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The Evolution of Human Intelligence Throughout a Person's Life - A Lifelong Journey

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Abstract

This is an extended article from the book *Intelligence, from Natural Origins to Artificial Frontiers - Human Intelligence vs. Artificial Intelligence*, by Nicolae Sfetcu[2]. The evolution of intelligence during a person's lifetime is a process influenced by an interaction between biological development, genetics, environmental factors, and personal experiences. To comprehend the progression of intellectual growth, it is essential to explore the emergence, maturation, and sometimes, the decline of cognitive abilities, illustrating a complex interplay between genetic predispositions and environmental influences.
Keywords: evolution, human intelligence, childhood, adolescence, adulthood, intelligence, wisdom

Evoluția inteligenței umane de-a lungul vieții unei persoane - O călătorie pe tot parcursul vieții

Rezumat

Acesta este un articol extins din cartea *Intelligence, from Natural Origins to Artificial Frontiers - Human Intelligence vs. Artificial Intelligence*, de Nicolae Sfetcu. Evoluția inteligenței în timpul vieții unei persoane este un proces influențat de o interacțiune între dezvoltarea biologică, genetică, factorii de mediu și experiențele personale. Pentru a înțelege evoluția creșterii intelectuale, este esențial să se exploreze apariția, maturizarea și, uneori, declinul abilităților cognitive, ilustrând o interacțiune complexă între predispozițiile genetice și influențele mediului.
Cuvinte cheie: evoluție, inteligență umană, copilărie, adolescență, maturitate, inteligență, înțelepciune

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Introduction

Human intelligence is a complex construct that undergoes significant changes throughout an individual's lifespan. The evolution of intelligence during a person's lifetime is a process influenced by an interaction between biological development, genetics, environmental factors, and personal experiences.

According to *Encyclopedia Britannica*, human intelligence is the "mental quality that consists of the abilities to learn from experience, adapt to new situations, understand and handle abstract concepts, and use knowledge to manipulate one's environment" (Britannica 2024).

Researchers from Brisbane, Edinburgh and Aberdeen reviewed a study which found that a quarter of people experience a change in intelligence due to genetic and environmental factors (Deary et al. 2012). Peter Visscher noted that "Identifying genetic influences on intelligence could help us to understand the relationship between knowledge and problem solving and an individual's outcomes in life, and especially to understand why some people age better than others in terms of intelligence. " (Philips 2012).

Myelin develops as children grow, improving brain function. Myelination and neural connections increase brain volume until age 40, then slowly shrink as the tissue begins to degenerate.

To comprehend the progression of intellectual growth, it is essential to explore the emergence, maturation, and sometimes, the decline of cognitive abilities, illustrating a complex interplay between genetic predispositions and environmental influences.

Early Childhood: The Foundations of Intelligence

The inception of human intelligence occurs during early childhood, a phase characterized by rapid cognitive advancement. From infancy to approximately five years of age, the brain experiences substantial growth, with synaptic connections proliferating at an exceptional pace. It is during this period that children acquire fundamental cognitive skills, including perception, language, memory, and problem-solving capabilities.

Jean Piaget's theory of cognitive development, which delineates stages such as the sensorimotor and preoperational stages, offers a theoretical framework for understanding these initial developments. Piaget arrived at a theory of cognitive development that describes the developmental stages of childhood (Parke and Gauvain 2009).

1. *Sensorimotor stage (Child 0–2 years)*: Intelligence is present; motor activity but no symbols; knowledge is developing but limited.
2. *Preoperational stage (Toddler and early childhood 2–7 years)*: Symbols or language skills are present; emotion and imagination develop; irreversible and non-logical thinking.
3. *Concrete operational stage (Elementary and early adolescence 7–12 years)*: Logical and systematic form of intelligence; manipulation of symbols related to concrete objects.
4. *Formal operational stage (Adolescence and adulthood 12 years and up)*: Logical use of symbols related to abstract concepts.

Even before birth, the foundations of cognitive abilities are laid. The brain begins to form neurons and synapses at an incredible rate.

During the first few years, the brain grows rapidly, reaching almost 80% of adult size by the age of three. This period is critical for sensory development, language acquisition, and the establishment of cognitive frameworks. Babies and toddlers learn primarily through sensory experiences and interactions with their environment.

Lorena Bragg writes that early childhood is a time when neurons can explore and make as many connections as possible, but we cannot maintain them all over time. The connections that

remain are strengthened thanks to so-called myelin, an insulating layer that wraps around neural projections, isolating them. (Bragg 2022)

Within the sensorimotor stage (from birth to two years), infants explore their environment through sensory and motor experiences. They begin to grasp the concept of object permanence, understanding that objects persist in existence even when they are out of sight. Transitioning to the preoperational stage (from two to seven years), children engage in symbolic play and refine their language skills. Nonetheless, their cognitive thinking remains predominantly egocentric, indicating an inability to consider perspectives other than their own.

Recent research has suggested that early experiences and social interactions play a critical role in the development of reasoning (Banerjee, Watling, and Caputi 2011). Infants as young as six months can engage in basic logical reasoning. Cultural factors, such as educational practices and emphasis on critical thinking, can also influence the development of reasoning skills.

Middle Childhood and Adolescence: Refinement and Expansion

In preschool through early school age (ages 3-12), children develop reasoning, memory, and problem-solving skills. They begin to understand abstract concepts such as numbers and relationships.

Formal schooling begins to shape cognitive skills significantly. Reading, writing, and arithmetic become the tools by which children engage and expand their intelligence.

As children transition into the middle childhood stage, spanning from ages 6 to 12, their cognitive capabilities undergo significant refinement. This period is characterized by the development of logical thinking skills, a hallmark of Piaget's concrete operational stage. It enables children to engage in mental operations concerning concrete objects and events, marking a crucial

stage in their academic journey. During this time, formal education plays a pivotal role in enhancing children's memory, attention, and problem-solving abilities.

Adolescence: A Critical Phase in the Evolution of Intelligence

Adolescence, which spans from ages 12 to 18, represents another pivotal phase in the evolution of intelligence. It is during this stage that individuals progress into Piaget's formal operational stage, a phase where abstract and hypothetical thinking becomes the norm. Adolescents acquire the capacity to reason logically about potential outcomes, engage in systematic problem-solving, and critically analyze complex issues. Additionally, this period is characterized by the development of metacognitive skills, which involve an increased awareness of one's own thinking processes and strategies. This heightened self-awareness empowers individuals to plan, monitor, and regulate their cognitive activities more effectively.

During adolescence, the brain begins to smooth out unused neural connections and strengthen others, making thought processes more efficient. There is substantial development in executive functions, which include planning, impulse control, and attention. Risk-taking behaviors can also influence cognitive development through new and diverse experiences.

Adulthood: The Peak and Maintenance of Intelligence

The general belief was that cognition stops improving after a certain age, with the brain being mostly mature by age 18 and then more frontal lobe maturation occurs by age 20. According to this theory, cognitive decline begins at an advanced age.

In the early stages of adulthood, cognitive abilities typically reach their zenith. This phase is characterized by the peak of fluid intelligence, which encompasses the capacity to solve novel problems and think abstractly. Furthermore, it is marked by the accumulation of crystallized intelligence, which is comprised of knowledge and skills acquired through life experiences and

formal education. Crystallized intelligence is often stable or even increases with age, as adults continue to accumulate expertise in their respective fields.

During early adulthood (ages 20-40), intelligence, especially crystallized intelligence (accumulated knowledge and skills), stabilizes and continues to grow. Fluid intelligence, which involves problem solving and the ability to adapt to new situations, can peak during this period. Higher education, careers, relationships, and personal interests continue to shape cognitive abilities.

The biggest losses begin in the 30s in the prefrontal cortex (important for attention, planning, reasoning, problem solving) and the hippocampus (involved in learning, memory and navigation).

However, the nature of intelligence in adulthood is dynamic. Throughout middle adulthood, individuals may experience a gradual decline in certain aspects of fluid intelligence, such as processing speed and working memory. Despite these declines, many adults compensate for these changes by leveraging their accumulated knowledge, experience, and heuristic strategies, which facilitate efficient problem-solving. Moreover, practical intelligence, or the ability to manage everyday tasks and navigate complex social environments, continues to develop and frequently improves with age.

Late Adulthood: Adaptation and Wisdom

In the later stages of adulthood, the manifestations of cognitive decline become increasingly discernible. Specifically, fluid intelligence, which is particularly adept at handling tasks that demand swift reasoning and mental agility, may experience further diminishment. The efficiency of memory retrieval may wane, and the pace of cognitive processing continues to

decelerate. Nonetheless, this phase of life also presents avenues for cognitive enhancement in various domains.

Between the ages of 40-60 there may be slight declines in processing speed and memory. However, experiential knowledge and skills often continue to improve. Individuals often develop deeper expertise in their career fields and improved problem-solving skills related to real-world problems.

Over 60 years of age, cognitive decline can occur, with varying degrees of severity. Memory, processing speed, and problem-solving skills may decrease. Older adults often compensate for these losses by relying more on accumulated knowledge and experience.

Older adults are frequently characterized by wisdom, a quality marked by profound insights into life, the adeptness in managing intricate social and emotional scenarios, and the ability to render judgements grounded in accumulated experience. Furthermore, empirical evidence suggests that cognitive engagement, social interaction, and physical exercise can play pivotal roles in sustaining cognitive function among the elderly. The principle of neuroplasticity, which denotes the brain's capacity to reorganize itself through the formation of new neural connections, underscores the brain's enduring adaptability throughout life. Consequently, the pursuit of lifelong learning and mental stimulation is imperative in the preservation of cognitive capabilities in later years.

Recent studies have shown that there is no given maximum for human capabilities, including intelligence, but IQ tests referentially assess fluid intelligence, leading to the idea that young people are more intelligent. But in everyday, repetitive problems, the elderly are better (synapses and myelination are influenced by experience, so circuits are strengthened through repeated use) (Bragg 2022).

Conclusion

Raymond Cattell and John Horn proposed the theory that dominated for many decades, that intelligence is not a specific thing, but a collection of different abilities working together (Cattell-Horn theory) (Wasserman 2019). Skills can be classified into two categories: fluid intelligence and crystallized intelligence. Fluent intelligence allows solving new problems and calls on short-term memory. Crystallized intelligence emerges from general knowledge and information. Both types of intelligence develop during childhood and adolescence. Fluid intelligence peaks in the early twenties, and crystallized intelligence continues to develop with a peak around age sixties or seventies.

Throughout life, the brain's plasticity, or its ability to change and adapt, plays a crucial role at every age. Learning new skills, engaging in complex cognitive activities, and maintaining a healthy lifestyle can help preserve and even improve intelligence. Socioeconomic status, education, cultural exposure, and social interactions continually interact with genetic predispositions to shape intelligence across the lifespan.

The evolutionary trajectory of intelligence is highly individualized, with each phase presenting opportunities for growth and challenges. Understanding these phases can help to adopt strategies that optimize cognitive development at different stages of life.

In conclusion, the evolution of human intelligence throughout the lifespan stands as a testament to the brain's extraordinary potential for growth and adaptation. From the rapid cognitive development observed in early childhood to the wisdom frequently displayed by the elderly, intelligence is not a trait that remains static but rather a dynamic process influenced by biological, psychological, and environmental factors. By comprehending this developmental trajectory, we are better equipped to appreciate the intricacies of human intelligence and the myriad factors that contribute to its evolution across an individual's lifespan.

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