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Genetic Expression On Verbal And Performance Cognitive Abilities Of Twins

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Abstract

The present investigation formulated with the aim of expression of genetic on verbal and performance cognitive abilities of twins. 100 pairs of twins with the age group 6-8 years were selected from two districts namely: Bhiwani (N=90) and Hisar (N=110) from the Haryana state. The verbal and performance cognitive abilities of twins were measured using the Wechsler Intelligence Scale for Children (WISC-R). Heritability estimate was used to analyze the genes expression on verbal and performance cognitive abilities of twins. The result stated that the heritability estimates for verbal cognitive abilities of twins were 61 percent and 54 percent in Bhiwani and Hisar districts respectively. For performance cognitive abilities the heritability estimates were 57 percent and 52 percent in Bhiwani and Hisar districts. The heritability estimates for performance cognitive abilities in Bhiwani district were 53 percent and 59 percent in the age group 6-7 years and 7-8 years respectively and in Hisar district were 51 percent and 55 percent in the age group 6-7 and 7-8 years. The result also revealed that the monozygotic twins were more correlated in both verbal and performance cognitive abilities as compared to dizygotic twins. The twins study clearly revealed that genetic expression on verbal and performance cognitive abilities increased significantly as increase in the age group.

Key words: Genetic, Environment, Monozygotic twins, Dizygotic twins.

Introduction

In the field of psychology and behaviour genetics the cognitive ability is the most studied area. Twin study provides valuable information regarding the genetic expression of composite character. Cognitive development may be defined as the development of thinking across the life span. For the significant achievement in verbal and performance cognitive abilities the childhood developmental period is a substantial time for these cognitive changes (Gur *et al*. 2014). During this period successful development of cognitive abilities leads to future mental and physical well being, occupational success and financial success. Better cognitive abilities expect attainment of education, income, health and longevity. Thus it successful contributes to the intellectual capital of knowledge-based societies (Deary 2012).

The vast majority of heritable traits, such as, height, cognitive abilities and Intelligence Quotient are highly heritable and very complex (Benyamin *et al.* 2013). Heritability may be defined as the proportion of variation that arises from genetic expression. Heritability

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plays a vital role to investigate the expression of genetic on verbal and performance cognitive abilities (Ropers 2010).Monozygotic (MZ) twins are genetically identical and share approximately 100% of their genetic material, while dizygotic (DZ) twins are fraternal twins and full siblings share on average 50% of their segregating genes (Oommen 2014).

Genes influences the both verbal and performance cognitive abilities. Many studies on twins suggested that the genetic contribute in cognitive abilities 30-80 percent at different levels. The genetics expression increase with age, mainly from early childhood to early adulthood (Oommen 2014). The genes affect the cognitive abilities of twins that develop into the first decade of life and increase over time (Briley *et al.* 2013). Lyons (2017) suggested that genetic expression influenced both verbal and performance cognitive abilities of twins differently with age. Rosalind et al. (2018) reported that cognitive abilities of twins were heritable and observed that the genetic influences on different developmental patterns of verbal and non-verbal cognitive abilities of twins from the age group 7 to 12 years. Spengler et al. (2018) investigated that genetic on verbal and non verbal cognitive abilities of twins in the age of 7-14 years.

Bergen *et al.* (2007) observed that heritability may change due to age-related changes in genes-expression and the proportion of variants may be due to change of environmental factors which increased with age and decreased in interaction with family members. Marieke *et al.* (2008) studied several quantitative genetic models to find out the heritability of cognitive abilities by using data from twins and found that additive genetic effects account for 67% of the variation in verbal and nonverbal cognitive abilities of twins. Panizzon *et al.* (2014) indicated that verbal and nonverbal cognitive abilities were highly heritable (86%) and genetics affected the specific cognitive domains.

Hansell *et al*. (2015) used the classical twin model, estimated the heritability for verbal and performance cognitive abilities, intelligence (IQ), reasoning, and working memory in a twin and sibling sample. The results indicated that genetic material affecting the cognitive abilities of twins.

Materials and methods

Study Design: The aim of twin study was to find out genetic expression verbal and performance cognitive abilities. The study was carried out in two districts namely: Bhiwani (N = 90) and Hisar (N = 110) of Haryana state. The purpose of selection of state Haryana was availability of maximum numbers of twins in the required age group of 6-8 years.To assess the cognitive abilities of twins, total 100 pairs of twins were selected from two districts with the age group 6-to-8 years.

Data collection: Data were collected by assessment, interview, observation and questionnaire method from the twins.

Tool: The cognition of twins was examined by The WISC-R (Wechsler 1974) and it is applicable on normal and abnormal children with both sexes and any socio-economic status of children's family. It included six verbal subsets (information, similarities, arithmetic, vocabulary, comprehension, and digit span), and six performance subtests (picture completion, coding, picture arrangement, block design, object assembly, maze).

Statistical Analysis: The statistical analysis performed in software SPSS (Statistical Package for the Social Sciences). Correlation coefficient and heritable estimate were used to meet the objectives of the study. Heritability estimates (h^2) were calculated by the following formula given by Falconer (1960), h^2= 2(RMz-RDz) Where, h^2 is the heritability estimate, RMz is the correlation coefficient for monozygotic twin pairs and RDz is the correlation coefficient for dizygotic twins. Correlation coefficient was used to find the correlation between the verbal and performance cognitive abilities of twins.

Result

Heritability estimates for verbal and performance cognitive abilities in both districts

Table 1 revealed that heritability estimates for verbal abilities of twins in Bhiwani district was 61 per cent. The data clearly indicated that the the remaining 39 per cent variance in verbal abilities in Bhiwani district was attributed to environmental factors. The heritability estimates for performance abilities of twins in Bhiwani district was 57 per cent and the remaining 43 per cent variance in performance abilities was due to environmental situations. In Hisar district the heritability estimates for verbal and performance abilities were 54 per cent and 52 per cent, respectively. The interpretation of data clearly showed that the remaining 43 per cent and 48 per cent variance in verbal and performance abilities respectively was attributed to environmental factors. The findings on heritability estimates showed that the gentic influence on verbal and performance abilities of twins was more in Bhiwani district than in Hisar district.

Table 1: Heritability estimates for verbal and performance cognitive abilities in both districts

Cognitive abilities	**Heritability (%)**	
	Bhiwani	**Hisar**
Verbal	61	54
Performance	57	52

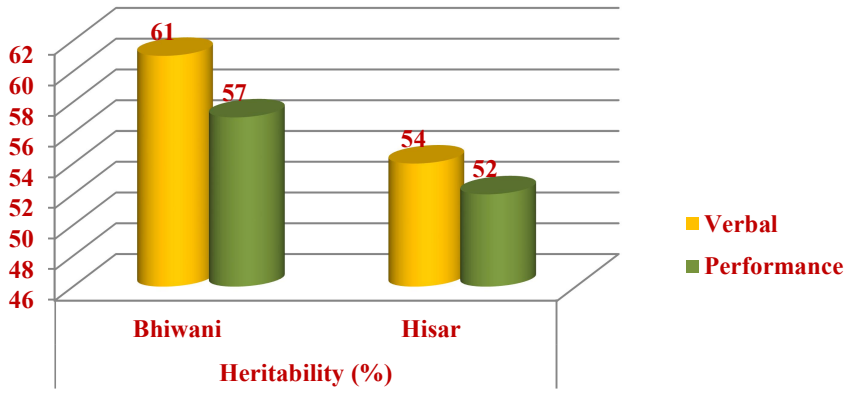

Fig. 1Heritability estimates for verbal and performance cognitive abilities in both districts

Heritability estimates for performance cognitive abilities over the years in both districts

Table 2 revealed that heritability estimates for performance cognitive abilities of twins in Bhiwani district was 53 per cent in the age group 6-7 years. The data clearly indicated that the the remaining 47 per cent variance in performance cognitive abilities in Bhiwani district was attributed to environmental factors. The heritability estimates for performance abilities of twins in Bhiwani district in the age group 7-8 years was 59 per cent and the remaining 41 per cent variance in performance abilities was due to environmental situations. In Hisar district the heritability estimates for performance cognitive abilities were 51 per cent and 55 per cent in the age group 6-7 years and 7-8 years respectively. The interpretation of data clearly showed that the remaining 49 per cent and 45 per cent variance in performance cognitive abilities was attributed to environmental factors. The findings on heritability estimates showed that the gentic influence on performance cognitive abilities was increases as increase in the age of twins in the districts.

Table 2: Heritability estimates for performance cognitive abilities over the years in both districts

Years	Heritability (%) of performance cognitive abilities	
	Bhiwani	Hisar
6-7 years	53	51
7-8 years	59	55

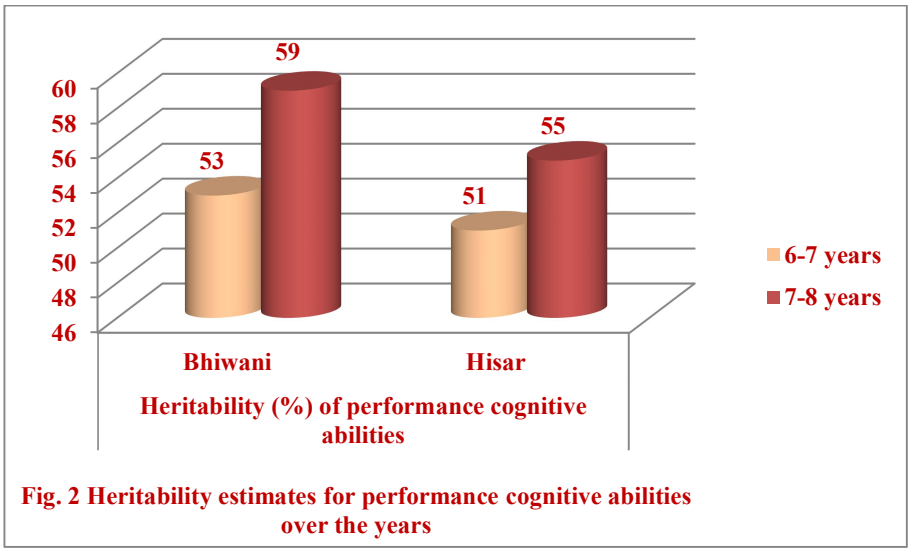

Fig. 2 Heritability estimates for performance cognitive abilities over the years

Correlation Coefficient of monozygotic and dizygotic twins

The data in figure 3 revealed regarding the correlation coefficient of monozygotic and dizygotic twins. The data clearly indicated that the correlation coefficient(r) of monozygotic twins was 0.93 in the age group 6-7 years and 0.95 in the age group of 7-8 years. Further the data in figure 3 portrait regarding the dizygotic twins, the correlation coefficient(r) was 0.64 and 0.69 in the age group 6-7 years and 7-8 years respectively. The result provided robust evidence that the monozygotic twins were more correlated with each other than the dizygotic twins. The monozygotic twins in the age group 7-8 years were more correlated with each other in cognitive abilities than the age group 6-7 years.

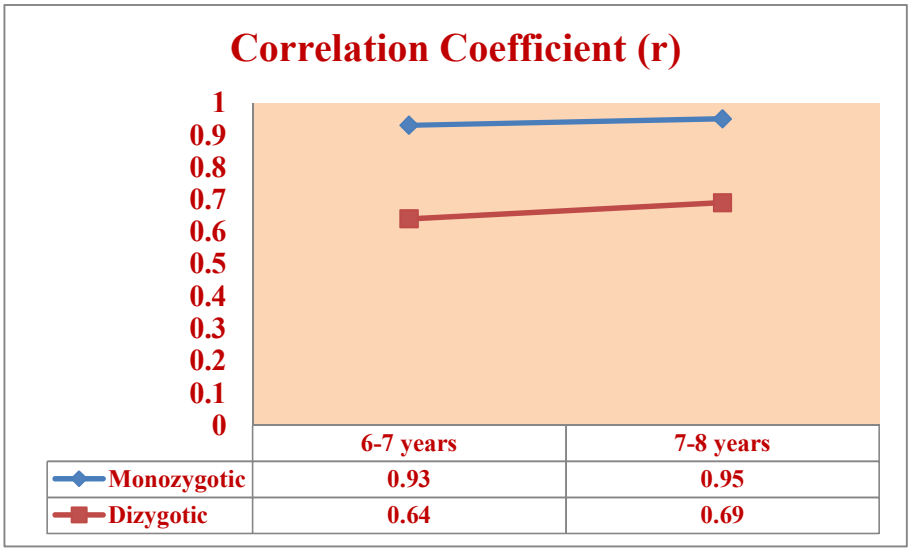

Fig. 3 Correlation Coefficient of monozygotic and dizygotic twins

Discussion

The findings on heritability estimates showed that the gentic influence on verbal and performance abilities of twins was ranging from 50 to 60 per cent in both Bhiwani district and Hisar district. Lazaroo *et al*. (2019) conducted twin study to examine the genetic influence on non-word reading ability, verbal and nonverbal cognitive abilities, and standardized academic achievement and concluded that 62% of variance in Verbal cognitive abilities and 51% of variance in Performance cognitive abilities of twins. The similar findings supported the result that the heritability estimate of cognitive abilities was 40-60 per cent (Trzaskowki *et al*. 2014). The heritability estimation method used to assess the genetic expression on cognitive abilities of twins and concluded that genetic differences between individuals account for between approximately 20% to 70% of the variance in cognitive abilities (kan *et al*. 2013). Claire *et al*. (2008) indicated that genetic influences account for over 60% of the variance in cognitive outcome of twins, with environmental influences accounting for the remaining variance.

The heritability of verbal and performance cognitive abilities showed that the genetic influence increases as increase in the age group. Other study supported the results and stated after conduct multiple tests using the twins that the genetic variance increaes with increasing age and affect all cognitive abilities (Mollon *et al*. 2020). Reynolds and Finkel (2015) conducted a meta-analysis of cross-sectional twin and family studies of specific cognitive abilities and concluded that patterns of age differences in heritability estimates across cognitive domains.

Gene × Age (G × A) interaction on cognitive abilities can be tested using a cross-sectional design that models differences in cognitive performance as a function of both relatedness and similarity in age between individuals. As well as providing an estimate of genetic influence on cognitive abilities, G × A interaction analysis suggested that this effect is due to fluctuations in action of the same genetic factors and variation in the genetic factors influencing the trait at different ages (Calkins *et al*. 2015). The general trend is that the magnitude of genetic variance increases gradually from early childhood to adulthood while shared-environmental variance decreases (Tucker-Drob *et al*. 2013).

The result of correlation coefficient of monozygotic twins and dizygotic twins indicted that that the monozygotic twins were more correlated with each other than the dizygotic twins. The similar findings stated by conducted research on monozygotic and dizygotic twins that the cognitive abilities of monozygotic or identical twins were more similar than dizygotic or fraternal twins (Kovas *et al*. 2007). De Fries *et al.* (2013) showed that genetic correlations between diverse tests of verbal and nonverbal cognitive abilities are greater than 0.50.

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