at risk” for reading and writing did indeed have problems with these when they began school. Differences in spelling ability were very stable from the second grade on: the correlation between spelling ability at 8 years and 23 years was high – the LOGIC study participants’ performance ranking in spelling in second grade was stable 15 years later.

Elsbeth Stern of the Max Planck Institute for Educational Research in Berlin examined mathematical ability. One of the questions she posed was: Why do some children find it more difficult than others to make the



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transition from natural to formal mathematics? Children spontaneously learn how to count, just as they spontaneously learn how to speak. Stern calls viewing the world in terms of quantitative aspects a “natural number sense.” To learn formal math, children have to abandon the belief that numbers relate to tangible amounts, and learn that they often have to be associated with other variables before they can be understood. The children “who began to quantify the world earlier” found it easier to make the transition to abstract mathematics.

Stern’s tasks revealed a significant relationship between quantitative abilities at preschool age and mathematical abilities at the age of 23, suggesting that the foundations for understanding formal mathematics are laid at primary school age. Although Stern’s study confirmed the frequently found correlation between IQ and mathematical ability, there were many instances over the course of the LOGIC study where a highly intelligent child had below-average mathematical skills, or vice versa. Elsbeth Stern’s conclusion: “Mathematical ability does not have a great impact on general intelligence.”

Beate Sodian and Merry Bullock, now at the American Psychological Association, discovered that, where the development of scientific thinking is concerned,

children’s performance often lags behind their understanding. They also found that those adults who understood how to do science and who were able to develop their own opinions on the basis of logic and fact were those who had had better formal analytical skills at the end of elementary school. “Interestingly,” the researchers found no gender differences, but those who had attended a Gymnasium performed better than those who had attended a Hauptschule.

“However, these differences should not be interpreted as a result of the type of schooling, as they already existed before the children reached secondary school age,” explains Sodian. This is why she is calling for children to be intentionally introduced to the basics of scientific thinking at an early age. This includes learning how to critically assess their own ideas as well as those of others, and to evaluate arguments.

Motor skills are gender-dependent

The LOGIC researchers studied motor development from preschool age to early adulthood. Jutta Ahnert and Wolfgang Schneider from Würzburg University and Klaus Bös of the Institute of Sports and Sport Science at Karlsruhe Technical University analyzed the stability and development of motor abilities. Movement tests carried out at the ages of 4, 5, 6, 8, 10, 12 and 23 showed that motor skills are strongly dependent on gender and on what physical activities are pursued from preschool age to early adulthood.

Predictably, in fitness tasks such as performing a standing long jump, young adults performed better than they did as children. However, in coordination tasks, such as balancing while walking backwards or moving sideways, they performed worse than they did at the age of 12. Gender differences showed up mostly in strength tasks – from adolescence onward, the male participants were noticeably more dominant in strength-oriented tasks.

The generally high stability of motor skills suggests that the foundations for later development are laid in childhood. However, whether a child – and later an adult – is physically active or not is determined only to a limited extent by their family’s socio-economic status, the type of school education they receive and whether or not they belong to a sports club. What is of lasting significance is the “level of parental encouragement received at an early age to participate in sports.” The study concluded that “children from families that often participate in sports and whose parents actively support their child’s sports activities perform better in tests of motor ability at every stage of their development.”

ANNE GOEBEL

Timidity delays development only slightly

By the age of 23, the group of extremely timid children did not judge themselves to be any more timid than the comparison group, and noticeable negative personality traits could be detected only if the group was narrowed down further to the 8 percent of the children who were the most timid. This means that, unlike timidity in adulthood, preschool timidity is a risk factor for feelings of inferiority later in life only if it is particularly pronounced. However, timidity at an early age does lead to a slight delay in the timing of when young adults establish themselves in the development of vocations and partnerships. Timid people take longer to open up and often don’t have enough confidence to do what they really want to do.

Wolfgang Schneider investigated literacy, looking at the “predictability of literacy based on pre-literacy characteristics at preschool age” – namely, the extent to which a preschool child’s language and writing skills predict how good they will be at reading and spelling later in life. To determine their “phonological awareness,” an important precursor to reading and writing, children had to solve tasks involving rhymes and identify logos as correctly as possible.

Schneider found that children who were slightly better at this in preschool performed better in reading and