Notes on Intelligence

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Overview

Given that we are continuously involved in new learning experiences, intelligence appears to develop over our entire life span. If in fact intelligence was fixed the concept of lifelong learning *(Leister & Field, 2000)*, which is becoming a prerequisite for continued socio-economic success and personal growth for most people in developed nations, would make little sense. The question is what intelligence actually is and if, besides functional information-processing *(Kruse, 2013)*, the strength of human intelligence lies in the qualitative integration of different types of intelligences *(Gardener, 1983)*.

Is Intelligence Fixed or Malleable?

The cognitive leap that children undertake from early- to middle childhood around 7-8 years of age *(Arnett, 2012, p.294-296)* is a good example for developing intelligence. The transition from the preoperational to the concrete operational stage *(Piaget, 1963)* entails the development of cognitive abilities such as decentering (seeing multiple aspects of a problem), abstract classification, seriation into logical orders and transitive inference (mental seriation).

Intelligence develops epigenetically within a reaction range *(Arnett, p.302)* which means that it is partially bounded by genetic inheritance and that its development increases exponentially as environments become more nurturing and stimulating. Such findings disprove the fixedness of intelligence by biology as suggested by Jensen *(1998)*. Supported by the phenomenon of neuroplasticity even in the ageing brain *(Berlucci, 2011)*, analytical -, creative- and practical intelligence *(Sternberg, 1985)* continue to develop over the human life span.

On a cultural level the exponential increase of inter-generational intelligence since the 1930s, the 'Flynn Effect' *(Flynn, 1987)* supports the wider anthropological argument that human intelligence and consciousness has historically emerged for homo sapiens via qualities such as increasing complex social organization, language development and self-awareness *(Flinn et al., 2005, p.36)*.

Intelligence and Occupation

During our life span different types of intelligence play different roles for the individual.
For example, for a nurse, a lecturer, PR-manager or a counseling psychologist emotional intelligence *(Salovey & Grewal, 2005)* will be of great value. If we would apply Steinberg's Triarchic Theory of Intelligence *(Sternberg, 1985)* to occupations we would perhaps find that for an administrator or finance manager *analytical intelligence* is of essence, for a designer it would be *creative intelligence* and for an engineer *practical intelligence*. Individual differences can be explained by the modular architecture of our brain *(Swanson, 2003)* allowing for multiple types of intelligences to emerge *(Gardener, 1983)*.

In Gardener's model a journalist for example depends on *linguistic intelligence* for writing articles, on *logical competence* for interpreting statistics and *intrapersonal intelligence* for self-critically reviewing one's work before publication.

Gravitational Theory states that the correlation between intelligence and occupational success increases over life span because individuals 'gravitate' towards positions that are more in congruence with their abilities, supporting the predictive power of IQ-scores for maintaining social status. A negative relation is however claimed for repetitive and less cognitively demanding occupations *(Strenze, 2007, p.406).*

Conclusion

A more holistic definition of intelligence requires the inclusion of cultural and social factors. E.g., the confounding factor of social mobility restricts the assumption of mainly the parent's SES and intelligence causing occupational success in life *(Stenze, 2007, p. 416).*
To develop intelligence tests with a greater explanatory power the groundbreaking work of Sternberg and Gardner may lead future research *(Arnett, p.304).*

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Nature versus Nurture and Reaction Range

On the topic of reaction range Arnett *(2012, p. 302)* notes that children with a weak influence from inheritance for a higher IQ will not develop superior intelligence despite a highly stimulating environment, whereby children with a strong influence from inheritance are unlikely to end up with a below normal IQ in a subnormal environment. Such a scenario would be to a developmental advantage to the child with weak inheritance and of disadvantage to the child with strong inheritance for a higher IQ. In both cases intelligence would appear to be moderated (stimulated or inhibited) by environmental factors while genetic inheritance poses the developmental potential and cognitive 'raw material' that the child can draw upon. Such a view may lead to the conclusion that genetic factors for intelligence are relatively fixed while environmental factors fluctuate and merely determine how genes 'play out'. Arnett is correct in his predictive example but, as he points out himself, the relation between genes and the environment is not as simple as suggested.

Nisbett and colleagues *(Nisbett et al., 2012, p.130)* state in their recent review that heritability varies greatly by social class. They note the importance of environmental factors for IQ. Various studies where children had been adopted from families with low SES into middle-class families for example showed a 12-18 point increase in IQ *(Locurto, 1990, Loehlin et al., 1997).*

There is an underlying methodological difficulty in measuring factors as well. The concept of heritability, which was derived from animal breeding, depends on the relative variance of predictors, in our case genotype and environment. In experimental animal studies both variables are relatively stable and can successfully predict specific traits. In the free and multi-facetted human life-world both variables however can take on virtually any degree of estimate, which renders correlations between nature and nurture ambiguous *(Nisbett et al., p.132).*

The authors found that in poor environments genetic influence appears almost non-existent while in well-off environments genetic influence increases. Overall heritability appears to increase with a higher SES. One hypothesis is that children in low-income, low-education settings do not get to develop their full genetic potential *(Nisbett et al., p.134, Turkheimer et al., 2012)* while negative factors such as prenatal and social stress present negative neuro-physiological and behavioral implications for the development of intelligence *(Nisbett et al., p.152).*

These findings suggest that intelligence is to a far larger part initiated by environmental and social factors as assumed in early studies on IQ. Noteworthy is also that the search for 'intelligence genes' have been remarkably unsuccessful. Only six genetic markers have been identified so far to account for only 1% of variance in cognitive ability *(Butcher et al., 2008).* The number of genes involved in evoking intelligence is suspected to be fairly large and not within reach of identification anytime soon. Illuminating to find out would be the inter-generational effect of stimulating environments on the variance of genetic inheritance of individuals who originated from low SES-backgrounds. Genes are, after all, an evolutionary response to environmental changes.

Such a view suggests the flexibility of IQ on epigenetic and evolutionary level. Nature seems to protect IQ in subtypical environments while genetic expression flourishes in stimulating ecologies. Given our responsible intervention, nurture assists nature to develop its fullest potential.

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Understanding the Twisted World of IQ Tests

To fully understand the twisted world of IQ tests and before starting to critique the concept, we may first explore some of the merits. IQ tests such as the Wechsler Intelligent Scale (Wechsler, 1939) that have been administered since the 1950s have been fairly successful in predicting academic achievement of children. Concerned parents are eager to know their child's IQ by testing them with the Wechsler Intelligence Scale for Children. Who can blame them?

Many parents have never been educated on how to interpret an IQ-rating. The famous intelligence factor *(g)IQ* is only a summative average of the individually tested sub-scores (factual knowledge, arithmetic, vocabulary and comprehension, picture completion etc.). By today's pedagogical standards many of these sub-scores are hopelessly antiquated, as are many of the outdated curricula that many children have unfortunately to endure.

A new Wolfgang Amadeus Mozart or John Lennon, a new Picasso, Emily Dickenson or Maya Angelou may fail miserably as children in such an assessment grid. The IQ scales work well because, statistically speaking, they measure reliably the construct they are supposed to.

There is also growing evidence that many non-intellectual qualities such as self- regulation (Nisbett et al., 2012, p.151) are essential to future success and happiness in life. Remarkable is that most tests are geared towards individual performance and none of them appears to measure social competence and communicative skills. I could imagine creating less biased IQ-tests that address more specifically certain domains following Sternberg's idea on focusing on intra-personal, inter-personal, object-interactional and environmental-contextual competencies.

Another viable approach would be representing intelligences similar to the *'Big 5'* personality test as separate qualities, without implying bias or negativity, while there would be no need for a summative *(g)IQ* that informs *per definitionem* nothing about the real-world performance of cognitive skills.

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