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Intelligence: Heredity and Environment

Tasnim Bibi Kazi[1] and Vartikka Indermun[2]
[1]Regent Business School, South Africa.
[2]Management College of Southern Africa (MANCOSA), South Africa.

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ABSTRACT
Each of us is a unique person, a combination of inherited genetic material and environmental influences. A basic theme and controversial issue throughout the history of psychology has been the debate and investigation of the relative roles of heredity and environment in the formation of individual differences. Despite beliefs that men are born equal, they are not. Every person possesses a unique set of genetic material bestowing them with variations in aptitude, physical development, and capacities, which in turn are acted on by the occurrence of unique environmental experiences some of which even influence the creature prenatally There are many claims, opinions, and arguments about where intelligence comes from - is it from our genetic heritage, or is it a result of the environment and our experiences? A substantial body of research tells us that both heredity and environment affect intelligence.

Introduction

Today, researchers generally agree that both heredity and the environment have a collaborative influence on intelligence. Many researchers believe there is a reaction range to IQ, which refers to the limits placed on IQ by heredity. The environment determines where within these limits the person's IQ will be positioned. Despite the dominant view that both heredity and environment influence intelligence, researchers still have differing opinions about how much each contributes and how they interact.

Defining Intelligence

Operational definitions define constructs according to what the construct measures.

Such definitions, like Boring's (1923), state that intelligence is what 'psychological tests test', and have serious shortcomings. First, they are circular in that tests were not created to define intelligence but to measure it. Second, such definitions impede progress in understanding intelligence because they do not "allow for the possibility that new tests or conceptions of intelligence may be superior" (Gregory, 2007: 164). This definition also assumes that IQ tests are a reliable and a valid measure of intelligence, which though has been proven true, has been disproven as well. Operational definitions are therefore severely lacking and focus needs to be given to real definitions discussing the actual construct.

The following are a range of expert 'real' definitions of intelligence that Gregory (2007: 165) presents from two symposiums of intelligence. Spearman (1904) states that it is a general mental ability, or the ability to judge, understand and reason well (Binet & Simon, 1905). Terman (1916) defines it as the ability to create concepts and understand them while Sternberg (1985) asserts that intelligence is made up of meta-, performance- and knowledge acquisition-components. Eysenck (1986) states it is the "error-free transmission of information through the cortex". Finally, Ceci (1994) defines intelligence as abilities that develop or fail to develop "depending upon motivation and exposure to relevant educational experiences".

Family background and intellectual development

Arthur Jensen, Richard Hernstein and Hans J. Eysenck – genetic theorists

Jensen is infamous for his belief that intelligence is determined by nature – genetic makeup, and not nurture – social environment and education. He believed that the genes-to-IQ relationship was so strong one could "estimate a person's genetic standing on intelligence from his score on an IQ test" (Taylor, 1980:1). He estimated that 80% of the variance in IQ is accounted for by genes and 20% by social environment, education, gene-environment interaction, and everything else. In his studies he found estimates of between 0.60 and 0.90 and 0.65 and 0.80.

Jensen also believed there were racial differences in intelligence when he found a 15-point difference between blacks and whites on standardised IQ tests such as the Stanford-Binet, Wechsler, and Raven's. Jensen (1969: 49) conceived that because of the apparent physiological, anatomical and biochemical differences between blacks and whites, "there is no reason to suppose that the brain should be exempt from this generalisation". He stated that while genetically-based differences within groups do not prove differences between groups are genetic, the higher the heritability of IQ between groups, the greater the chance their IQ difference is genetically determined. He believed that one-half to a three-quarter of the black-white difference in IQ is genetic.

Drawing on Jensen's work, Hernstein (1971-1973) made four conclusions (Taylor, 1980). First, current IQ tests like the Standford-Binet and WAIS are valid and reliable intelligence measures. Second, intelligence is 80% genetically heritable, and there is no empirical challenge to the genetic contribution to IQ scores. This has obviously been refuted by other studies. Third, IQ scores depend on genes and success depends on IQ, therefore success is determined by genes. Finally, if individuals become more equal in their social environments, then even less of their IQ differences will be attributed to environment, thus, the genetic contribution to IQ will be more than 80%.

Hernstein believed that society was genetically disadvantaged at the bottom and genetically more fortunate at

Tele:
E-mail addresses: vartikka1804@yahoo.com

the top. In other words, social classes could be differentiated by their genetically caused intelligence, where the higher classes had more intelligent genes. With respect to Jensen, the "less able gravitate downwards in the SES [socioeconomic status] hierarchy... they of course take their genes for intelligence with them" (Taylor, 1980: 8). Eysenck also agreed with Jensen and Hernstein in that IQ is 80% heritable for both blacks and whites, black white differences do exist and are largely genetically determined.

All three authors are criticised on numerous grounds, chiefly for being racist in their arguments, yet not only have their findings not been disproved – in terms of psychometrics – certain aspects of their theories are still prevalent today.

Twin Studies

Bouchard, Lykken, McGue, Segel and Tellegen (1990: 223) assert: "[Twin studies] provide the simplest and most powerful method for disentangling the influence of environmental and genetic factors on human characteristics". Kamin (1974:52) also states that the best evidence supporting the idea that intelligence is genetic comes from separated identical twins. There are two different types of twins. Monozygotic (MZ) twins are identical twins with identical genes. They are of the same sex with striking physical similarities. Dizygotic (DZ) twins are fraternal twins no more genetically alike than normal siblings. They are not necessarily of the same sex and are physically dissimilar. Since MZ twins are the only paired individuals with identical genes, any difference between them will be non-genetic. MZ twins who (due to circumstances) are separated are therefore used for experiments on heredity.

If intelligence is a result of environment, the twins will not be very alike. As per a genetic hypothesis, if IQ was only heredity, the IQ resemblance between MZ twins would be very substantial. If one uses an environmental hypothesis, there should be no IQ resemblance between MZ twins. But, the environment one twin may be placed in may be very similar to the environment of the other twin. If environments are similar, IQ could be environmentally produced. Therefore when one is using an environmental hypothesis, the IQ correlation should not be too large (Kamin, 1974).

Here a major criticism of MZ twin research arises: separated twins are never randomly assigned to environments (Kamin, 1974; Vernon, 1979). Parents are more likely to place a twin at a sociocultural level similar to their own. According to Vernon (1979: 173), this "implies matching to some extent on the basis of true-parent intelligence, education, and SES... The high correlations between twins in different homes arise largely, or wholly, because of selective placement in similar homes".

Kamin (1974) reports the results of four statistically analysed early IQ studies of separated MZ twins. The IQ correlations between the MZ twins are: Burt (1966), 0.86; Shields (1962), 0.77, Newman et al. (1937), 0.67; and, Juel-Nielsen (1964), 0.62. Burt's data has been criticised widely: data is full of arithmetical inconsistencies and verbal contradictions, descriptions of data collection and tests are inconsistent, data is fraudulent, IQ assessments are heavily subjective, there is a complete lack of procedural information, and therefore "there can be no science that accepts such data as its base" (Kamin, 1974: 99).

The Shields study discusses 'theoretical expectation bias' where the theoretical orientation of the tester – that is the heredity or environmental orientation – may bias the IQ measurement of the twins. Kamin (1974) also discusses another bias where reward structure between experimenter and subject may lead the subject to overstate the degree of separation, which happens because there is a reliance on twins to provide separation information. Such criticisms such as weaknesses in data and non-random placement of twins that were initially brought up by Kamin (1974) were never included in an analysis of variance by earlier twin studies (Vernon, 1979).

McGue & Bouchard (1998) reviewed five studies of MZ twins reared apart and found an average correlation of 0.75, when accounting for contact between twins and environmental similarity. A relatively new point raised in their research was that specific mental abilities (SMAs) seem to be less heritable than general cognitive ability. The Swedish Adoption/Twin Study of Aging (SATSA) found average heritability estimates of three verbal, three spatial, two perceptual speed and five memory tests of 0.58, 0.46, 0.58 and 0.38 respectively. On the contrary, they found a general cognitive ability estimate of 0.81. Kamin and Goldberger (2002) criticise studies such as the SATSA and the Minnesota Study of Twins Reared Apart (MISTRA) studies, and other twin studies, on numerous grounds: frivolous analyses, inadequate reports, inaccuracies in data, tendency for twins to lie and compare notes, selective placement in similar environments, and limited reliability and validity of measures for contact and separation.

Taylor (1980) states that the genetic heritability of IQ scores is not a reliable estimable quantity and there is no concrete and convincing evidence to prove that the heritability of IQ is near substantial, and he criticises genetic studies for arithmetic errors and concealments, a questionable inclusion and exclusion of studies and correlation values, and misquoting, incorrect transcriptions. The author states that in the face of such 'faulty' methods and data, it is difficult to conclude in favour of a genetic effect on intelligence, and thus this hypothesis should be rejected. Furthermore, because of the implications of such conclusions for policies and for minorities, one needs to be careful in making them at the outset.

Social Environment And Intellectual Development

Neisser et al. (1996: 86) believes that there is concrete information available on the relationship between environment and intelligence: "Some of these variables affect whole populations, while others contribute to individual differences... Some of them are social, some are biological; at this point some are still mysterious. It may also happen that the proper interpretation of an environmental variable requires the simultaneous consideration of genetic effects".

The Flynn Effect

Sternberg & Kaufman (1998: 488) state that "the simplest and most potent demonstration" of the effect of environment on intelligence is the Flynn effect: "IQ has increased over successive generations around the world through most of the century. The effect must be environmental, because obviously a successive stream of genetic mutations could not have taken hold and exerted such an effect over such a short period".

The Flynn effect, posited by James Flynn, began to question the idea that intelligence is largely genetic. Neisser et al. (1996: 89) describe the worldwide increase in IQ scores as "the most striking of all environmental effects", and believe that the rate of the gain may also be increasing. There is an average increase of 5-9 IQ points over a decade or 18 IQ points over a generation, in children and adults. The Flynn effect is greater on tests that measure fluid intelligence than those that measure crystallised intelligence. The effect is especially evident on culture-free tests like Raven's Progressive Matrices (Daley, Whaley, Sigman, Espinosa & Neumann, 2003). The massive and consistent increases in IQ cannot simply be attributed to test sophistication and similar reasons. Researchers have proposed three possible environmentally-related reasons (Daley et al., 2003; Neisser et al., 1996; Neisser, 1997 Sternberg & Kaufman, 1998).

First, there are noticeable cultural differences between generations in daily life – especially the visual and technological environment – and the increased environmental complexity of this may have led to an increased complexity in intelligence. Specifically, Daley et al. (2003: 215) state: "Individuals with intellectually stimulating and complex job conditions demonstrate increased cognitive flexibility... Youths exposure to a more technical and complex visual world through... televisions and computers may affect performance". Children's exposure to this has led them to acquire complex visual analytic skills exceeding their parents and grandparents. This is probably why tests that measure visual analysis directly, such as the Raven's, have shown most marked increases in IQ. This has also led to teen 'multitaskers' – teens that are concurrently watching TV, channel-surfing, texting and chatting – who in this process are exercising and training vital aspects of their intelligence, memory and attention, which in turn boosts intellectual development and IQ scores.

Second, some ascribe IQ increases to the effect of gains in nutrition. That is, better nutrition affects brain function; indicators of nutrition are related to cognitive performance. Mild to severely undernourished children are shown to have lower school grades, reduced reasoning, perception and spatial functioning, and low concentration when compared to nourished children. The argument is that increase in nutrition and health that has increased height and stature, has also increased brain size, resulting in higher levels of intelligence. That is, the rise in test scores is related to cognitive gains. However, the actual evidence of this is unstable.

Third, family structure and parental factors are important aspects of an individual's social environment. This contributes to the Flynn effect because decrease in family size means that parents have more resources – in terms of providing time, money, attention, food, schooling opportunities, educational materials – for each child, thereby giving the child the means to develop to the best of their potential by providing them with a favourable environment in which to do so. Also, Neisser (1997:7) states: "Parents everywhere are now interested in their children's intellectual development and are probably doing more to encourage it than they did in the past". This early stimulation and encouragement increases overall intelligence. In addition, Daley et al. (2003) state that parent's migration from rural to urban areas leads to more importance given to schooling and thus enhancing IQ.

Neisser (1997) argues that the gains in IQ are too substantial to be a result of genetic changes. He states that even if we cannot currently comprehend these gains, there are clearly a significant environmental influence. Begley & Springen (2003) assert that the belief that IQ is a fixed capacity you're born with is a defeatist view, and the Flynn effect is proof that IQ and intelligence can be developed and enhanced by environment.

Nurture Working With Nature: James Flynn and William Dickens

The dominant view in the field of intelligence has been that variance in an individual's IQ is an effect of hereditary. In 1996, a committee of leading psychologists concluded that up to three quarters of the variance in IQ is genetic. With the discovery of the Flynn effect and other studies, this began to be questioned. Flynn and Dickens (in Viadero, 2002: 8) argue that "people match their biological gifts to their environments. Since genetic differences are persistent, that tendency creates a 'multiplier' effect that makes genes seem more important than they really are in determining intelligence". This effect suggests that those who believe in genes or environment are both right: "Genes working through environment account for the lion's share of individual differences in IQ, but only because genes lead you to certain life experiences, which collectively form your 'environment'. According to Begley & Springen (2001), this same environment cultivates differences in IQ.

The authors draw an analogy with basketball skills, explaining how, when those born with genes that make them taller and faster enter school, they are more equipped to be better at basketball. When you are better at it, you will enjoy it more and play it more. This will in turn make you excel at it. The same thing can happen on a societal scale: when it becomes more popular, more people will play it. Those who wish to excel at it will work harder at it. Since actual 'basketball' genes do not improve between generations, the environmental 'trigger' – its' increased popularity – will have a big impact on performance.

Thus, intelligence or IQ works in the same way: "The environmental trigger could simply be that a complex, technological driven, urbanised society demands more of the skills that intelligence tests are good at measuring: spatial organisation, problem-solving, lateral thinking" (Viadero, 2002: 8). This questions the controversial belief that genetic variance is the result of the IQ gaps in black-white scores, because if a group has inferior performance this does not mean it cannot be improved. The authors also explain how this theory also clarifies why the IQ progress poor children placed in Head Start programs make, diminish once they enter secondary school: "Isn't it amazing that once they're tossed back into the environments in their ghetto schools that those gains seem to disappear?" (Flynn, in Viadero, 2002: 8).

Thus, the authors do not state that genes do not influence intellectual development, rather they say that genes impact on the environment, at the same time that the environment is impacting on genes. With the numerous changes occurring in the environment worldwide, demands are placed and impacting on intelligence, creating a generational increase in IQ.

IQ and achievement

Sternberg, Grigorenko & Bundy (2001) state that psychologists believe that the intelligence quotient (IQ) is the greatest predictor for effectively all criteria that will lead to success in life. Research aims to study the predictive validity of IQ tests, target occupational and educational outcomes. Deary, Strand, Smith and Fernandes (2007: 13) state that if firm evidence can be found to show that IQ scores predict real-world success, it will have much significance on both a theoretical and practical level and "would justify the use of such tests as... selection tools".

The Relationship between IQ Scores and Educational Attainment

Educational achievement plays an important role in determining future opportunities, in relation to what choices one will be able to make, and which one should eliminate. Laidra et al. (2007) argues that while many factors are related to achievement, the most important are intelligence and personality. Research indicates that cognitive and personality variables must both be considered when attempting to foretell school performance, that is, using only one of these variables will be insufficient.

About the relationship between IQ and achievement, they argue the following: First, it has been repeatedly shown that the average correlation between IQ scores and achievement is around 0.5 which may vary depending on measures. Second, this correlation declines with age; it is higher in primary school than in middle school and college. Their study proved both of these to be correct, and they concluded that intelligence is the "best single predictor of academic achievement in all grades...

[However] the prominent role of intelligence... in predicting academic achievement agrees that any kind of success is a result of ability and effort" (Laidra et al. 2007: 4). Even after 100 years of studying the correlation between IQ scores and education – beginning with Binet's broad study in 1905 – Deary et al. (2007) assert that there is a need for a definitive study using multiple cognitive tests as predictors and multiple education outcomes. Their 5-year longitudinal study uses approximately 70000 children and found that there is a large overall contribution of general mental ability to educational attainment: cognitive ability tests that were administered to children at age 11 correlated 0.81 with the national school examinations they took at age 16.

A student with an average score on the cognitive ability tests had a 58% chance of attaining 5 exam scores between A and C. In addition, a student with one standard deviation higher on their ability test had a 91% chance of attaining 5 exam scores between A and C. The strengths of this data are as follows: the sample was large and representative, the test used had 10 individual subtests, timing of the study, it' longitudinal nature, and the correlation of test scores with national exams. A major weakness of the study however was the lack of data on family background and environmental factors. The authors concede this and state that both are important in examining correlations as well as differences between IQ scores and educational attainment (Deary et al., 2007). They do still conclude that their study establishes the validity of *g* for educational attainment as a life outcome.

Colom & Mendoza (2007) state that although the correlation between intelligence and achievement is generally around 0.50, there is a large methodical variation between different studies. The authors cite Jensen (1980) who gives many causes for this. First, because individuals in higher education are more restricted in their range of ability than primary and high school children, such samples have lower correlations (0.30-0.40) than the latter samples which produce higher correlations (0.50-0.70). Second, the reliability of the different criteria used to measure achievement is problematic; scores of grades assigned by teachers are more prone to bias than scores on objective tests. Third, correlation between intelligence and achievement are higher with tests that measure abstract subjects such as science and maths because of the hierarchically-ordered complexity and skills and knowledge required in such subjects. Fourth, correlations are higher when students are uniformly exposed to intelligence tests with a range of topics; tests that fail to measure a range of subjects' decreases correlation.

Sternberg et al. (2001) state that due to the lack of an ideal data set, a study with a truly representative sample linking academic achievement to IQ scores has not been carried out. Psychologists use certain corrections to make up for the lack of an ideal data set. One such correction is done on the correlations for attenuation – the unreliability of measurements.

When making corrections, three things need to be considered: the coefficient attained after corrections describe a situation that does not exist in practice, it is for an ideal, not an actual, measurement situation; corrections make psychometric assumptions that cannot be met in practice; and, the correction is less likely to be accurate when a greater correction is applied. Another correction is for restriction of range. This occurs when there is a problem with the distribution of grades, when participants have a narrow range of abilities, and when using specialised groups. In these situations, correlations between intelligence and achievement may be low because other factors like motivation need to be considered as they are more important in predicting performance. Thus, such corrections should not be made blindly.

The relationship between IQ and educational achievement is not one-sided, it is bidirectional: variations in one variable causes variations in the other (Ceci & Williams, 1997). Sternberg et al. (2001: 7) state: "IQs respond to adequate intellectual challenges and grow as an outcome of successful educational experiences". An extra month in school increases an individual's IQ, compared to the individual who has dropped out of school. IQ will also determine the educational opportunities that a person will or will not pursue. It was found that in particular IQ scores is the best predictor of whether or not one would decide to attend universities; and that just one IQ point can lead to an individual deciding to remain in school longer.

On the other hand, IQ itself may not be the reason for this, the reason could be the opportunities afforded to those with higher IQ scores. The decision to remain in school or pursue tertiary education may not be a direct result of IQ but the result of individuals and institutions who value those who have higher IQ scores, and give them opportunities that others do not receive.

Two additional factors that are influential in increasing, decreasing and understanding the strength of the relationship between IQ scores and educational attainment are self-efficacy and self-discipline (Sternberg et al., 2001; Duckworth & Seligman, 2005). These beliefs assert that intellectual strengths (memory, abstract thinking, information processing) and non-intellectual strengths (motivation, self-efficacy, self-discipline) are essential in predicting performance and educational achievement. Sternberg et al. (2001: 8) states that self-efficacy – the belief in one's ability to succeed – is a requirement for success, and is also closely linked to cognitive development. They discuss research that discerned that "children's belief in their ability to regulate their own learning activities and master difficult subject matter affect their academic motivation, interest, and scholastic achievement" .

In addition, high parental efficacy of children's achievement and high involvement has a positive effect influencing children who then achieve higher educational success. Together, children's self-efficacy, parental self-efficacy as well as (dis)engagement and other types of efficacy account for 58% of the variance in academic achievement, without IQ scores. Thus, the strong predictive success of IQ in terms of academic achievement is possibly a result of "the feelings of self-efficacy that IQ creates in those who have more of it" (Sternberg et al., 2001: 8). Duckworth & Seligman (2005) actually found that self-discipline is a stronger predictor of academic achievement than IQ.

In their high test-retest reliability study, they found that the "correlation coefficients between self-discipline and most achievement indicators were significantly higher than and at least twice the size of correlations between IQ and the same outcomes". For example, the correlation between self-discipline and grade-point average (GPA) was 0.67 while the correlation between IQ and GPA was 0.32. Sternberg et al. (2001) warns that such results must be interpreted with care. Non-intellectual strengths like self-efficacy and self-discipline may be a result of or be affected by a person's IQ, abilities, achievements, and motivation, thereby influencing IQ scores and educational achievement.

The Relationship between IQ scores and Occupational Attainment

When considering the relationship between IQ scores and occupational attainment, when one speaks of occupational attainment a range of issues as well as other types of

achievement come into effect, including but not limited to, income and wealth, career or socioeconomic success, training success, job performance and occupational status or prestige.

The Relationship between IQ and Occupation

Raymond Cattell (1941)

In the process of vocational guidance, essentially one is attempting to find a key that fits in a lock. So in processes of personnel selection, besides physical qualities, mental qualities such as IQ, scholastic achievement, and specific aptitudes are also considered. While some people may have the aptitudes, abilities, and interests for certain occupations because occupations require a certain combination of qualities in an individual if they are to be successful in the occupation, and there are tests that are available to measure these qualities, this is only the key.

The lock itself – the occupation – still needs to be understood. Cattell (1941) cites Burt who classified occupations according to IQ scores. Burt's classification is as follows (Cattel, 1941: 623):

IQ 150+ Higher professional and executive positions – doctor, lawyer, architect, chartered accountant, large business executive, editor

IQ 130-150 Lower professional and large commercial positions – accountant, dentist, bank official, school teacher, social worker, reporter, buyer

IQ 115-130 Clerical, technical and highly skilled work – bookkeeper, small merchant, insurance agent, nurse, tool-maker, foreman, shorthand typist, office clerk

IQ 100-115 Skilled work – tailor, bus driver, farmer, routine typist, shop assistant

IQ 85-100 Semi-skilled repetitive work – barber, miner, painter, postman, shoemaker

IQ 70-85 Unskilled repetitive work – labourer, loader, packer, farm-hand, deliveryman

Cattel's (1941: 524) own study of the IQs of adults in various occupations came up with a similar distribution in terms of the fit of certain occupations within specific IQ ranges. Cattell (1941) states that the demands an occupation makes is in line with a person's character and intelligence. In terms of selection, an objective method would first compare the qualities of (un)successful people in an occupation, and then study IQ levels needed for that occupation.

Arthur Jensen

Jensen (1969: 8) states: "The evidence for a hierarchy of occupational prestige and desirability is unambiguous" and to this effect discusses three scales. First, psychologists that developed the Barr scale in 1920 listed 120 occupations that are rated on a scale from 0 to 100 according to intelligent required for success in the occupation. Second, the National Opinion Research Center (NORC) in 1964 developed the prestige ratings of a number of occupations relative to others, from a public opinion poll. Third, a SES rating assigns 100 occupations a score from 0 to 96 according to the income and education level for each occupation. Correlations between the ratings ranged from 0.81-0.91.

Thus, Jensen (1969: 8) states: "Psychologists' concept of the 'intelligence demands' of an occupation (Barr scale) is very much like the general public's concept of the prestige or 'social standing' of an occupation (NORC ratings), and both are closely related to an independent measure of the educational and economic status of the person pursuing an occupation". Therefore, the *prestige* hierarchy of occupations is a reality in society, despite the income and acclaim of an occupation.

Jensen (1969) cites an interesting study by Duncan (1968) that found that intelligence plays a role in terms of differential earnings: individuals earnings are determined by one's mental ability, or IQ. For Jensen, the importance of IQ scores is that it decides which individuals will fulfil which occupational roles. This is in accordance with Cattell's and Burt's ideas. Here it is reiterated what was discussed in the first section: Jensen's belief that the less intelligent remain at the bottom of the SES hierarchy, while the more intelligent are higher in the SES hierarchy. Jensen (1969: 46) regards the occupational hierarchy (in terms of occupational types) as an "intellectual screening process" that works along an "intelligence continuum".

A Related Study- Ree and Earles

Across jobs, Ree and Earles (1992) correlated the positions individuals held in the army with the jobs they had before the army and it was found that those with highest position had the higher IQ scores and had held jobs in accounting, medicine and engineering. Those with average positions had average IQ scores and held jobs as electricians, police men and meat-cutters. Finally, those with lowest positions had the lowest average of IQ scores and held jobs as labourers, farm workers and lumberjacks. IQ scores decreased when jobs moved from being cerebral to physical, and from abstract to concrete (Ree & Earles, 1992). Thus, as Jensen (1969) states, there is much dispersion in IQ scores across occupations. As you move from higher-skilled to lower-skilled occupations, IQ scores generally decrease.

B J Swanepoel

Such classifications and rankings of IQ and jobs as the ones developed by Burt, Cattell and Jensen are not outdated in present times. They are still very much in use. Swanepoel (1998) discusses job ranking and classification similar to the above. Job ranking entails judgement of a jobs importance and its subsequent arrangement in a hierarchy. Job classification is the fitting of groups of jobs into grades or classes. The point method assigns point values to the degree to which certain factors correspond to a job. The points are then converted to pay or income for each job. Examples of such systems – widely used in South Africa – are the Paterson Decision Band, Peromnes system, and TASK grades.

A visual display of the Paterson will show how these correspond with previous classification methods in Fig.1 below:

Band	*Decision/Task*	*Skill*	*Title*
F	Policy-making/ Strategic	Top management	President, managing director, vice president, executive director
E	Programming	Senior management	General manager, works manager
D	Interpretive/	Middle management	Dept/section manager, superintendent
C	Routine/specialised	Skilled	General foreman, artisan
B	Automatic/	Semi-skilled	Chargehand, apprentice, machine op.
A	Defined/basic	Unskilled	Labourer

Fig.1

Source: (Swanepoel, 1998: 522)

The Peromnes system evaluates jobs in terms of eight factors: problem-solving, judgement, pressure of work, knowledge, job impact, comprehension, educational qualifications required, and training/experience required. Here, one can see how many aspects of intelligence are accounted for. Following this, complexity and requirements of jobs are assigned to factors and job levels (or skills) like the Paterson system. Then, the job skills/levels are assigned grades between 1 and 19. A graphic representation follows in Fig.2 below:

Job level	Paterson Band	Task grade	Peromnes grade

Unskilled	A (A1-A3)	1-3	16-19
Semiskilled	B (B1-B5)	4-8	12-15
Skilled	C (C1-C5)	9-13	8-11
Lower/middle mgmt	D (D1-D5)	14-18	5-7
Senior mgmt	E (E1-E5)	19-23	2-4
Top mgmt	F (F1-F5)	24-28	1++, 1+, 1-2

Fig.2

Source: (Swanepoel, 1998: 527)

The above systems of grading and ranking are used in many organisations in South Africa. Once a person is graded and placed at a job level, their income is decided from this. Because these are skills- and knowledge-based pay systems, the person, instead of the job, is the basis for pay. That is, jobs are grouped in terms of the skills required for that job. New employees are paid an entry level rate and this is increased once they gain additional skills and knowledge.

Despite the problems with these evaluation systems – its' scientific management roots, and its actual relevance in a changing global context and organisational structure – Swanepoel (1998: 528) argues that they will "remain an essential element of compensation practices for some time to come" and they have. From a pay survey, the organisation develops a pay structure whereby the pay an employee receives relates to single jobs, groups of jobs and grades. However, the grade system is most common. As grade increases (or decreases in Peromnes) salaries increase.

Perhaps a direct link needs to be made between this and intelligence. From this article, it has been argued that as a result of a person's genes, environment, or an interaction of genes and environment, each individual has a level of intelligence that may be malleable according to their circumstances or may not be malleable if intelligence is genetic. This intelligence will determine the years of schooling a person has (or vice versa), the further education they may (or may not) seek, and the qualifications they will (or will not) receive. As a result of all this, a person develops a skills and knowledge base that will be evaluated once they enter the labour arena, by means of – for example – an IQ test.

The IQ test and other job selection methods will evaluate and judge a person in terms of their IQ scores and other results and will then classify them into the complex interplay of a job level or skill, tasks required within that job, and the grading and band within that level. In terms of how they fall within the system (for example: skilled with routine/specialised tasks, artisan, C3, peromnes grade 10/task grade 11), the compensation they receive in terms of income will be decided. Therefore, a person with a higher IQ score would have greater occupational achievement, being placed higher up in the hierarchy, and thereby receiving a higher income.

IQ Scores, Career Success and Occupation Attainment

Decades of research on IQ scores have found that IQ scores are positively correlated with many desirable outcomes. According to Strenze (2007: 402), one of the most significant of these is "socioeconomic success (or career success)... The scientific research on the topic leaves little doubt that people with higher scores on IQ tests are better educated, hold more prestigious occupations, and earn higher incomes than people with lower scores". However, that there exists an overall positive correlation between career success and intelligence seems to be the only established fact. Left behind are many questions concerning the size of the correlation, the predictive power of IQ, and the effect of age and context on the relationship (Strenze, 2007). To answer such questions, Strenze (2007) states that it is important to consider longitudinal studies, as such studies which measure intelligence before the actual success, and therefore allows one to make causal statements of the effect of intelligence on success.

Hernstein and Murray (1994) brought into light the question of the relationship between intelligence and career success with *The Bell Curve*. The authors concluded that "the role of intelligence in status attainment has been growing throughout the 20th century and... the social structure of American society is increasingly based on mental ability" (Strenze, 2007: 403). But the ideas posited in *The Bell Curve* have been widely criticised for using inappropriate measures of parental SES thereby underestimating its importance in the relationship with intelligence, and for misinterpreting previous research creating unstable conclusions.

However, other researchers have supported and confirmed these ideas. Strenze's (2007: 416) study, although modest, confirmed that: "Intelligence is an independent causal force among the determinants of success... the fact that intelligent people are successful is not completely explainable by the fact that intelligent people have wealthy parents and are doing better in school".

The above study is of interest for a number of other conclusions. First, IQ scores of older individuals are better predictors of success, either because older individuals are experienced or have greater genetic influence; or that the IQ scores of younger kids are less reliable and have less predictive power. Second, correlations with income and occupation became stronger as individuals grew older. This confirms the belief that as people grow older, intelligence accumulates, leading people to social positions (occupation) corresponding to their intelligence. In addition, the declining validity hypothesis "received no support for occupational and income attainment indicat[ing] that being successful in these areas is a complex activity that never ceases to be cognitively demanding" (Strenze, 2007: 416).

Schooling, IQ and Occupational Attainment

Ceci and Williams (1997) describe a relationship where more schooling relates to higher income (and career success). Individuals with more schooling are more intelligent and have higher IQs than those with less schooling. As a result they are more successful in careers and earn a higher income. Intelligence has both direct and indirect economic benefits.

First, indirectly it affects income because more intelligent workers are paid more for the skills they display during training and on the job. Second, directly more schooling provides the applicant with the minimum intelligence level required to enter into jobs. If intelligence is controlled in the relationship between schooling and job success, very little of the variance in job success (0.0-0.2) can be explained by schooling. One can therefore infer that intelligence, depicted by IQ scores, is a predictor of occupation achievement, in terms of job success and income. Ceci & Williams (1997: 1052) summarise as follows: Students who possess higher IQs are given more attention by teachers and students, thereby reinforcing "students' decisions to remain in school, where they may acquire more job-related skills and better entry-level credentials. Also, because they are more intelligent, they often will do better in future jobs than will their less intelligent peers. Thus, the relationship between intelligence and income and job success is influenced by the relationship between schooling and intelligence. But, there are many other variables that need to be considered when studying this relationship.

IQ Scores, Employment and Wealth, Parental SES and Schooling

Sternberg et al. (2001) question how IQ scores, obtained prior to entrance in the workforce, predict employment and wealth, by way of parental/family SES and amount of schooling. Parental SES accounts for 30% of the variance in young adults SES and 20% of the variance in their income. Half of this predictive power however is due to the link between parental SES and young adults' IQ. IQ predicts 25% of the variance in SES and 15% of the variance in income. When controlling for parental SES, the predictive power of IQ decreases by 25%.

Jencks (1979, as cited in Sternberg et al., 2001) describes a scenario of two brothers who grew up in the same family. If their adult SES was compared, the brother with the higher IQ would have higher adult SES and higher income. Still, this relationship is mediated by schooling. Even though when one controls for IQ, only 2% of the variance in adult SES is accounted for by schooling, higher IQ generally means a person would have more schooling which in turn raises a person's IQ. Schooling provides a person with a path to certain high-paying jobs, and in turn higher SES and higher income. Sternberg et al. (2001: 9) state: "IQ seems to be predictive of all steps of career life in a stable society... schooling is valued and rewarded, income is scaled in rough correspondence to years of education, and highly skilled labour is needed". In countries just developing or in turmoil, research on this is scarce.

Conclusion

Fergusson, Howard and Ridder (2005) carried out a 25-year longitudinal study of over a 1000 children. They used four verbal and four performance subscales of Revised Weschler Intelligence Scale for Children (WISC-R) to measure child IQ on 8 and 9 year old children. The reliabilities found were 0.93 for 8-year olds and 0.95 for 9-year olds. The authors found strong associations between IQ scores measured in middle childhood and school and vocational qualifications, university entrance and employment and income.

They concluded that at age 25, a higher IQ is related to increasing educational success, higher rates of post-school educational/vocational attainment, degree success, lower rates of unemployment, and higher income. Interestingly, they also found that "statistical control for a wide range of factors including early conduct problems and family, social and childhood circumstances failed to explain these associations, supporting the view that intelligence has a direct relationship to later educational, occupational and related outcomes independently of other childhood characteristics and family environment" (Fergusson, Howard and Ridder, 2005: 15).

Conversely, Weinberg (1989) states that the use of IQ scores as the foundation for making educational, occupational and other similar decisions for individuals and their future needs to be discouraged. Scores must take cognisance of a person's context, their behaviour in and outside of a particular environment as well as the other options available to them in their broader environment. Educational and occupational achievement cannot alone be predicted using IQ as a basis. IQ scores must not be used to design remedial programs, instructional designs, or similar prescriptions or to make potential future-altering decisions.

Weinberg (1989 102) states: "As IQ tests are used to guide placement decisions, parents, educators, and others contributing to these judgements should be well informed and should understand the technical characteristics of the testing tools as well as cultural and racial/ethnic background characteristics". This is because IQ relies too much on academically learned content and does not cover the full range of an individual's intellectual competencies including the ability to use personal and environmental resources to adapt to surroundings (Ree & Earles, 1992).

In the educational context, besides IQ, a child's motivational history, personality, behaviour external to the classroom and other similar factors would offer an encompassing prediction of the child's possible educational achievement. In the organisational context, employers are advised to use other selection instruments in addition to intelligence tests, such as other types of tests (personality, aptitude, interest), biographical data, interviews, role-playing and case-studies.

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