Second Edition

An Introduction to Personality, Individual Differences and Intelligence

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SAGE

Los Angeles | London | New Delhi
Singapore | Washington DC | Melbourne

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First edition published 2007

Reprinted 2008, 2010, 2011 (twice), 2012 (twice), 2013, 2015 (thrice)

This second edition published 2017

13 Intelligence in Everyday Life

Learning objectives

- To develop an understanding of the contribution of intelligence to behaviour and outcomes in everyday life.
- To understand the mechanisms through which intelligence may influence life outcomes.
- To understand the challenges of researching intelligence within different domains of life.
- To know the direction of causality and conclusions that can be drawn from studies in the area.

The previous chapter showed that intelligence has played an important part in the development of psychology as a discipline. The chapter explored the structure, assessment and biological foundations of intelligence, but it did not answer the more applied question of how important intelligence is to our everyday life. That is the focus of our discussion in this chapter. More specifically, the discussion will revolve around a review of the contribution of intelligence to behaviour and outcomes in different domains of life. We hope you will have a greater appreciation for the importance of intelligence in everyday life by the end of this chapter.

This chapter will demonstrate that intelligence is fundamental to meeting many of the challenges of everyday life. We may not be conscious of its importance until new demands are made on our ability to perform a task or when we see someone else struggling with some aspects of their lives, for example coping with the effect of brain injury following a motor vehicle accident. Tasks that were originally easy to perform become a lot more difficult and demand extra effort. It is worth highlighting that when we discuss the importance of intelligence, this 'importance' refers to its role in achieving the particular goals that are valued by our society (Gottfredson, 1997b). Therefore, the value placed on a concept such as intelligence is bound by its context. Indeed, intelligence is a concept that is closely tied

to cultural, social aspects of life (Sternberg, Grigorenko, & Bundy, 2001). As a result, the interpretation of what is a successful outcome in life, as a result of intelligence, ought to be considered within the context of that culture. That which is considered successful or important in one culture or society may not be so in another.

Intelligence tests: Their use and predictive validity

We cannot examine how functionally important intelligence is in everyday life without having a means of assessing it and without conducting research to find out whether intelligence assessments predict things that matter. In the previous chapter you have been introduced to the different types of tests that have been used to measure intelligence. The practical usefulness of these tests in real life will be the focus of our discussion in this section.

The use of IQ tests has been controversial and can be an issue of concern for different reasons. Concerns have been expressed about their fair use and how their results should be interpreted. Whether IQ test scores adequately represent the concept of intelligence has also been challenged. We often hear students critique a particular intelligence test by saying it does not seem to resemble the challenges presented in everyday life, thus questioning its 'ecological validity'. (We will discuss this critique later in the chapter in a discussion about intelligence and job complexity.)

Despite these concerns, intelligence tests are widely used to make important decisions, and they have been applied in many different settings. In education, they are used to inform the educational psychologist of students' relative strengths and weaknesses in order to plan an intervention programme if they are not performing academically as well as expected. In clinical or neuropsychological settings, intelligence tests are used to gauge the extent of deterioration of cognitive function following a traumatic brain injury, for example. Such an assessment of intelligence would assist in designing rehabilitation programmes or to manage the person's cognitive deficits. In organizational psychology contexts, intelligence testing may be used to assess job candidates' capacities to handle cognitively taxing work roles.

In addition to these examples of how intelligence tests can be deployed, they are used in research to examine relationships between people's level of intelligence and other facets of their life. One of the ways of doing this is to find out how well intelligence, as measured by an intelligence test, can predict life outcomes. For example, the importance of intelligence can be investigated by examining how well a group of individuals' intelligence test scores correlate with job performance. If intelligence scores predict job performance well, then there is evidence that intelligence contributes to explaining job performance, and thus showing the value and practical importance of intelligence as a concept.

The predictive capability of an intelligence test can be expressed by what is known as a criterion (or outcome) validity coefficient. This measure of predictive validity is measured by a correlation coefficient (see Chapter 2), which shows the strength of relationship between two scores – an IQ test and a supervisor's rating of job performance, for example – on a scale

of −1.0 to +1.0. The closer this coefficient is to +1.0, the stronger the positive relationship between the two scores, showing the importance of intelligence in predicting the outcome (Gottfredson, 1997b). Validity coefficients can be generated from cross-sectional studies which measure intelligence and a life outcome at the same time. These are limited in the conclusions they can draw as they cannot show that one variable is causally responsible for the other (e.g., that high intelligence causes superior job performance). Validity coefficients can also be derived from longitudinal prospective studies, which measure intelligence early in life and correlate these measurements with life outcome scores later in life. This research design is less limited and provides stronger evidence on the causal relationship between the two variables. For example, it eliminates the possibility of 'reverse causality': the possibility that the positive life outcome causes high intelligence. In the absence of time travel, adult job performance cannot cause childhood intelligence. Longitudinal prospective studies can therefore provide strong evidence that intelligence is not only validly associated with life outcomes, but also that it is at least partially responsible for these life outcomes.

In the next section, we will discuss the relationship between intelligence, typically indexed by IQ scores, and life outcome measures.

Domains of life

There have now been many decades of research exploring the validity of intelligence tests as predictors of a wide assortment of life outcomes, across many domains. Intelligence has been found, through a meta-analysis of 85 data sets, to be a powerful predictor of success in education, occupation, and income (Strenze, 2007). For example, in Poland, IQ score at as young an age as 13 has been found to be a good predictor of life outcomes such as education level attained, occupational status, and financial outcomes such as family income, at age 36 (Firkowska-Mankiewicz, 2011).

The main areas that we will discuss in this section are academic achievement, work, money, and health. Before doing that, it is good to recognize that there are also other areas where intelligence research has been conducted. For example, intelligence has been found to be related to fertility indicators such as birth rate (Shatz, 2008); suicide rate (Voracek, 2004); crime indicators such as frequency of imprisonment (Levine, 2011); habitual illegal drug use (White, Mortensen, & Batty, 2012); psychosocial adaptation such as bullying behaviour (Huepe et al., 2011); juvenile offending (Moffitt, Gabrielli, Mednick, & Schulsinger, 1981); and risk and severity of mental disorders (Macklin et al., 1998). Understanding effects of intelligence on these life domains is the focus of an area of study known as cognitive epidemiology, which examines the implications of cognitive ability at a population level.

Academic achievement

There is a strong relationship between schooling and intelligence. This relationship appears to be causally complex: higher intelligence is partly responsible for positive schooling

outcomes, and schooling has an effect on intelligence. Research has shown for quite some time now that not attending school for an extended duration can have a detrimental effect of up to 2 standard deviations in IQ scores (Nisbett et al., 2012). There is a strong relationship between IQ and the total years of education too, such that childhood IQ predicts the total years of education that people undertake (Neisser et al., 1996).

One of the clearest schooling-related correlates of intelligence is academic performance. Replicating Binet's original insight, it seems that aptitude for school, as measured by tests such the American SAT, simply is general intelligence, g (Frey & Detterman, 2004), and that g predicts school grades better than any other measure apart from the student's previous year's grades. Over the years, and across many studies, validity correlations between .30 and .70 have been reported for the relationship between intelligence and academic achievement (Roth et al., 2015). A recent meta-analysis of 162 studies published between 1922 and 2014, which included 105,185 participants drawn from 240 samples from 33 different countries, showed a correlation coefficient of 0.54 between IQ and academic achievement. The meta-analysis also found that the relationship between IQ and academic achievement was strongest when the IQ measure incorporated both verbal and non-verbal tests, demonstrating the importance of general intelligence, g. Other results from this study include the finding that intelligence seemed to become more important as school grade level increases, suggesting that as the complexity of the learning material increases, intelligence level seemed to become more important too. In terms of subject areas, intelligence is most strongly related to performance in subjects which have a clear logical structure, such as mathematics and science (Roth et al., 2015).

It is important to remember here that the correlation between intelligence and academic achievement cannot be interpreted in a simple cause-and-effect manner. The correlation between intelligence and academic achievement does not necessarily mean that intelligence is causally affecting achievement in a one-directional way, as the intelligence–academic achievement relationship is reciprocal. For example, educational interventions that promote academic achievement can affect intelligence, as shown by early childhood education intervention programmes such as the American Head Start initiative (Puma et al., 2010), which was described in Chapter 12.

Although the relationship between intelligence and academic achievement may be complex, it is undeniably strong. The Roth et al. (2015) study implies that almost 30% of the differences between people in academic achievement are related to IQ. However, this leaves over 70% of these differences unexplained by intelligence. Other factors that might account for some of the missing 70% are random influences on academic achievement, such as measurement error, and environmental factors, such as opportunities or encouragements provided to individuals, their beliefs that they can succeed, and their parental expectations (Sternberg, Grigorenko, & Bundy, 2001). Additional factors that influence academic achievement include motivation, school anxiety (Roth et al., 2015), and personality traits such as Conscientiousness (Di Fabio & Busoni, 2007), Openness to Experience and Agreeableness (Farsides & Woodfield, 2003). When intelligence, personality and **emotional intelligence**

(to be discussed in Chapter 14) were investigated together in a study of high school students (Di Fabio & Palazzeschi, 2009), they all independently predicted academic achievement. Intelligence was responsible for 10% of students' differences in achievement, compared to 7% for emotional intelligence and 5% for Big Five personality traits. Therefore, although it is important to acknowledge the contribution of other factors, intelligence remains a major contributor to academic achievement.

The remainder of this section provides a snapshot of the intelligence–academic achievement relationship examined over an assortment of student groups, ranging from primary school pupils to postgraduate university students. In a longitudinal study of mid-childhood students (age 8–9), which is part of the Christchurch Health and Development Study in New Zealand, students' IQ scores were measured using the Wechsler Intelligence Scale for Children and a range of life outcomes variables, including academic success, were assessed when they were aged between 15 and 25. There was a strong and statistically positive correlation between childhood intelligence and adolescent and young adult academic success. The higher the IQ, the higher their qualifications attained, including university degree qualifications. When statistical analysis was applied to control for factors such as early childhood conduct problems and family circumstances, the relationship between IQ and academic success remained, showing that intelligence and academic outcome are associated even when these other potential contributors to academic achievement were taken into account (Fergusson, Horwood, & Ridder, 2005).

Another longitudinal study conducted in the United Kingdom (Deary, Strand, Smith, & Fernandes, 2007) examined 70,000 11-year-old children, who were administered a reasoning ability test, from which their general intelligence (g) was calculated. Their academic achievement was measured at age 16 based on performance in national examinations that determine which students could pusue further education or training. The relationship between g and academic achievement was a very strong correlation of .8. Children who achieved an average score on the intelligence test had a 58% chance of obtaining exam results that would qualify them for further education, which increased steeply to 91% chance if the student had a cognitive ability test score that is 1 standard deviation higher than the average. Together, these striking findings show the large contribution of intelligence to academic achievement in a large study that is representative of a cohort of students in a single country.

Turning from a study of 11-year-olds to a study of a sample of late teenagers, Di Fabio and Busoni (2007) investigated the relationship between fluid intelligence, personality and end-of-year academic results among 17- to 19-year-old high school students. Fluid intelligence was the strongest predictor of academic achievements, although the personality trait Conscientiousness also did so, probably in part because it contributes to diligence, organization and good study habits. At university level, a meta-analysis of 127 studies, comprising 20,352 university students, examined whether performance on the Miller Analogies Test (MAT) predicted academic performance later in the student's degree. The MAT is an analogy test – its items take the form 'A is to B as C is to ?' – that measures a combination of g and verbal ability. Scores on the MAT were found to be associated with early academic performance

soon after being admitted into an undergraduate course, and also to behaviours and outcomes later in the course (Kuncel, Hezlett, & Ones, 2004).

Beyond undergraduate degrees, individuals who, by the age of 13, scored in the top .01% on the SAT, a cognitive ability measure used in the USA for selection into university, showed that 51.7% of male participants and 54.3% of female participants had a doctoral-level qualification. Impressively, this is a 50 times higher rate than the 1% expected of the general population. There were also more of these individuals (21.7%) who later managed to secure permanent academic positions in the top 50 US universities as full professors compared to 6.5% of another highly capable 'control' group (Lubinski, Benbow, Webb, & Bleske-Rechek, 2006). Therefore, intelligence can predict academic success and qualifications even beyond undergraduate degree qualifications.

The world of work

The relationship between IQ and academic performance may not seem surprising. After all, IQ tests were initially designed to be relevant in the context of schooling and they are clearly related to academic skills. However, intelligence also has the capacity to predict outcomes in non-academic domains. For example, performance at work has been repeatedly shown to be best predicted by general intellectual ability (Gottfredson 1997b; Ones, Viswesvaran, & Dilchert, 2005; Ree & Earles; 1992). At work, across a range of occupations, the validity of intelligence as a predictor of eventual job level attained, job-related training performance, and actual job performance is in the high .40s–.50s range (Schmidt & Hunter, 2004). Validity coefficients as high as .74 have been reported (Ones et al., 2005). IQ also appears to be strongly predictive of performance in job training programmes as well as in jobs themselves, with researchers finding validity coefficients ranging from .30 to as high as .70 (Ones et al., 2005).

Since the 1970s, researchers have gone beyond merely documenting the strength of the relationship between intelligence and job performance and explored the relationship between different occupational *types* and intelligence. They examined how strongly ability test scores predicted job performance in various occupations. Initially, the validity coefficients were relatively low, with one even showing a negative relationship. However, when re-analyzed more appropriately, these coefficients increased in magnitude. Cognitive abilities were found to predict performance in managerial, and clerical jobs most powerfully, and to predict performance as a sales-clerk and vehicle operator least powerfully (Ones et al., 2005). High IQ scores were typically found in persons holding more 'cerebral' jobs that are thought to require more mental ability and abstract cognition (Ree & Earles, 1992), while lower IQ scores were reported in persons holding more physical and concrete jobs, such as labourer, farm worker, and lumberjack (Ree & Earles, 1992).

Research has also shown that intelligence predicts people's work trajectories. One longitudinal study (Wilk & Sackett, 1996) showed that within a five-year period, people with higher intelligence scores move upwards in the hierarchy of jobs, while those with lower

intelligence scores move downwards. This job movement was related to people's intelligence and also to the complexity of the job they held originally, such that if their intelligence level was deemed to be above the complexity level of their original job, they were likely to move upwards to a job that is more complex. This tendency for individuals to gravitate towards jobs that are commensurate with their ability has been dubbed the 'gravitational hypothesis' (Wilk, Desmarais, & Sackett, 1995). Could these tendencies to move up or to remain behind be due to other confounding variables, such as opportunities that were available, or the quality of school the workers attended? Apparently not. In another study where rigorous control of variables such as family background, schools, and socio-economic status was put in place, siblings who had higher intelligence test scores had more education and held more prestigious jobs than siblings who had lower intelligence scores. This also translated into income differences – siblings who scored 120 IQ points were earning US$18,000 more than siblings who had average (i.e., 100) IQ scores. In turn, these average IQ individuals earned US$9,000 more than their siblings who had IQ scores lower than 80 (Murray, 1998).

Why should intelligence be predictive of job performance? One explanation is that both variables involve learning. Intelligence relates to the ability to learn and job performance is dependent on the learning of job-related knowledge. While job knowledge is not the same as job performance, these two aspects are closely related. As Ones, Viswesvaran, and Dilchert (2005) demonstrated, intelligence becomes a better predictor of job performance as job complexity increases, consistent with the idea that high cognitive ability is especially important for learning to master the challenges of cognitively complex work roles.

Another explanation for the role of intelligence in job performance is that intelligence relates to the successful processing of complex information, not just the amount of knowledge that workers must acquire (Gottfredson, 1997b). For example, although the tasks included in IQ tests, such as describing how two concepts are similar to each other, may seem very far removed from everyday work tasks, it is the ability to handle and manipulate complex information that is being tested. In the IQ test, the ability to abstract the key attributes of both concepts may be easier in the first few items as they only require concrete thinking. However, as the concepts become increasingly abstract as the test progresses, the complexity in the processing of thoughts becomes more salient. In the world of work, this same ability to problem-solve or process complex information is required.

The success of intelligence as a predictor of work performance is an argument in favour of the use of intelligence tests in personnel selection. Intelligence tests are especially useful in this context because the intelligence measured is not specific to particular situations or job types (Schmidt, 1988). This means that with the increasing possibility of employees moving between jobs, the selection of a suitable candidate into one role is likely to translate into the future success of the same person in another role. This may bring long-term benefit to the hiring institution. However, a problem, especially in the US context, is that certain ethnic groups, such as African Americans and Hispanics, do not fare as well as other groups in cognitive tests relating to employment selection (Schmidt, 1988). Whether this is due in part to limitations or biases in the specific ability tests used, and what should be done about it, remains very much

unresolved. However, it is not self-evident or inevitable that selection using intelligence tests is intrinsically biased against particular groups. For example, using archival data of 4,462 male army recruits in 1986, researchers found that African Americans matched on intelligence level with Whites were not disadvantaged in terms of job status or income, at least in the group scoring higher than median of IQ in the total Black–White sample (Nyborg & Jensen, 2001).

Partly in response to concerns over IQ testing, Sternberg and Wagner (1993) advocated that tests of 'practical intelligence' should be used instead. These tests measure 'tacit knowledge', which involves information and skills that are not taught directly but relate to the know-how of how to succeed in a given job. Sternberg and Wagner (1993) reported that tacit knowledge predicts job performance moderately well and to a similar degree as conventional IQ tests (Sternberg & Wagner, 1993).

In an example practical intelligence test, participants rate the best options for dealing with 12 scenarios presented using a rating scale from 1 (poor solution) to 7 (excellent solution). An example of a scenario from the Sales domain is:

> You sell a line of photocopy machines. One of your machines has relatively few features and is inexpensive, at $700, although it is not the least expensive model you carry. The $700 photocopy machine is not selling well and it is overstocked. There is a shortage of the more elaborate photocopy machines in your line, so you have been asked to do what you can to improve sales of the $700 machine.
>
> Rate the following strategies for maximizing your sales of the slow-moving photocopy machine.
>
> _____ Stress with potential customers that although this model lacks some desirable features, the low price more than makes up for it.
>
> _____ Stress that there are relatively few models left at this price.
>
> _____ Arrange as many demonstrations as possible of the machine.
>
> _____ Stress simplicity of use since the machine lacks confusing controls that other machines may have.
>
> (Sternberg & Wagner, 1993, p. 4)

Thus far, we have only discussed the predictive validity of intelligence in the world of work but not whether intelligence makes a causal contribution to work performance. One piece of evidence supporting the causal role of intelligence comes from the study of military personnel in the USA. This is enabled because cognitive abilities are measured prior to military induction and training, thus minimizing the possibility of reverse causality, as mentioned earlier in this chapter. The majority of the personnel whose scores were at the higher end of the range successfully completed military training, whereas a substantially lower proportion of those who scored towards the lower end of the score distribution completed the training (Gottfredson, 1997b). In addition, training and the length of experience in the job did not

substantially increase job performance. Even when provided with training, individuals with lower IQ did not seem to benefit such that their performance becomes on par with the performance of higher IQ individuals. This shows the importance of intelligence and that it cannot be readily compensated through job training. The importance of intelligence is especially salient when the nature of the jobs is not routinized but required different information-processing ability (Gottfredson, 1997b).

It would be remiss not to discuss briefly other variables that relate to work performance. Although extent of work experience and personality traits such as Conscientiousness can predict some job-related performance measures, they do not predict as well as intelligence (Schmidt & Hunter, 2004). When emotional intelligence (see Chapter 14) is investigated together with general intelligence in relation to job performance as measured by supervisors' ratings, emotional intelligence and general intelligence play a compensatory role for the other. In other words, low general intelligence employees can perform their job satisfactorily if they have high emotional intelligence and vice versa (Côté & Miners, 2006). This compensatory relationship between emotional intelligence and general intelligence has also been observed in a study which required participants to attend a simulated job interview session. The performance of individuals with lower IQ was as good as individuals with higher IQ *if* these lower IQ individuals had high emotional intelligence (Fiori, 2015). Therefore, it is important to remember that there are other factors that may compensate for a shortfall in general intelligence. However, it remains true that general intelligence is the pre-eminent psychological predictor of job performance (Gottfredson, 1997b; Ones et al., 2005).

Money matters

We have seen that intelligence predicts both academic and job performance. It also predicts measures of economic success. In a meta-analysis, 85 data sets on intelligence and income that included samples from the USA, the UK, New Zealand, Australia, Estonia, the Netherlands, Norway, and Sweden were scrutinized (Strenze, 2007). A correlation of .20 was found between intelligence and income, a figure that is lower than typical correlations between intelligence and education (.54; Roth et al., 2015), and between intelligence and occupation (.43; Strenze, 2007). This relatively low correlation between income and IQ has also been reported by other researchers. Why would income be related to IQ? Higher IQ individuals may be likely to be paid more for the more efficient production of work (Lynn, 2010), and, as we have seen, they tend to occupy better-paying occupations and be more successful in obtaining promotions within their workplaces. The famous Terman study, which examined a sample of high-achieving individuals born around 1910, offers some insight, finding that IQ, together with personality, affects the income level of these individuals. The researchers showed that IQ and personality influence income level through educational choice, such as returning to study at postgraduate level. The additional knowledge and skills acquired by individuals with high IQ through further study are viewed positively by employers, leading to higher incomes (Gensowski, 2014).

Health, morbidity, and mortality

Although links between intelligence and academic, occupational, and economic success have been well established for many years, the idea that intelligence might have a bearing on physical health has only been examined relatively recently. However, there is now strong evidence that intelligence can predict even such a fundamental phenomenon as death. Intelligence has been shown to be negatively correlated with risk of mortality, meaning that low IQ scores are related to higher likelihood of death by a particular age. To put it another way, intelligence is related positively to longevity and physical health. This has been demonstrated prospectively by studies where children with higher IQ have lower risk of mortality in adulthood. In addition to mortality risk, childhood intelligence scores are negatively correlated with morbidity risk factors, such as the development of hypertension and the uptake and continuation of smoking (Batty, Mortensen, Nybo Anderson, & Osler, 2005). Research in the growing field of cognitive epidemiology (Luciano et al., 2010) is increasingly showing that a wide range of health problems are correlated with low intelligence, including obesity, alcohol consumption, lung and stomach cancer, and proneness to physical injuries (Der, Batty, & Deary, 2009).

In terms of specific diseases, a Danish study of 6,910 school-aged boys whose intelligence was assessed at age 12 years and followed up from age 25 to 35 years old, found that childhood IQ is negatively correlated with the risk of coronary heart disease in adulthood. This relationship persisted even when birthweight and social class, which were higher in higher IQ children, were statistically controlled (Batty et al., 2005). A few explanations have been offered for this relationship. First, the *disease prevention hypothesis* posits that higher intelligence is associated with a healthier lifestyle and higher socio-economic status (SES), which hinder the development of the disease. Intelligence may be an index of low rates of exposure to early psychological or physiological childhood events that predispose people to coronary heart disease, or its link to socio-economic advantage in adulthood may be a protective factor. Alternatively, higher intelligence early in life may be related to the acquisition of healthy behaviours, such as physical activity, good diet, and avoidance of smoking (Batty et al., 2005). A second set of explanations can be described as the *disease management hypothesis*. This hypothesis proposes that individuals with higher intelligence are better equipped to manage health problems that they suffer from. For example, intelligence may assist with early detection of health problems, accessing appropriate health care, and adherence to self-administered medication regimes, and these behaviours may play an important role in maintaining health (Deary et al., 2009). A third explanation, proposed by Gottfredson and Deary (2004), is that more intelligent people may suffer less disease because they are more likely to avoid unhealthy and unsafe environments and practices.

Some light on the pathways from intelligence to health is shone by a study on risk for cardiovascular diseases (CVD). The study of 1,145 participants (Batty, Deary, Benzeval, & Der, 2010) examined the relative importance of multiple risk factors for mortality as a result of CVD within a 20-year period. The researchers found that in decreasing order of importance, the risk factors were smoking, low IQ, low income, high systolic blood pressure, and low

physical activity. A second study confirmed that there is a significant correlation between low general intelligence, *g*, and CVD risk factors, especially heart rate, and reported that the intelligence–CVD risk factors association is mainly due to genetic rather than environmental causes. That is, intelligence and CVD risk factors are underpinned by the same genetic influences (Luciano et al., 2010). There is a clear need for research in this field to clarify the mechanisms underlying these remarkable associations between intelligence and cardiovascular disease.

It is often reported that obesity is negatively related to IQ. Although this appears to be true, the direction of causality is unclear. One of the criticisms for some of the research on this topic is that the conclusion made about obesity being linked to lower IQ are often based on cross-sectional design studies which do not allow for the direction of causality to be inferred: does high IQ protect against obesity, does obesity in some way inhibit the development of intelligence, or does some third variable account for the intelligence–obesity association? Some longitudinal studies do indicate that low IQ has some causal role in obesity. Typically, these longitudinal studies, conducted in countries including Sweden, New Zealand and the United Kingdom, have measured IQ when participants were young, and then followed them up with health indicator measurements in adulthood. By doing so, the intelligence levels of individuals have been captured prior to the development of adult disease (Kanazawa, 2014). One New Zealand study, in which 1,037 infants were tracked prospectively until they are 38 years old, found that obese adults tended to have lower adult and childhood IQ scores than non-obese adults. Obese adults showed no decline in IQ over time, indicating that lower IQ (since childhood) increases the risk of obesity, but obesity had no impact on IQ (Belsky et al., 2013).

There are other ways of investigating the relationship between intelligence and health. One way is to examine whether parents' IQ is related to their offspring's health and health behaviour. One study of 2,268 parent–offspring pairs (Whitley et al., 2013) used data from the National Child Development Study in Great Britain, health and health behaviour measures including sedentary behaviour of watching television, injuries treated at hospitals, illness not treated at hospitals, and body mass index. It found that the offspring of parents with higher IQ were less sedentary and less likely to have injuries requiring hospitalization. These findings indicate that parental IQ is related to their offspring's health and health behaviours, although because parental IQ is confounded with socio-economic status, part of the relationship may reflect the more hazardous and constrained living conditions associated with low socio-economic status.

Reverse causality can be an issue of concern in studies where somatic diseases such as hypertension may cause deterioration of intelligence rather than (low) intelligence influencing (unfavourable) health outcomes. Measuring childhood IQ and then following up people as adults can minimize this concern. A systematic review examined nine studies, conducted in Swedish, Australian, American, Scottish, Danish, and British samples, in which IQ was measured before the age of 24 and prior to the onset of disease. In all cases, IQ and mortality were inversely correlated, such that higher IQ was related to a reduced likelihood of early death (Batty, Deary, & Gottfredson, 2007). A systematic review and meta-analysis based on

an initial sample size of 1.1 million participants was conducted to examine the relationship between intelligence in childhood or youth and mortality during mid- to late adulthood. The results showed that for both men and women, with one standard deviation increase in intelligence, there was a 24% reduction in mortality risk (Calvin et al., 2011). This relationship appeared to be independent of childhood socio-economic conditions as indexed by parents' occupation or income.

Links between IQ and health may also encompass mental health. In the US National Longitudinal Survey of Youth 1979 (NLSY79), 12,686 participants were given a test of intelligence at age 14–21 and tests of depression and general mental and physical health at age 40. The intelligence measure was found to be related to a range of health outcomes, both mental and physical (Der et al., 2009). Once again, the measurement of intelligence well before the health outcomes strongly suggests that the relationship between them is not due to reverse causality (i.e., poor health giving rise to reduced IQs). Instead, low intelligence appears to confer a heightened risk of ill health.

ILLUSTRATIVE STUDY

Why lower IQ predicts earlier death

Scottish psychologists Ian Deary and Geoff Der (2005) set out to study explanations for the surprising finding that people with lower IQs tend to die younger, a finding that has been replicated several times. For example, an earlier study found that if two people had IQs that differed by one standard deviation, the person with the lower IQ was only 79% as likely as the person with the higher IQ to live to age 76. Remarkably, in that study IQ was measured at age 11, indicating that childhood cognitive ability predicts adult longevity.

Deary and Der examined whether the greater mortality risk of people with lower IQs might reflect their less efficient information processing. They studied a representative sample of 898 Scottish adults in 1988, when they were aged about 54–58. These participants completed measures of verbal and numerical ability and a set of reaction time tasks, and also indicated their education, occupation, and some lifestyle data. The researchers were notified by the National Health Service of any deaths among the participants until the end of 2002. By this time 20.6% had died. Statistical analysis showed that cognitive factors (lower IQ, slower and more variable reaction times) predicted who had died even after controlling for other predictors associated with mortality risk (i.e., being male, smoking, lower socio-economic status). Moreover, reaction times were more strongly associated with death than was IQ, and appeared to explain the association between lower IQ and death. The authors speculate that reaction times may reflect an important aspect of the person's physical integrity, although the precise mechanism linking reaction times to mortality remains unclear.

Other correlates of intelligence

In this final section of this chapter, we change tack somewhat while remaining on the same course of investigating how intelligence is related to different spheres of life. Thus far our emphasis has been on the real-world correlates of intelligence that intelligence may play a role in influencing, such as academic attainment and work performance. Now we will briefly discuss the real-world factors that may play a role in influencing intelligence. Perhaps before launching into this discussion, it is worth reiterating that there is a difference between intelligence as a theoretical concept and IQ scores as a measure of the behaviour manifestation of that concept. Therefore, although we use IQ and intelligence somewhat interchangeably throughout this chapter, it is worthwhile acknowledging that there are differences between these two ideas. An ideal IQ test should be measuring intelligence purely and nothing else: that is, it should be a valid measure. It is wise to have a degree of scepticism when we hear reports about new drugs to improve intelligence, for example. The question we should ask is whether it is really intelligence that is being raised, or whether it is just IQ scores? In the following section, we will discuss the possibility of schooling, cognitive exercises, physical activities, food supplements, drugs, and environmentally hazardous metals as factors that may be associated with intelligence.

In Chapter 12, we discussed how schooling has an effect on IQ, such that absence from school for a period of time can lead to a reduction in IQ scores. Not only is the length of schooling correlated with intellectual performance (Cliffordson & Gustafsson, 2008), but schooling is also found to be strongly related to the development of intelligence (Stelzl, Merz, Ehlers, & Remer, 1995).

Formal schooling in childhood, adolescence, and young adulthood may promote intelligence, but what about the use of mental exercises or cognitive training that have become increasingly popular and heavily marketed? Do these interventions improve intelligence? One study examined this possibility using eye movement data. It showed that although a cognitive training programme led to improved scores on a test of fluid intelligence, the improvement could be accounted for by the learning of a test-taking strategy and an improved ability to use a variety of cognitive strategies flexibly for the right task. If the latter is considered a facet of fluid intelligence, then this could be evidence that intelligence can be improved. However, if that ability is seen instead as a specific, tacitly learned skill, then the increase in fluid intelligence test scores may not represent a true increase in the underlying intelligence (Hayes, Petrov, & Sederberg, 2015). Another factor that appears to be related to intelligence is physical activity. Level of aerobic physical exercise has been shown to be positively correlated with cognitive ability. In a systematic review paper, cognition, as defined as the ability to learn, reason, analyze and making judgements, was shown to be correlated with aerobic physical activity, although no inference could be made about whether exercise promotes intelligence, intelligence promotes activity, or both factors are underpinned by a hidden third variable such as physical health (Lees & Hopkins, 2013). In the absence of any evidence for the causal basis of the association between aerobic exercise and intelligence, it

would be premature to engage in more exercise in the hope of turbo-charging one's intellectual powers, although there may be other good reasons for doing so.

Just as the benefits of brain training and physical exercise for mental acuity are often extolled, claims are sometimes made about the cognition-boosting effects of pharmaceutical products and nutritional supplements. Common supplements such as an Omega-3 essential fatty acid known as docosahexaenoic acid (DHA) have sometimes been thought to prevent cognitive decline. However, a study of participants aged between 44 and 77 years following 90 days of ingestion of this supplement did not show any improvement in cognitive functioning (Stough et al., 2012). Other supplements, such as Bacopa Monnieri, Gingko Biloba, and American ginseng, have also been researched in relation to specific cognitive functions such as working memory (Scholey, Pase, Pipingas, Stough, & Camfield, 2015). Although working memory is correlated with intelligence, the two capacities are not identical (Ackerman, Beier, & O'Boyle, 2005). Therefore, the effect of these supplements on intelligence is currently unclear. The same can be said for some stimulant drugs, such MDMA and d-methamphetamine. These have been found to produce deterioration in performance on some cognitive tasks and improvement in others, but these effects tend to be short-lived and affect working memory and reaction time rather than intelligence proper. At present there is no pharmaceutical short-cut to high intelligence.

In addition to the abovementioned factors that have been proposed to enhance intelligence, there are others that have been found to be related to IQ deterioration. One such factor is exposure to lead. The Port Pirie Cohort Study of 516 7-year-old children, conducted in South Australia, found that environmental exposure to lead was negatively correlated with intelligence. This effect was observed in the same cohort of children earlier, when they were age 2, and then again at age 4 (Baghurst et al., 1992). In a subsequent meta-analysis, the author asserted that, based on the strength of the relationship, the known action of lead in the brain, and cognitive function interference observed in studies of primates, it is reasonable to conclude that lead adversely affects IQ scores (Schwartz, 1994). Other researchers have reported that levels of hair arsenic and manganese in 11–13-year-old children living near a hazardous waste site in Oklahoma in the USA was negatively correlated with IQ (Wright, Amarasiriwardena, Woolf, Jim, & Bellinger, 2006). Similar findings conducted in the Great Lakes region of the USA have been reported in relation to exposure to polychlorinated biphenyls, which are found in some types of electrical equipment (Stewart et al., 2008), and also in relation to prenatal exposure to mercury (Axelrad, Bellinger, Ryan, & Woodruff, 2007). In short, a variety of environmental toxins have established damaging effects on the cognitive abilities of young people. Whether these adverse effects can be remedied and whether they naturally decline over time remains to be determined.

Conclusions

In this chapter we have explored several domains in which intelligence predicts major life outcomes (including death, the most major of all). Some of the predictive relationships were

powerful. It would be simplistic to conclude that intelligence *causes* all of these outcomes. To be highly confident that intelligence causes better academic performance, job performance, or health, we would need to conduct an experiment in which people were randomly assigned to different groups and the levels of intelligence in these groups were experimentally manipulated. Needless to say, this experiment is impossible, and if it was possible, it would probably be unethical. However, we can have some confidence that intelligence is part of the complex causal stories that give rise to these outcomes. IQ measurements taken in childhood routinely predict outcomes assessed in adulthood, ruling out the possibility that the intelligence–outcome relationship operates in the reverse direction. Clarifying the role that intelligence plays in life outcomes, and determining the genetic and environmental mechanisms and pathways through which it does so, are high priorities for individual difference researchers. However, we already know a great deal. We know that intelligence, rather than merely being a statistical abstraction that is marginally relevant to a few school-related cognitive tasks, is in fact a real factor with diverse and often powerful links to outcomes in many domains of life. High intelligence is associated with academic accomplishment, with success at work, with financial status, and with better physical and perhaps even mental health. Intelligence is not the only factor that contributes to these outcomes, of course, and other individual difference variables also play significant roles. But for all the controversies surrounding its measurement and conceptualization, intelligence is a factor whose real-world implications cannot be ignored.

Chapter summary

- Intelligence is an important factor in people's capacity to function successfully in everyday life, although its importance is to some degree dependent on cultural norms and social values.
- One of the many contributions of intelligence to everyday life is through IQ tests. These tests have a range of important functions in personnel selection, clinical assessment, and education psychology settings.
- Cross-sectional research designs are limited when examining relationships between intelligence and life outcome measures, as they make it impossible to draw any causal conclusions about whether intelligence may contribute to these outcomes. The better alternative is to use longitudinal studies.
- Reverse causality is an important issue to consider when interpreting studies examining relationships between intelligence and life outcomes, as it is sometimes plausible that the 'outcomes' may influence intelligence.
- Intelligence is one of the key correlates of academic performance, and an average validity coefficient of .54 has been reported.

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- The positive relationship between academic achievement and intelligence has been demonstrated from primary school through to postgraduate levels of study.
- Although other variables, such as Conscientiousness and emotional intelligence, contribute towards academic achievement, intelligence remains very important.
- Intelligence predicts job performance, the level of job status attained, and job training performance.
- The relationship between intelligence and job performance may be due to both requiring the ability to capture and deal with the complexity of information in an adaptive manner.
- Intelligence is predictive of personal income, although this effect is not as strong as the relationships between intelligence and academic or job performance.
- IQ is inversely correlated with risk of mortality.
- The disease prevention and disease management hypotheses help to explain why intelligence predicts health.
- It is likely that intelligence predicts obesity rather than obesity predicting intelligence.
- Intelligence is correlated and in some cases affected by schooling, aerobic physical exercise, food supplements, illicit drugs, and environmental toxins.

Further reading

Ceci, S. J. (1991). How much does schooling influence general intelligence and its cognitive components? A reassessment of the evidence. *Developmental Psychology*, *27*(5), 703–22.
An article focusing on the relationship between schooling and intelligence.

Gottfredson, L. S., & Deary, I. J. (2004). Intelligence predicts health and longevity, but why? *Current Directions in Psychological Science*, *13*(1), 1–4.
Provides a brief but good overview of the IQ–health relationship. It includes discussion about why intelligence predicts health in later adulthood.

Hayes, T. R., Petrov, A. A., & Sederberg, P. B. (2015). Do we really become smarter when our fluid-intelligence test scores improve? *Intelligence*, *48*, 1–14.
This article challenges the view that cognitive training will lead to enhanced cognitive ability by showing that scores on a fluid intelligence test can be improved by just changing the test-taking strategy.

Kuncel, N. R., Ones, D. S., & Sackett, P. R. (2010). Individual differences as predictors of work, educational and broad life outcomes. *Personality and Individual Differences*, *49*(4), 331–6.
A general review of life outcomes as related to intelligence (and also personality).

Ones, D. S., Viswesvaran, C., & Dilchert, S. (2005). Cognitive ability in selection decisions. In O. Wilhelm & R. W. Engle (Eds.), *Handbook of understanding and measuring intelligence* (pp. 431–68). Thousand Oaks, CA: Sage.
A review of intelligence as applied to the world of work.

Schmidt, F. L., & Hunter, J. (2004). General mental ability in the world of work: Occupational attainment and job performance. *Journal of Personality and Social Psychology*, *86*(1), 162–73.
An article about work and intelligence. It also includes a table listing jobs and the associated cognitive ability scores.