

The role of general cognitive ability and math performance in college students with math difficulties

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Introduction

It is a well known fact that every area of academics that requires cognitive operations is positively correlated with each other in the general population (Jensen, 1998). Moreover, this positive correlation (often termed *positive manifold*) is almost always due to the fact that all these academic tasks tap, in some manner, general cognitive ability (g ; Spearman, 1904). To date, the majority of this research have studied individuals who do not come from atypical populations, so there remains a need to understand if the same pattern of relationships hold with various atypical populations. To that end, this study sought to determine the relationship between g and psychometric (i.e., paper-and-pencil) math tasks in a group of college students with math difficulties.

Method & Results

170 college undergraduates with self-identified (and confirmed) math difficulties each underwent a comprehensive psycho-educational test battery including the Wechsler Adult Intelligence Scale-III (WAIS-3), Wechsler Memory Scale-III (WMS-3), and Woodcock Johnson-III Tests of Achievement (WJ-3). The WAIS-3 FSIQ range was 84-143 (avg. 108), which is what would be expected from a college-student population.

From the $R_{p=18}$ matrix, four factors were extracted and obliquely rotated. From this $R_{p=4}$ matrix 1 factor (g) was extracted. **Figure 1** gives a graphical representation of the factor extraction. It was expected that the proportion of variance explained by the factors would look like it does in the most studies of a similar nature (see **Figure 2**), where g explains the most covariance, and other factors explain significantly less. Instead, the factor pattern for this atypical population looked much different (see **Figure 3**). While g still explained the most of the covariance (~ 30%), the others factors explained much more than was predicted (13-20%).

After extracting the factors, following Jensen's (1998) *method of correlated vectors*, the g factor was correlated with four math tasks (3 from the WJ-3 and 1 from the WAIS-3, none of which were in the original correlation matrix) (see **Table 1** for coefficients). As the table shows, no math task was significantly related to g , indicating that for this particular group of people, math performance is not as heavily reliant on g as it is in the population as a whole.

Discussion

While the results were unexpected from the viewpoint of g -theory, they can be possibly explained from a developmental/lifespan perspective. For this particular sample of college students, there was a heterogeneity of reasons for their math difficulties, ranging from early difficulty with subtraction in elementary school to only having difficulty with the more abstract mathematical concepts, such as algebra. Moreover, there were a significant number of students who had no difficulty with math *per se*, but had developed other psychological issues throughout their pre-collegiate schooling (e.g., exorbitant anxiety, attention deficits) that had an adverse impact on their college-level math performance. Consequently, when they take higher level math classes (i.e., college-level algebra), the students' previous areas of difficulty are exposed and amplified, resulting in a manifestation of similar symptomology (i.e., the end result of math difficulty), but for very different reasons. While there needs to be much more research done in this area, the implications of the current findings, if the developmental/lifespan perspective is correct, is that failure in math is not necessarily of function of overall cognitive ability. Moreover, in order for this particular group of students to experience success in mathematics, it appears that there needs to be a wide variety of interventions available, both in quality and in onset of delivery.

References

Jensen, A. R. (1998). *The g factor: the science of mental ability*. Westport, CT: Praeger.

Spearman, C. (1904). "General intelligence" objectively determined and measured. *American Journal of Psychology*, 15, 201-293.

Figure 1. Hierarchical Factor Structure of Cognitive Abilities

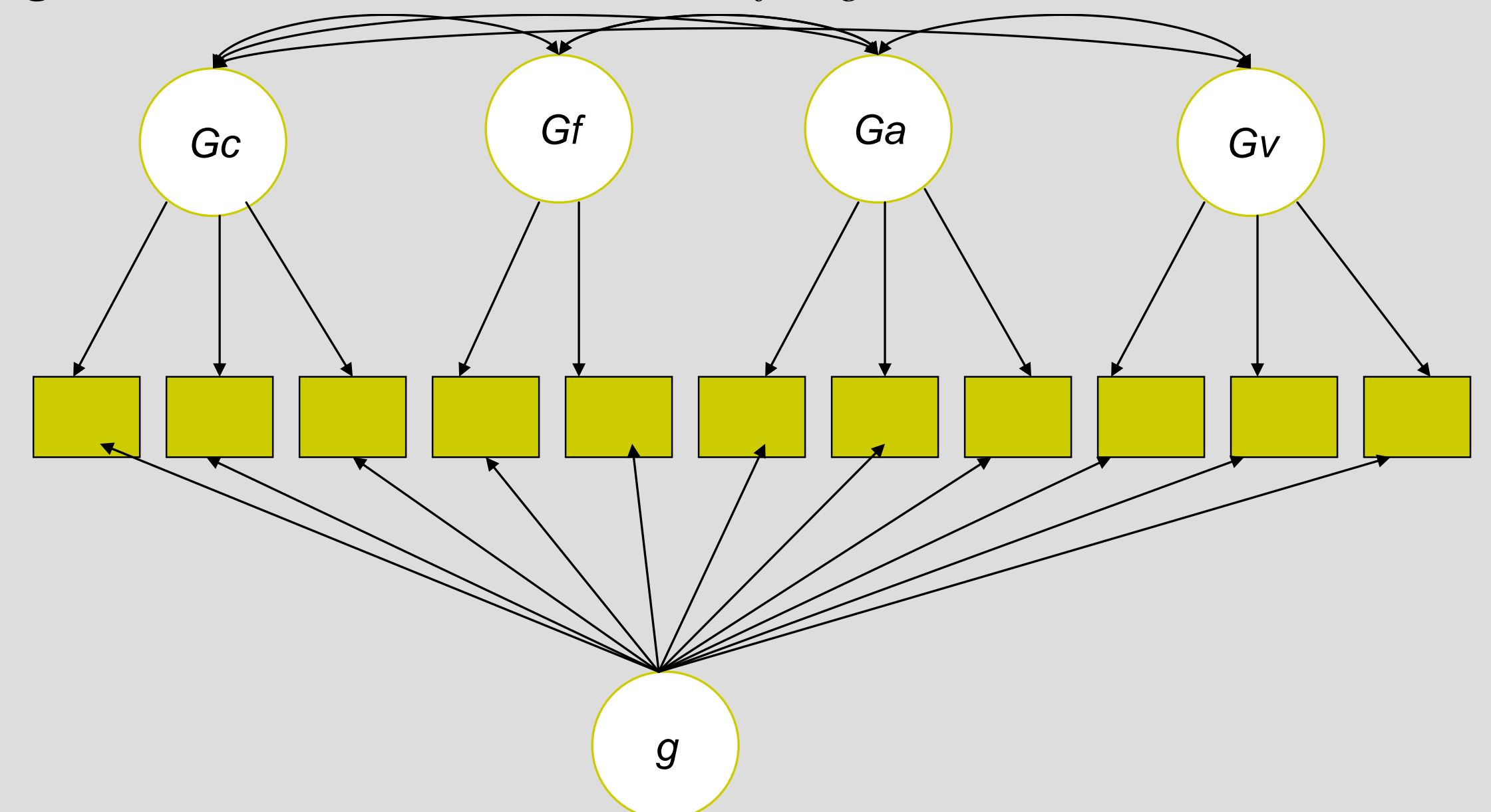


Figure 2. Percentage of Variance Explained by Factor Structure (Typical Study)

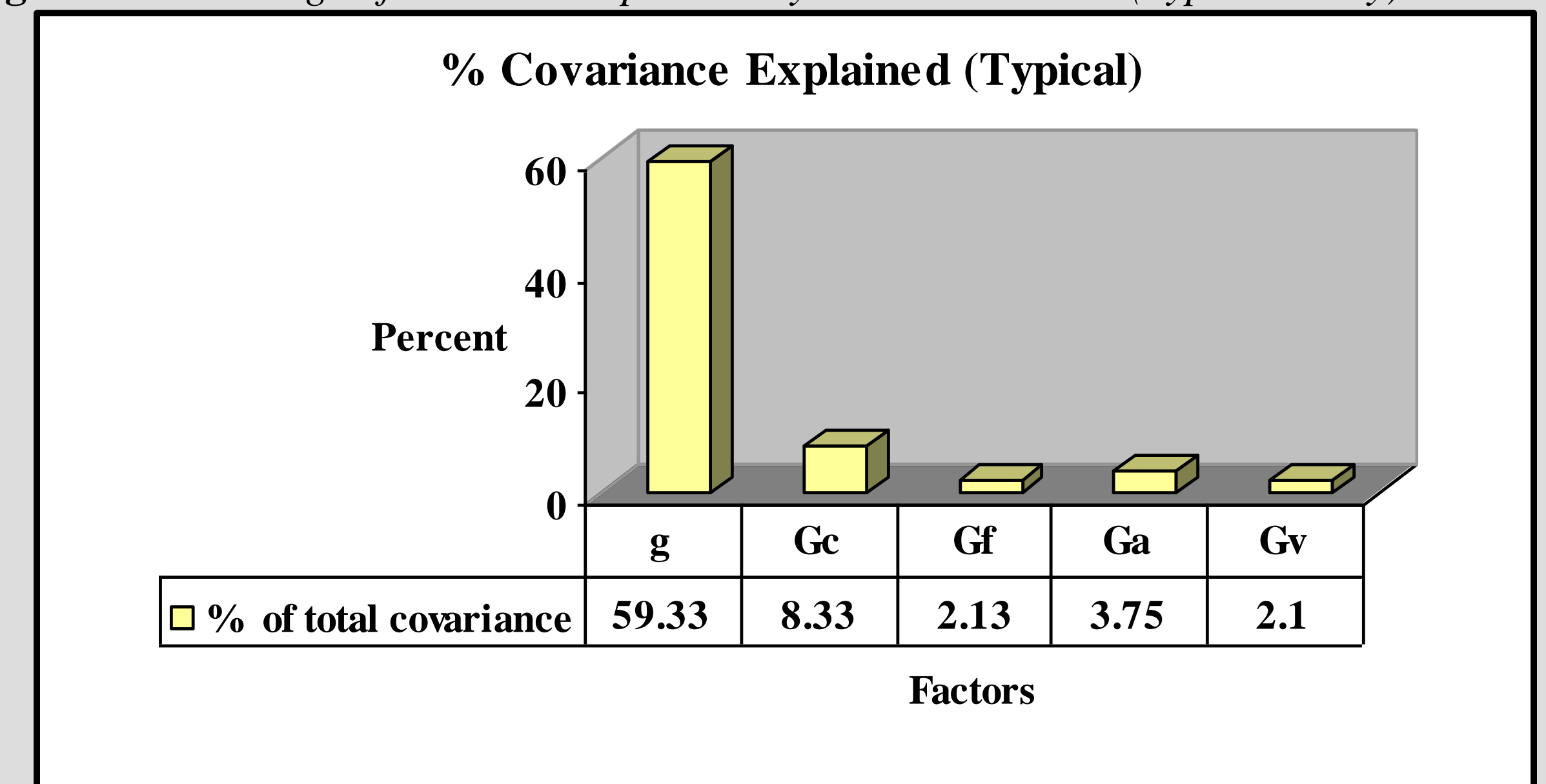


Figure 3. Percentage of Variance Explained by Factor Structure (Current Study)

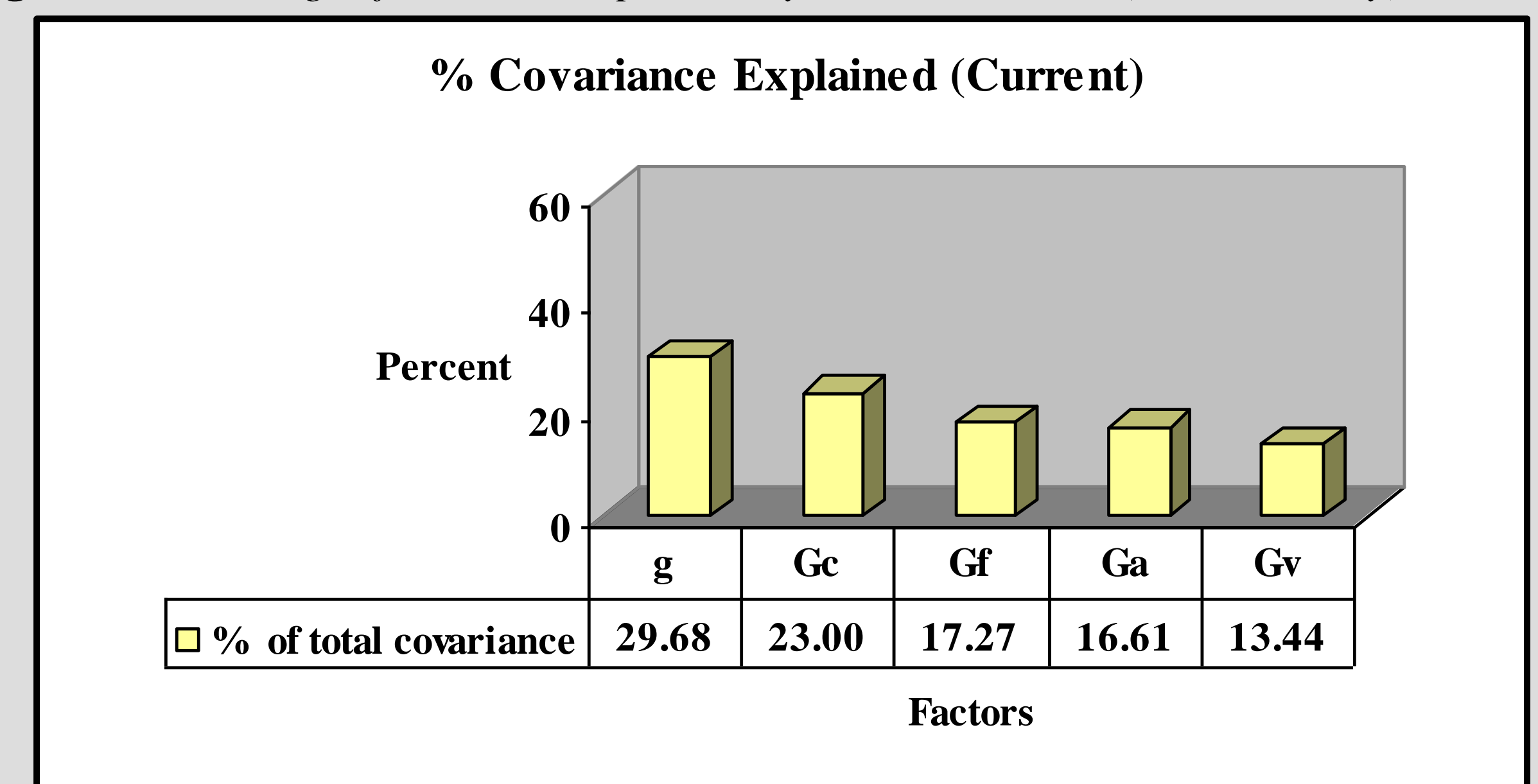


Table 1. Correlated Vectors Results

	Calculation	Applied Problems	Math Fluency	Mental Arithmetic
r_{xy} (RO)	-0.018	0.264	-0.335	0.155
p-value	0.945	0.289	0.175	0.539