

## VIII. Appendix A

### Intelligence quotient: definition, evaluation and problems as a measure of ‘intelligence’

Despite being a valuable measure in MR research, several limitations and shortcomings in IQ testing render it less suited to gauge general intelligence.

#### A. Definition and testing of the intelligence quotient

IQ, that is, mental age divided by chronological age, is tested by evaluating verbal and non-verbal abilities.

Common sense says that intelligence is a continuous as well as a complex trait. *An attempt* at objective measurement of human intelligence resulted in the formulation of the IQ, which is mental age divided by chronological age<sup>1287</sup>. IQ is estimated by means of an IQ test and, although the term IQ is still used, modern tests no longer apply the IQ formula, but instead compare one’s performance with that of others of the same age. The best-known tests are those developed by Wechsler (WAIS)<sup>1288</sup>, and Binet and Simon (Stanford-Binet intelligence scales)<sup>1289</sup>, which evaluate verbal and performance (that is, non-verbal) abilities. All tests are normalised so that the mean IQ in the general Caucasian population is 100 with an SD of 15. It should, however, be stressed that the Gaussian distribution of IQ is an artefact inherent to the scientific process<sup>1290</sup> and to the design of IQ tests<sup>1291</sup>.

#### B. Problems with testing the intelligence quotient as a measure of general intelligence

Although IQ tests have some value as predictors of school performance ( $r \sim 0.50$ )<sup>1292</sup>, level of education ( $r \sim 0.55$ )<sup>1293</sup>, socio-economic status ( $r \sim 0.30 - \sim 0.40$ , depending on the individual variable)<sup>1276</sup>, job performance ( $r \sim 0.30 - 0.50$ )<sup>1294</sup> and socially undesirable outcomes ( $r \sim -0.17$ )<sup>1277</sup>, they have considerable limitations as a measure of ‘general intrinsic intelligence’.

## B.1. Problems of definition

Attempts to universally define intelligence have not yet been successful.

No universally accepted definition of intelligence exists, not only among specialists<sup>1295</sup>, but also between cultures; it even varies considerably within a given society<sup>1296</sup>.

‘General intrinsic intelligence’ itself, first postulated by Spearman as a ‘general’ or ‘g’ factor, has been described as a kind of mental energy<sup>1297</sup>, a mere statistical regularity<sup>1298</sup>, a generalised abstract reasoning ability<sup>1299</sup> or an index measure of neural processing speed<sup>1300</sup>.

## B.2. Practical problems intrinsic to testing the intelligence quotient

Testing conditions and interpretation of test results influence the IQ measure.

It has been shown that the outcome of an IQ test can depend on familiarity with the test materials (e.g. clay vs. wire)<sup>1301</sup>, with the testing procedure and with the examiner<sup>1302</sup>. Emotional tension and anxiety have also been indicated as factors affecting test scores<sup>1303</sup>. Asking 99 school psychologists to independently score an IQ test from identical records resulted in IQs ranging from 63 (mildly mentally retarded) to 117 (gifted) for the same individual<sup>1304</sup>, indicating the critical role of tester attitudes, qualifications, and instructions on testing<sup>1305</sup>. In addition, differences in the interpretation of test scores of entire groups have been documented. Mean Japanese IQ scores of 111<sup>1306,1307</sup> and between 101 and 105<sup>1308</sup> have been reported. Although a correlation exists between the outcomes of different IQ tests<sup>1309</sup>, results may vary as much as one SD<sup>1310</sup>. Finally, ceiling effect for subtests of common IQ testing batteries have been reported<sup>1311</sup>.

Taken together, these observations point out several practical shortcomings when estimating the IQ.

## B.3. Principle problems intrinsic to testing the intelligence quotient

IQ tests are culturally biased and do not consider all intellectual abilities.

IQ tests are psychometric tests only capturing a few aspects of many different ‘intelligences’ or ‘systems of abilities’<sup>1312</sup>, omitting, for example, creative and practical intelligence<sup>829</sup>, social<sup>1313</sup>, emotional<sup>1314</sup> and moral intelligence<sup>1315</sup>, and lateral<sup>1316</sup> and radiant<sup>1317</sup> thinking. Also, wisdom is not considered. IQ tests are ‘static’ (that is, ‘What has the child learned?’) rather than ‘dynamic’ (that is, ‘What does the child achieve when given guided

and graded feedback?’)<sup>1318</sup>. Intelligence of infants and of severely mentally disabled patients cannot be measured satisfactorily by means of an IQ test and longitudinal studies indicate that IQ scores are slightly age-dependent<sup>1319</sup>. IQ scores do not always reflect the societal situation<sup>1320-1322</sup>, even though it has been shown that they correlate with socio-economic status<sup>1276</sup>. Cognitive abilities measured by IQ tests represent, at least in content, culturally learned abilities<sup>1323</sup>. Various programs have been shown to raise IQ scores<sup>1324</sup>, but these are often short-lived gains that fade with time once the intervention has been terminated<sup>1325</sup>. Worldwide, the average IQ has been steadily increasing since testing began, the so-called Flynn effect. The average gain is about three points every decade; cumulatively as much as one SD over the last 50 years, and the rate of gain may be increasing<sup>1326,1327</sup>. The Flynn effect cannot simply be attributed to an increase in population IQ, as tests are restandardised on a regular basis. Instead, explanations include modern improvements in nutrition<sup>1328</sup> and the adaptation of every generation to a more complex, urbanised and technologically advanced daily life<sup>1329</sup>. However, conclusive reasons underlying the Flynn effect remain elusive. In any case, should IQ tests measure ‘general intrinsic intelligence’, it would be highly unlikely that, for example, the increase of 8.74% ‘highly gifted’ individuals (IQ  $\geq$  140) from 1952 to 1982 recorded in the Netherlands would have remained as unnoticed as is the case<sup>1326</sup>.

In conclusion, it is clear from the above that a variety of principle problems obscure reliable IQ testing.

