CORPUS PUBLISHERS

Current Research in Psychology and Behavioral Science (CRPBS)

ISSN: 2833-0986

Volume 3, Issue 7, 2022

Article Information

Received date : 06 September, 2022

Published date: 10 October, 2022

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Key Words

Standardized IQ-score; JLMQ; Education levels; Occupation specialization; Neurocognition; Prefrontal cortex; Recruitment instrument; Performance

Research Article

Standardization of the JobMatch Loqiq (JMLQ) Instrument to IQ-Scores

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Abstract

In the present study, standardized IQ-score distributions were constructed (M=100, SD=15) for the norm-group and for each of the JMLQ scales, including the General factor and the JMLQ scales (Math, Numerical, Logical 1 & 2, Speed). Subsequently, the influence of levels of education, i.e., elementary school, upper secondary school, post-secondary and university education, and occupational specialization, including advanced tasks, leadership, administration, practical skills, communication, practical work, upon IQ-scoring were assessed. It was found that normal frequency distributions of standardized IQ-scores were obtained for the General (N=1017), Numeric (N= 1004), Math (N=1001), Logic (N=1005), Logic2 (N=998), Complex (N=990), and Speed (N=1013) JMLQ-scales. Furthermore, it was observed that the standardized IQ-scores for the General scale over the four educational levels, elementary school, upper secondary, post-secondary and university, IQ-levels increased incrementally from the former, elementary and secondary school levels to post-secondary and university levels of education. Finally, the standardized IQ-scores for the six occupational sub-norm-groups, advanced tasks, leadership, administration, practical skills, communication, practical work, presented higher scores among the former three groupings, Advanced tasks, Leadership and Administration, than the latter three groups, Practical skills, Communication, Practical work presented. These results, consistent with those results presented in studies utilizing meta-analysis, intelligence testing and life-span analysis, underline advantages of higher academic preponderance and job specialization for the maintenance of higher intellectual and neurocognitive functioning.

Introduction

It has been observed that observed a strong internal construct validity was assured by the high mean factor standardized loadings, measures of reliability, whereas the high external relationships between the Job Match Logiq (JMLQ) factors and the sixten personality factor questionnaire (16pf) dimensions and the invariant patterns of correlations between both the former and the latter all argue the case for strikingly high external construct validity (Jansson et al. under review). The construct validity of the general and trait scales (math, numerical, logical, speed) was based on proportions of number of correct answers. Response times had served as the time limits related to each specific scale [1,2]. This type of measurement maintains an accordance with traditional scoring procedures [3]. Furthermore, strong correlations for reaction time mean values with the general mental ability (an index for IQ) which increases with age was found to be present [4]; thus, within population-representative cohorts reaction time means were correlated markedly with IQ values. Nevertheless, in a Cognitive Reflection Test (CRT), it was indicated that there was only a weak correlation between the CRT response times and accuracy of performance [5]. In this context, the item-level analyses failed also to evidence the predicted response-time differences between correct analytic and incorrect intuitive answers for two of the three CRT items which lead the authors to query whether or not participants who responding with incorrect intuitive answers on the CRT may legitimately be termed ‘cognitive misers, and whether or not the three CRT items measured the equivalent general constructs. However, as was investigated in section three of this report (DNV report 2021), an alternative measure unit (to number of correct answers) was found to be constructive. Rate, defined as correct answers per unit of time, was established as a consistent measure both at an aggregated item level, as well as on an individual level. Throughout, all standardized test scores for the JMLQ, were based upon the rate unit.

The recently introduced recruitment instrument for assessing logical-cognitive reasoning, the JobMatch Logic Aptitude test instrument (JML/JMLQ), was constructed in order to estimate cognitive performance within the scope of logic and intelligence testing [1,2]. Accordingly, it was shown that the combined measure of “Rate of answering” produced remarkably higher, yet positive, correlations with “Correct answers”, than did “Time to answer”, with comparable relationships appearing for the other combined measure “Prediction of outcome”. Central to its endeavors, the processing of rational reasoning within cognitive tasks of complex demands has been an ongoing requirement. Consequently, the correlations between ‘Correct answer’ and corresponding ‘Response time’ over JMLQ-category were found to produce increasing and incremental absolute values from the complex to the mathematical, to the numerical, to the logical and to the speed categories. Among mathematicians, cognitive and brain-structural (grey and white matter) characteristics, compared with non-mathematicians, were identified [6]. It was observed that among mathematicians there was a higher grey matter density within the right superior parietal lobule, whereas a lower extent of grey matter density within the right intraparietal sulcus and within the left inferior frontal gyrus. No significant group differences in fractional anisotropy or mean diffusivity were obtained for the white matter areas thereby presenting fresh revelations pertaining to the relationship between mathematical expertise/specialization and parametrical aspects grey matter in brain regions, In a study of MRI imagining and IQ-test performance, cognition comparisons found that participants presenting higher IQ-levels employed more adaptive learning strategies following positive feedback [7]. Subsequent assessment of neural brain activation showed that higher IQ-levels were associated with greater activation in the dorsolateral prefrontal cortex and dorsal anterior cingulate cortex during reception of positive feedback that were particularly selected for rules pertaining to low reward probability (i.e., unexpected positive feedback). Additionally, voxel-based morphometry analyses revealed that IQ correlated positively with the volume of grey matter within these regions. Metacognition involves cognitive processing of the highest order covering (i) knowledge, and (ii) regulation that are essential for problem-solving and comprehension. In a study of 21 patients, presenting traumatic brain injury and cerebral vascular accident, metacognition was associated significantly with the index of executive/frontal lobe functioning, wisconsin card sorting test number of categories but not assessment of total IQ [8].

Aim

The aims of the present study were twofold: For the Norm-group and for all JMLQ scales, including the General factor and the JMLQ scales (Math, Numerical, Logical 1&2, Speed), IQ-score distributions were to be constructed (M=100, SD=15). Moreover, mean values of IQ scores were divided to subgroups of the Norm-group, built on educational levels, occupational categories and orientations. The purpose of these orientations was to serve as norm-groups for the occupational sub-groupings.

Methods and Materials

Participants

The number of participants accounted for in the preliminary sections were initially 1028. However, in order to develop normal frequency distributions of IQ scores without extreme values by removal of outliers, sample sizes for the general and traits scales varied between 990 to 1017 subjects. The results of the study were based on 1017 participants, 742 women (73.1%), 259 men (25.5 %) and 16 other (1.5 %). The age range was 18-81 years (M=45, SD=12.6), women (M=46, SD=11.6), men (M=41, SD=14.4) and others (M=41 years, SD=14.1). Moreover, participants stated their occupational orientations, and educational levels. In addition, twelve reported occupational categories were divided into six occupational sub-norm-groups (advanced tasks, leadership, administration, practical skills, communication, practical work). The lowest Education level, 'Elementary School (n=34 out of N=1011), was not used for presentation of sub-groups due to the small sample size. In contrast, the number of participants within the other three categories ranged between 210 and 515 persons.

Instrument

The JMLQ test consists of five basic scales or categories: Mathematical, Numerical, Logical 1 & 2 and Complex cognition. An additional scale, labeled as speed, was created with a subset of items from the complex and logical scales. The instrument presents five main scales:

Mathematical understanding: The individual´s general understanding of mathematics principles;

i. Numeric understanding: The individual´s general understanding of numbers based on basic arithmetic's;
ii. Logical reasoning 1 & 2: The individual's ability to make inference-based conclusions;
iii. Complex cognition: the individual's ability to understand complex ideas and information;
iv. Cognitive processing speed: the speed in which the individual may understand and react to presented information.

Description of occupational sub-norm-groups

The occupational sub-Norm-groups were described as follows:

i. Advanced task: Advanced technology professions.
ii. Administration: Qualified non-practical professions.
iii. Leadership: Leadership Professions.
iv. Practical kills: Qualified Practical professions.
v. Communication: Semi-skilled professions.
vi. Practical work: Unskilled practical professions.

Statistical procedure

Initially, the norm-group included 1028 subjects. Before standardization was performed of the rate-based test scores, extreme values were excluded from each of the six JMLQ scales (SPSS, v26). Extreme values were technically set to missing data. As to the General scale, it was calculated as mean an of the Z-scores for the trait scales, not including speed. Finally, a Z-score was calculated for the general scale. All Z-scores for the General and trait scales, including speed, were presented as IQ scores (M=100, SD=15).

Results

IQ-scores for the Norm-group

The following sample sizes related to the Norm-group were used for the JMLQ scales: General (N=1017), Numeric (N=1004), Math (N=1001), Logic (N=1005), Logic2 (N=998), Complex (N=990), and Speed (N=1013). The frequency distributions of standardized IQ-scores were analyzed for the general and the trait scales, including the additional Speed scale (Figures 1&2). Moreover, the mean values at percentiles were calculated on standardized IQ-scores for he General and the six JMLQ scales (Table 1).

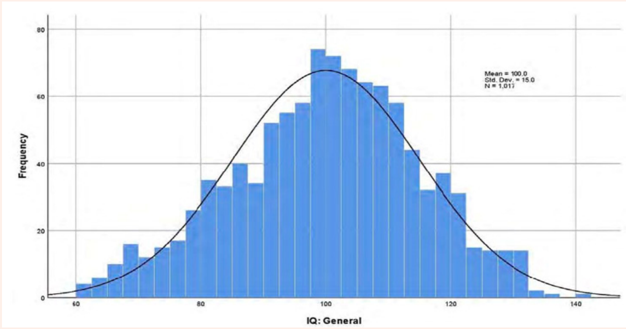

Figure 1: The frequency distribution of standardized IQ-scores of the General factor is presented for the norm-group (N=1017). The normal distribution curve is shown.

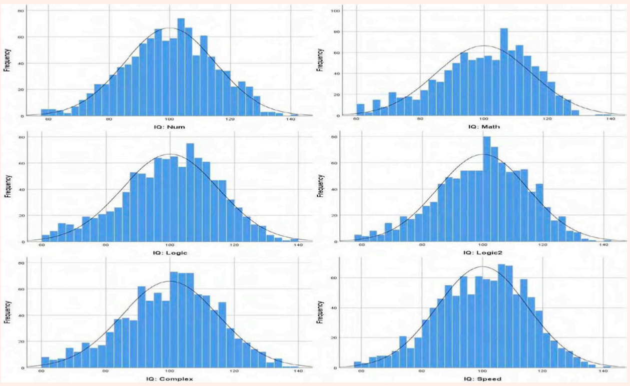

Figure 2: The frequency distributions of standardized IQ-scores (M=100, SD=15) of the six JMLQ scales is presented for the norm-group. Sample sizes differed somewhat: Numeric (N=1004), Math (N=1001), Logic (N=1005), Logic2 (N=998), Complex (N=990), Speed (N=1013). The normal distribution curve is shown for each scale.

Table 1: Average (weighted) values at percentiles, calculated on standardized IQ-scores for the general factor and the six JMLQ scales, are shown. Values were based on the norm-group.

Percentiles	5	10	25	50	75	90	95
IQ General	72.6	79.5	90.2	100.8	110.5	119.3	123.8
IQ Num	74.5	80	89.9	100.5	111	119.1	124.6
IQ Math	71.2	78.7	90.6	101.8	111.5	118.3	121.5
IQ Logic	72.6	79.2	90.2	101.2	110.5	118.5	123.1
IQ Logic 2	73.2	79.7	89.8	101.3	110.9	118.7	123.3
IQ Complex	72.8	79.9	90.5	101.1	110.4	118.6	124.2
IQ Speed	73.9	80.2	89.3	101.1	110.5	118.6	122.7

Note: Sample sizes differed to some small extent: General (N=1017), Numeric (N=1004), Math (N=1001), Logic (N=1005), Logic2 (N=998), Complex (N=990), Speed (N=1013).

IQ-scores for levels of Educational

Standardized IQ-scores were calculated for the General scale over four educational levels (N=1011). The range of the mean values was 4). Moreover, a line diagram with confidence intervals for the mean values of the General IQ-scores over educational levels was shown (Figure 3). As shown, IQ-levels increased incrementally from lower, elementary, school and upper secondary school to post-secondary and university levels of education.

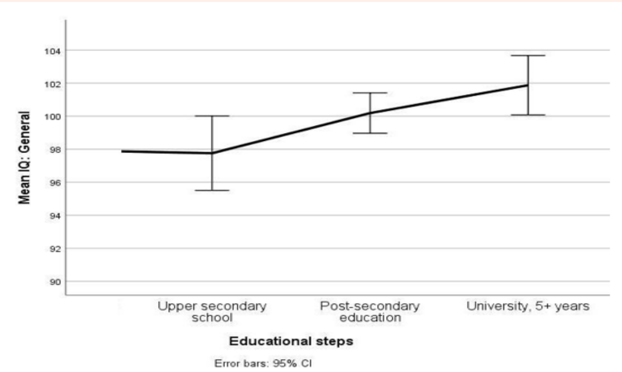

Figure 3: A line diagram depicting the mean values for the general IQ-scores over four educational levels. Confidence intervals (95%) and a reference line at M=100 was drawn (N=1011).

IQ-scores for the twelve occupational categories

Twelve occupational categories were investigated. Standardized IQ-scores were calculated for the General scale over each of the categories. The range of the mean values was 22 A corresponding line diagram was created with confidence intervals shown (Figure 4).

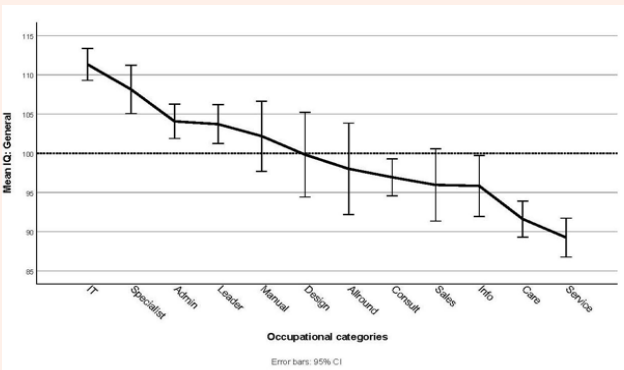

Figure 4: The line diagram depicts descending mean values of the general IQ-scores over twelve occupational categories n. A confidence interval (95%) is shown for each scale, as well as a reference line at M=100.

IQ-scores for the six occupational sub-norm-groups

For the six occupational sub-Norm-groups (advanced tasks, leadership, administration, practical skills, communication, practical work), standardized IQ-scores were calculated on the general scale. The range of the mean values was 19. In addition, a line diagram is presented with confidence intervals (Figure 5). The grouping including advanced tasks, leadership, administration had throughout higher scores than had the grouping with practical skills, communication, practical work. Moreover, in order to screen for homogenity of the JMLQ scales across occupational sub-norm-groups, a multi-line diagram was constructed. A similar pattern was found for the JMLQ scales (Figure 6).

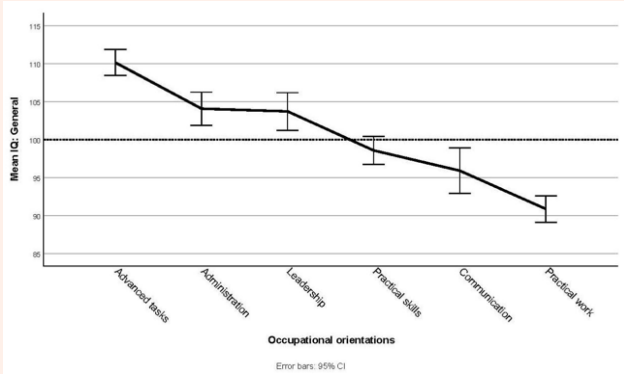

Figure 5: The line diagram is presenting descending mean values of the general IQ-scores over six occupational orientations. a confidence interval (95%) is shown for each.

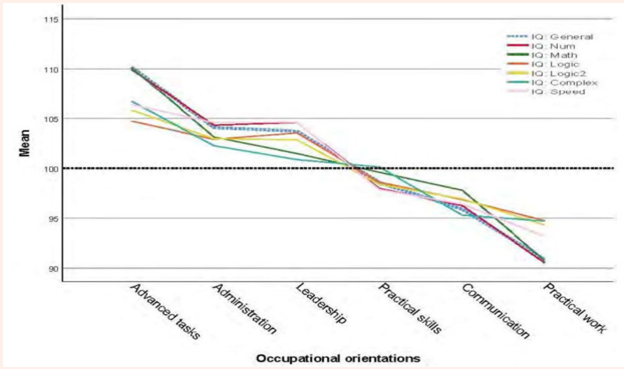

Figure 6: The line diagram depicts the descending mean values of IQ-scores for seven JMLQ scales over the six occupational orientations. A dashed reference line is drawn at M=100.

Discussion

The present findings that have arisen from examinations of the Norm-group over all the JMLQ scales, including the general factor and the JMLQ scales (math, numerical, logical 1 & 2, speed), and IQ-score distributions were carried out to ascertain the influence of levels of education and occupational complexity/specialization upon IQ-scores produced the following set of results:

i. Normal Frequency distributions of standardized IQ-scores were obtained for the General (N=1017), Numeric (N=1004), Math (N=1001), Logic (N=1005), Logic2 (N=998), Complex (N=990), and Speed (N=1013) JMLQ-scales as depicted in (Figures 1&2) (above).

ii. Standardized IQ-scores for the General scale over the four educational levels, elementary school, upper secondary, post-secondary and university, IQ-levels increased incrementally from the former, elementary and secondary school levels to post-secondary and university levels of education, and

iii. standardized IQ-scores for the six occupational sub-norm-groups, advanced tasks, leadership, administration, practical skills, communication, practical work, evidenced higher scoring among the former three groupings, advanced tasks, leadership and administration, than had the latter three, practical skills, communication, practical work. Taken together, despite methodologic and populational variation, the present study confirms the observations of a previous one implying that the highest academic levels and greatest degree of occupational specializations produced the paramount performance of logical reasoning and cognitive finesse [9].

Despite inconsistencies of confirmation and interpretation, consensus from correlational analysis studies between job performance and IQ-levels (e.g., Richardson and Norgate, 2015), the present findings support unequivocally the contention that higher levels of education and greater occupational specialization are associated with higher standardized IQ-scoring. Evidence implies that Students with greater propensity for intelligence go on to complete more education, or a longer education increases intelligence [10], who demonstrated beneficial effects of education upon cognitive abilities of approximately 1 to 5 IQ points for each additional year of education. Interactive relationships between educational levels and IQ scoring on the basis of the general factor of intelligence, cognitive ability, and cognitive skill, demonstrated mean increments that were equal to 1.9 IQ points in the IQ global composite score for each additional year of education [11], although the relevance of the general factor of intelligence decreased at increased educational levels. Higher educational and occupational attainment are associated with the reduced odds of cognitive impairment or reduced rate of cognitive decline [12], although a higher level of education and a greater occupational specialization were each linked to a higher late-life cognitive ability, only the educational level presented a unique contribution to cognitive ability, IQ-scoring, that was maintained over and above that association with the former pre-morbid IQ [13]. It has been established that the obtained correlations several brain regions, including that between temporal gray matter, temporal white matter and frontal white matter volumes with full scale IQ-testing, varying between 0.14 to 0.27 in children and adolescents, are due in large part to their correlations with performance IQ and not verbal IQ [14]. The volumes of other lobar gray and white matter, subcortical gray matter (thalamus, caudate nucleus, putamen, and globus pallidus), cerebellum, and brainstem do not contribute significantly to IQ variation. Additionally, it has been found that assessments based on the gray matter connectivity of functional brain networks conceded significant predictions for general intelligence scoring for the fronto-parietal network and the cerebellum [15-17].

Conclusion

Norm-group data over all the applied JMLQ scales indicated incremental increases in IQ-scoring as a function of level of education and greater specialization of occupation. This finding was consistent with results presented in studies utilizing meta-analysis, intelligence testing and life-span analysis. Thus, IQ-levels increased incrementally from elementary and secondary school levels to post-secondary and university levels of education whereas Occupational specializations consisting of advanced tasks, leadership, and administration tasks achieved higher IQ-testing levels than the more generalized workers, involving practical skills, communication, and practical work.

Limitations

The absence of any other demographic features, besides mean age, educational level and occupational specialization, such as health and personality characteristics, ought to considered as limitations that may have affected participants' attitudes towards the JMLQ instrument and the standardized IQ-scoring date. Nevertheless, the methodological features of the study design presented the main focus such that only those demographics were included were deemed to be of relevance.

Acknowledgement

The authors acknowledge the expertise provided by Klaus Olsen.

Ethical Considerations

Complete anonymity was guaranteed for each participant. The Job Match Talent Ethical Board approved this study.

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