Original Article

Study of Correlation of the Number of Languages Spoken with Intelligence among Young Indian Adults

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Abstract

Background: Intelligence is the ability to learn and adapt rapidly and is highly variable among individuals. The existence of language can be attributed to the brain and its capability to learn. Language, therefore, must be learnable by children. Very few studies correlate the language skills and the intelligence level of the person. **Aim of the Study:** The aim of this study was to correlated languages known and intelligence. We hypothesized that the mental circuitry responsible for linguistic skills must be more refined among those who know more languages. **Materials and Methods:** A correlational questionnaire-based study was conducted on 205 subjects of the age group of 19–22 years, who were required to fill in a case study form and take an IQ test (Cattell's Culture Fair Intelligence Test). The number of languages known among the 205 participants ranged from 1 to 6. Intergroup comparison was made using Pearson Correlation, Kruskal–Walli's test, and Mann–Whitney U-test. **Results:** When the Pearson Correlation was used, we did not find a statistically significant difference among the groups. No correlation between the number of languages known and the IQ of a person was evident (The Pearson Correlation Coefficient-0.029 and $P = 0.677$). The IQ in those who knew two or more languages were higher, while it was highest in those who knew four languages ($P < 0.001$). **Conclusion:** From the results, we could conclude that there is no direct correlation between the languages known by a person and the IQ. However, their comprehension capability may be better.

Keywords: Cattell's culture fair intelligence test, intelligence quotient, language awareness, multi linguistic proficiency

Introduction

Human intelligence has been described in several ways. Gottfredson LS defined intelligence as "the general mental capability involving the ability to reason, plan and solve problems, think abstractly, understand complex ideas, and learn quickly from experience."[1,2] As per the American Psychological Association, intelligence also depicts the difference between individuals in their ability to comprehend complex ideas and to effectively adapt to the environment, learn from experience, engage in various types of reasoning, and to overcome obstacles thoughtfully.[3] Studies conducted have associated the levels of intelligence or the intelligence quotient (IQ) to hereditary factors, developmental factors, and growing environment.[4-6] For people proficient in languages other than their respective mother tongue, comprehending thousands of words is a remarkable achievement of their cognitive and neuroanatomical systems.[7] It appears, there is a deep-rooted connection between the evolution of the brain and language. The language can be attributed to the brain that uses it for communication and comprehension.[8] A conflict between the theories of knowledge of the language and IQ, along with grades in the school, has been prevalent for a long time. This was best evident in published, which reported a lack of clarity in whether the children scored high grades because of better command over the language and words or because the child had better intelligence, which gave him/her a better command over the language. This has been mentioned as an overlap of intelligence and language.[6,9]

Because language is critical to an individual's ability to adapt, language would, by extension, influence the evolution of the

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brain.[8] The language is adapted as cultural evolution, while the human brain, in turn, is adapted to sub-serve language that is biological evolution. The fact that the brain and language suit each other can be attributed to this co-evolution.[10] There have been studies relating to intelligence and language fluency.[11,12] The brain's involvement in the reading capability has also been investigated in bilingual children.[13,14] There is a paucity of information about the association of knowledge of languages and the intelligence level of young individuals. Understanding the relationship between intelligence and multi-linguistic ability could act as an early interventional therapeutic option in children with learning disabilities.

India is a country with numerous languages and thousands of their local dialects. No study has analyzed the correlation of multi-linguistic status to the basic intelligence in the Indian population. This study was carried out to seek an insight into the direct relationship between crystalline and fluid intelligence and the linguistic proficiency among Medical Students, whether the intelligence among them varies based on their knowledge of languages.

Materials and Methods

Study design and type

This study is aimed to find the correlation between the intelligence level and multi-linguistic proficiency among young Indian Adults, using Cattell's Culture Fair Intelligence Test.[15] The Questionnaire consisted of four sections: General Information/Subject Information Sheet, Informed Consent Form, Case study Form, Cattell's Culture Fair Intelligence Test. The study was approved by the institutional ethics committee (IEC KMC MLR 04-18/68; Dated: 18.4.2018), and signed informed consent was obtained from each participant after thoroughly briefing them about the study protocol.

The subjects answered a 12.5-minute standard IQ Test (Cattell's Culture Fair Intelligence Test Scale 3). The Cattell Culture Fair Intelligence Test measures the two components of general intelligence: (1) Crystalline intelligence that is knowledge acquired based on experience (2) Fluid intelligence represents the biological ability to acquire knowledge and solve problems. We, in this study, evaluated the fluid intelligence. The endpoint was to find the correlation between intelligence level and multi-linguistic proficiency. Study site was a reputed medical college of India which has students from all parts of the country. The study population included 1st-year MBBS students, admitted to this institution in a single year.

Inclusion criteria

Normal students aged 17–22 years, willing to participate in the study. The participants voluntarily took part in the study and were not paid any money for taking part in this study.

Exclusion criteria

Those with any kind of learning disability, age beyond the mentioned range, and those who were unwilling to participate.

Sample size

The calculated sample size was 196 subjects, as per the formula.[16] Acceptable margin of error: 5%; Confidence level: 95%; Population: 400; the ideal sample size was found to be 196. Two hundred and five was chosen number for a lesser margin of error.

Study procedure and data collection

The Cattell's Culture Fair Intelligence Test Scale 3 was used as per the subjects' age group. The scale 3 test was chosen since it was a group administrable and provided a greater refinement in higher intelligence ranges. The test was a 12.5 min standard IQ Test. The raw scores obtained were then normalized to attain the score in terms of IQ points for further interpretation [Table 1].

Data analysis

The data were compiled and further analyzed using the Pearson Correlation Coefficient and SPSS 25.0

Results

Our study included 205 medical students as respondents from the study institute, between 17 and 22 years. All the recruits were considered for result analysis. Among them, 112 (54.63%) were female, and 93 (45.36%) were male. The mean age of the respondents was 18.49 years (Standard deviation: 0.94). The number of languages known ranged from 1 to 6. Out of 205 respondents, 0.4% knew one language, 47.3% knew two languages, 32.1% knew three languages, 12.1% knew four languages, 4.3% knew five languages, and 3.4% knew six languages. Across the number of languages known, the difference in median scores of IQ was not statistically significant.

The IQ scores were found to be highest for respondents who knew four languages (Median [IQR]: 117.00

Table 1: Classifications of questions, number of questions in each class, Time allocated for the questions, marking of each set

Subtest	Type of question	Number of questions	Time (min)	Mark
1	Series	13	3	13
2	Classification	14	4	14
3	Matrices	13	3	13
4	Conditions	10	2.5	10
	Total	50	12.5	50

The test consisted of 4 subtests, with a total of 50 questions. Each correct response was awarded one mark (Raw Score). There was no negative marking. The subtests are explained as below, and all the answer papers were assessed manually: Test 1: In the series subtest, the respondent was presented with an incomplete progressive series. He/ She had to choose from the given options, the most appropriate answer which best continued the given series. Test 2: In the classifications subtest, the respondent had to correctly choose the two options/figures which were different from the other three in some way. Test 3: The matrices subtest required the respondent to complete the given matrix correctly. Test 4: The conditions subtest required the respondent to select the option which duplicates/ mimics the condition given in the box on the far left

[109.50–124.00]) followed by two languages (Median [IQR]: 113.00 [101.50–121.00]) Kruskal–Walli's test ($P < 0.058$). A comparison of intergroup difference by applying unpaired Student's "*t*"-test revealed a significant difference among the groups [Table 2].

When the IQ scores between males and females were compared while keeping the number of languages constant, the data were not statistically significant. The IQ of females was higher than that of males when the number of languages known was 2 (Female Median IQ: 113, Male Median IQ 109), 3 (Female Median IQ: 109, Male Median IQ 106), and 4 (Female Median IQ: 119, Male Median IQ 117). The IQ was comparable when the number of 2 languages known to the respondents was 6 (Male and Female median IQ: 96) [Table 3].

Pearson Correlation was used to analyze the correlation between the age and IQ points, keeping the number of languages known constant. When the number of languages known was kept constant at 2, the data were statistically significant. The correlation coefficient was −0.215, and the *P* value was found to be 0.035.

With an increase in the age of the respondent, there was a decrease in the IQ. When the number of languages known was 3,4,5,6, the correlation between the age and IQ points was not statistically significant [Table 3].

Table 2: Comparison of number of languages known with the IQ scores

Number of languages known	IQ median (IQR)
1 (*n*=1)	88 (88- 88)
2 (*n*=97)	113.00 (101.50- 121.00)
3 (*n*=66)	109.00 (96.00- 118.00)
4 (*n*=25)	117.00 (109.50- 124.00)
5 (*n*=9)	106.00 (98.00- 124.00)
6 (*n*=7)	96.00 (94.00- 109.00)

The statistical tool used for the group: Nonparametric tests: (Kruskal- Wallis test) revealed no statistical significance. Unpaired Student's *t*-test results: 2 versus 4 L: *t*=3.2668; df=120; standard error of difference=1.224; (*P*<0.001), 2 versus 3 L: *t*=3.3716; df=161; standard error of difference=1.186; (*P*<0.001), 2 versus 5 L: *t*=3.7107; df=104; standard error of difference=1.886; (*P*<001), 2 versus 6 L: *t*=7.7870; df=101; standard error of difference=2.183; (*P*<0.001). IQR: Interquartile range, IQ: Intelligence quotient

When Pearson Correlation was used to find out the overall correlation between the number of languages and the IQ of a person, the data were not found to be statistically significant [Table 4]. With the increase in the number of languages known, there is no increase in the IQ. The Pearson Correlation Coefficient was −0.029, and the $P = 0.677$.

Data of the class X percentage versus the number of languages known was tabulated.

Table 5 shows that multi-linguistic proficiency leads to better academic performance in class X. The results were analyzed by grouping the subjects into two groups of those who knew three languages and less and those who knew four languages and more [Table 5; 89.96; 92.89] ($P < 0.001$). A similar result was found when the Class XII results were analyzed by grouping the subjects into two groups of those who knew three languages and less and those who knew four languages and more (84.44; 89.17). This was also reflected as higher average IQ points in the same two subcategories (101.66; 107.71) ($P < 0.01$).

Discussion

In the present study, we evaluated the Intelligence levels (IQ) of a group of bright young students admitted to our medical college based on their proficiency in languages using Cattell's Culture Fair Intelligence test. We categorized them based on the number of languages known, gender and age, and then analyzed their performance in the test. We also correlated their performance in classes X and XII. Our study revealed that the cohort consisting of 205 students showed comparable intelligence, despite wide variability in the number of languages known.

The average IQ of respondents who knew <2 languages and those who knew three or more were comparable (109.43; 108.36)[17] have made an interesting observation in their paper. They mentioned that in bilingual children, the word input was lesser in each of their languages than monolinguals and had a smaller vocabulary. Their study reported that the trilingual children had far less receptive vocabulary than the majority language. The first language proficiency of all groups was comparable. This observation prompted them to suggest that

Table 3: Comparison of intelligence quotient between males and female respondents (Mann- Whitney U-test)

Number of languages known	Gender versus IQ				*P*
	Males		Females		
	n	IQ score, median (IQR)	*n*	IQ score, median (IQR)	
1	1	88 (88-88)	-	-	-
2	46	109 (94- 117)	51	113 (103- 121)	0.064
3	30	106 (94.75- 118)	36	109 (100- 120)	0.416
4	9	117 (92.50- 124)	16	119 (113.75- 124)	0.598
5	3	117 (106- 131)	6	103 (94.75- 120.25)	0.262
6	4	96 (92.25- 111.75)	3	96 (94- 109)	1

Median of IQ of each group and male and female respondents, the results are not significantly different. IQR: Interquartile range, IQ: Intelligence quotient

Table 4: Class XII academic performance and intelligence quotient scores

Number of languages	Count	Class 10 (%)	Class 12 (%)	Raw score mean	IQ points mean
1	1	77±0.00	74.8±0.00	17±0.00	88±0.00
2	97	92.17±4.96	89.42±6.23	25.14±5.00	109.64±15.32
3	66	91.78±4.82	89.11±6.68	24.42±4.59	107.34±14.08
4	25	93.99±3.05	89.96±8.11	26.2±6.48	112.64±19.75
5	9	93.88±3.58	92.72±4.96	25.55±4.54	110.66±13.90
6	7	90.81±5.30	84.84±8.53	22.14±2.94	99.85±8.74

The performance of students with knowledge of more than one language in Class 10 (higher secondary) and Class 12 (pre-university) showed comparable results. There was no statistically significant difference among the group. IQ: Intelligence quotient

Table 5: Academic performance in Class X and XII

Number of languages	Count (*n*)	Class X (%)	Class XII (%)	IQ points
3 and less	164	86.96	84.44	101.66±11.88**
4 and more	41	92.89	89.17	107.71±6.88**

Academic performance in the form of scores achieved by those who had knowledge of 3 or less languages (n=164) and more than 3 languages (n=41) (P<0.01). IQ: Intelligence quotient

the home language suffers at the hands of the majority language and hence needs to be supported by the parents and the brain alone cannot independently take care of it.

Haman *et al*.,[18] in a study involving the monolingual and bilingual polish subjects, observed that the monolinguals performed better in all parameters of linguistic proficiency except in discourse. They went on to suggest that productive grammar performance was better in the monolinguals than the bilinguals. However, this study was exclusively on language parameters and not on the cognitive parameters. Contrary to this report, earlier workers attributed the learning skills among bilinguals comparable to those of monolinguals, and the milestones are achieved almost at the same time frame.[19] In another recently published paper, Woumans *et al*. (2019),[20] evaluated the intelligence, cognition, etc., tested on the exposure to a second language. They reported a positive correlation between learning and language acquisition. However, this study was on monolinguist children. First language and second language vocabulary development involved the brain and intelligence to a great extent, including speech perception, short-term phonological memory, and phonological awareness. The study was conducted in 5-year-old French kindergarten children on their acquisition of English as a second language for three consecutive years. Their auditory attention and executive language skills were improved.[21]

In the present study, we correlated the multilinguistic status to the IQ. We have not analyzed the proficiency of the language in this study. We did not assess their vocabulary or comprehension. The "knowledge" of language to the limited meaning of "read, write, and speak." Hence, this study differs from the other studies on language proficiency.

Young adult medical students manifested increased IQ with an increase in the number of languages known (The Pearson Correlation Coefficient was −0.029, and the P = 0.677). The increased IQ among the students who knew more than one language suggested that cognitive skills could be higher in multilinguistic students.

Comparing the IQ among males and females keeping the number of languages constant, the IQ of females was higher than that of males when the number of languages was 2, 3, and 4. The IQ was the same when the number of languages known to the respondents was six. Furthermore, In the academic performances in classes X and XII, respondents who knew three or more languages scored a higher percentage in class X but scored lesser in class XII. However, this was not statistically significant, and hence, we could not assert any conclusion on it.

The cohort included high achievers since they were a group of fresh students qualified for admission to the MBBS course through a rigorous national entrance examination. India is a country with a huge population, and there is fierce competition to achieve entry to the Medical profession. In this regard, most of the students recruited were above average IQ grades. However, there was wide variability in the number of respondents in each category of knowledge of the language, while we had only one subject with ONE language, and seven of them knew six languages, 97 knew two languages. We achieved the homogeneity of the subjects, as all were high achieving medical students who qualified the National Eligibility Cum Entrance Test. The IQ of almost all the respondents was above average, thereby reducing the variability in the raw data. However, the nonuniform distribution of the subjects across the different subgroups (Only one respondent knew one language, 97 respondents knew two languages, 66 respondents knew three languages, 25 respondents knew four languages, nine respondents knew five languages, and seven respondents knew six languages). This meant that specific correlations and conclusions were not drawn since only one person knew one language. Clearer results could be revealed if a bigger sample size with comparable numbers of respondents in each group is used. Hence, further research could reveal the relationship between the knowledge of language and intelligence.

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Conflicts of interest

There are no conflicts of interest.

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