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PREVIEW

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**Differentiation of intellectual functioning of children in three
ability groups**

Streur, Joseph Henry, Jr., Ph.D.

The University of Nebraska - Lincoln, 1989

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300 N. Zeeb Rd.
Ann Arbor, MI 48106

PREVIEW

DIFFERENTIATION OF INTELLECTUAL FUNCTIONING
OF CHILDREN IN THREE ABILITY GROUPS

by

Joseph H. Streur, Jr.

A DISSERTATION

Presented to the Faculty of
The Graduate College in the University of Nebraska
In Partial Fulfillment of Requirements
For the Degree of Doctor of Philosophy

Major: Interdepartmental Area of Psychological and Cultural Studies

Under the Supervision of Professor Wayne Piersel

Lincoln, Nebraska

November, 1989

DIFFERENTIATION OF INTELLECTUAL FUNCTIONING OF CHILDREN IN THREE ABILITY
GROUPS

Joseph H. Streur, Jr., Ph.D.

University of Nebraska, 1989

Advisor: Wayne Piersel

It has been predominantly believed that the organization of intellectual functions is essentially invariant across a range of ability, and that this structure is not significantly affected by the level of IQ. This research examined whether or not increased differentiation of intellectual ability could be observed in three groups of children with varying ranges of IQ.

A sample of 806 children (528 males, 278 females; IQ range 40 to 139; C.A. 41 to 250 months) was divided into three ability groups on the basis of their WISC-R Full-Scale IQ (Group 1 = 79 and below; Group 2 = 80 to 100; Group 3 = 101 and above). The WISC-R subtests (excluding Mazes) together with the standard scores from either the Wide-Range Achievement Test, Peabody Individual Achievement Test, or the Woodcock-Johnson Psycho-Educational Battery Subtests of Reading, Spelling, and Arithmetic from each group were submitted to a factor analysis.

As a result, Groups 1 and 2 yielded a two- and three-factor solution respectively, suggesting an increase in intellectual differentiation. While four factors were extracted from Group 3, only two of these met the a priori criteria required for interpretation. Interfactor correlations within each group did diminish significantly

from a mean of .39 for Group 1, to -.05 for Group 2, and to -.002 for Group 3.

In summary, the results of this study indicate that some degree of differentiation of intellectual ability occurs in association with increasing levels of IQ. It remains for additional research to provide further confirmation of this hypothesis.

PREVIEW

TITLE

DIFFERENTIATION OF INTELLECTUAL FUNCTIONING

OF CHILDREN IN THREE ABILITY GROUPS

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DEDICATION

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PREVIEW

CHAPTER I

INTRODUCTION

"Intelligence is not to be conceived as a self-contained or stationary faculty; implanted once and for all at birth," wrote Burt (1954). Instead, intelligence may more accurately be defined as a capacity for adaptation or adjustment of the individual to the environment (Burt, 1954). The efficacy of that adaptation is strongly influenced by both the general level of intellectual functioning and the specialization of mental abilities themselves derived from the general ability. The relationship between general intellectual functioning and specialized abilities is therefore worthy of examination in terms of what each contributes to the ability of an individual to perform effectively in response to various demands, and in terms of the sheer number of specific abilities which proliferate from the general ability.

The relationship of general or a specific ability to an intellectual demand is rather straightforward. Tasks that require specialized performance are most likely related to a more or less specific ability, while performance on a broader base is best predicted in terms of one's general ability (Spearman, 1904). An example of this proposition, as applied to intellectual assessment, is that one's capacity for solving arithmetic problems may be most accurately predicted by a test of mathematical reasoning ability and assessment of one's skill in performing math calculations, while a predictive determination of an individual's overall academic performance is best

made on the basis of an assessment of their general intellectual ability.

The second aspect of the relationship between general ability and its specific derivatives, having to do with the number of specific abilities as a function of the level general ability, is perhaps less intuitively clear than the role that specific abilities play in solving equally specific problems. It is the purpose of this study to determine whether a relationship does in fact exist between the overall level of intellectual ability and the occurrence of specific abilities which would make the organization of intelligence more complex in those of higher cognitive potential. But first, other related issues having to do with past theory and organization of intellectual ability must be discussed.

Factor Theorists

One cannot gain a very complete understanding of the organization of intelligence into general and specific abilities without employing some objective method for organizing empirical data presumed to be representative of intellectual functioning (Anastasi, 1985; Sternberg, 1984). Factor analysis, a technique for classifying and describing various aspects of intellectual functioning, as evidenced by individuals' performance on psychometric tests of human intelligence, has proven to be a useful tool. Although factor analysis does not explain intelligence, it does provide an effective means of organizing its various aspects into descriptive constructs.

Factor analysis long has been an accepted method for describing the organization of intellectual functioning (Humphreys, 1962; Sternberg, 1981). However, very often in its history of use, factors derived from the analysis of test data were interpreted as representing

an all-inclusive and authoritative structure of intelligence. The procedure of factor analysis itself and the overinterpretation of its results may be said to have evolved out of the early research of Spearman (1904, 1927) that served as a counterpoint for Thurstone's (1938) multi-factor theory of intelligence. Spearman (1907) proposed the existence of a factor of general ability, termed "g," which underlay more specific abilities in every individual. "g" was defined as a construct which was dependent upon and also represented the mental energy with which the individual was endowed. To complement the "g" factor, Spearman (1904, 1927) theorized there existed a range of very specific, or "s" factors, which gave the global "g" its practical expression through the performance of specific tasks.

With the development of multiple factor analyses (Thurston 1938) several theorists, as will be discussed below, used the technique as a means to define their own interpretation of intellectual organization. These models varied in the degree of complexity by which intellectual processes were divided, as well as on the basis of whether or not a general factor of intelligence existed. The first theorist after Spearman (1904, 1927) to propose a factor-based organization of intellectual functioning was Thurstone (1938) who identified what he termed "primary mental abilities": Verbal meaning, number facility, inductive reasoning, perceptual speed, spatial relations, memory, and verbal fluency. Subsequent to the identification of the seven "primary mental abilities," Thurstone postulated that a general factor of intelligence might exist, since the seven abilities were themselves intercorrelated.

In a more complex model of intellectual organization, Guilford (1967) proposed a "structure of intellect" comprised of 120 factors. These factors were divided into three categories. The first category was operations, of which there were five kinds: cognitive, memory, divergent thinking, convergent thinking, and evaluation. Second, was a category of four different types of content: figural, symbolic, symantic, and behavioral. Product was the third category in Guilford's model and constituted the result of an intellectual operation in a given area of content. There are six areas of product: units, classes, relations, systems, transformations, and implications. As complex as Guilford's model is, it does not allow for a general factor of intelligence; however, this feature has not interfered with the "structure of intellect" being used as a basis for organizing the results of tests of intelligence (Meeker, 1969).

Another approach to the factorial organization of intellectual ability is based upon an hierarchical arrangement of factors of intelligence (Burt, 1940, 1949; Vernon, 1950, 1971). According to Vernon (1971) intellectual abilities are arranged in a four-tiered hierarchy. The structure of the hierarchy itself is inverse to the specificity of the abilities; that is, global intelligence occupies the apex of the hierarchy and represents overall general ability. Below the tier of general intelligence are two major group factors, verbal-educational and practical-mechanical. Inclusion of the two group factors was consistent with group factorists (Brown and Thompson, 1921; Holzinger, 1938) who argued that specific factors alone could not account for all mental abilities. Assuming the lower positions in the hierarchy are two levels of minor factors which, like those in

Spearman's (1927) model, were specific to tasks and which evolved out of interaction with the environment (Vernon, 1971).

Factor analysis has provided the means by which various aspects of intellectual functioning can be isolated and described. The efficacy of this data analysis technique, however, may have been overly relied upon to the extent the researcher tended to pronounce the factor structure derived from an analysis as representing intelligence itself. Yet, as has been pointed out, (Anastasi, 1985) the factors of intellectual functioning are influenced by education, culture, and other experiences of the individual. Considering the variability of experience, one would not be surprised to observe variation in the factorial composition of intellectual functioning between homogeneous groups.

During the first half of the twentieth century, while theorists (Spearman, 1904, 1927; Thurston, 1938; Vernon, 1950) were employing factor analysis in an effort to identify a model of intellectual organization which was presumably enduring in its structure, and generalizable in its application to various groups of individuals, other researchers (Anastasi, 1930; Garrett, 1928; Schiller, 1934; Schneck, 1928) were observing what appeared to be variations in the organization of intellectual functioning in individuals of different age groups. The differences discovered consisted of decreases in the intercorrelation of verbal, numerical, and memory processes among groups of individuals with increasing chronological age.

The role maturity plays in the differentiating of the organization of intellectual ability (Garrett, 1946; Wright, 1935) is unclear and open to dispute. More recent research (Cohen, 1956, 1957, 1959; Kaufman, 1975) found chronological age did not influence the factorial

composition of intelligence and it consisted of a verbal and a performance factor. However, it must be pointed out both Cohen (1956, 1957, 1959) and Kaufman (1975) used intelligence tests (Wechsler Intelligence Scale for Children--Revised; Wechsler Adult Intelligence Scale) which are standardized by age. Consequently, one would not expect to see age associated variability in the results. However, this apparent stability in the organization of intellectual functioning may be more a result of the tests' stability rather than any invariance of intelligence which these tests purport to measure.

Approaching the subject of the organization of intellectual functioning from another point of view, that is on the basis of the ability of the groups studied, causes one to reexamine previous research. Those who proposed that differences in the factor structure of intellectual functioning were influenced by age (Anastasi, 1930; Brian, 1934; Garrett, 1928; Garrett, Brian, and Pearl, 1935; Schneck, 1929; Schiller, 1934) seemed to have overlooked the fact that older samples represented not only a difference of increased age, but very likely a difference of increased intellectual ability and most certainly increased achievement as well. Consider that the samples of individuals in the younger groups studied were taken from public schools and may very well have represented a broader range of intellectual ability than the older high school and college students who would likely have constituted samples of generally higher intellectual ability.

Those researchers who found no significant change in the organization of intellectual functions (Cohen, 1956, 1957, 1959; Kaufman, 1975) also failed to account for the diversity in the level of ability among their subjects. Furthermore, their research was not

directed toward documenting the factorial structure of intellectual functioning. Instead the research was aimed at demonstrating the stability of the tests used in the research. In these researchers' efforts to "find factors," they engaged in certain modifications of the customary methods of defining factors.

It is a further limitation of the previous research which addresses the organization of intellectual ability that the analyses did not include achievement test data and in that way assessment of intellectual functioning may be considered incomplete (Anastasi, 1982; Kitson and Vance, 1982; Mercer, 1979; Mishroe, 1983). The differences between intelligence and achievement test data may be interpreted in the following way. Tests of cognitive ability measure intelligence in broad terms of achievement over an extended period of time prior to assessment, whereas achievement tests measure more recently acquired and specific ability (Anastasi, 1985; Sternberg, 1984).

Extending the proposition that intelligence and achievement tests measure different, but related, aspects of intellectual functioning it is reasonable to hypothesize that the organization of intellectual functioning would be more complex for individuals of higher ability than those of lower levels. Thus, there would not be a single factorial structure of intellectual functioning as earlier postulated (Gilford, 1967; Spearman, 1904, 1927; Thurstone, 1934; Vernon, 1950, 1971) nor as more recently identified (Cohen, 1956, 1957, 1959; Kaufman, 1975).

It is the purpose of this research to determine whether or not the factorial structure of intellectual functioning is more complex in conjunction with increases in the level of intellectual ability, as