

The Relationship between Cognitive Style, Sternberg's Triarchic Ability Test, and Raven's Standard Progressive Matrices in Gifted Students Matrices

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ABSTRACT

The aim of this study was to investigate the relationship between cognitive style, the three abilities (or kinds of giftedness) driven from the Sternberg's Triarchic Abilities Test (STAT), and Raven's Standard Progressive Matrix (RSPM). The construct validity of the STAT was also examined. The sample comprised 400 16-year-old gifted secondary school students. The students were given the Arabic version of Cognitive Styles Analysis (CSA), STAT and RSPM. The factor analysis showed that the STAT measures the three abilities which it is supposed to measure. Yet, the factor analysis of the STAT left much of the variance in performance unexplained (54.7%), meaning that the test is not yet perfect. The result showed that the correlations between the two dimensions of cognitive style and analytic, creative, practical abilities as well as the total score of STAT were roughly zero. Moreover, the correlation between RSPM and the style dimensions was also very low. These low coefficients suggest that the styles measured by CSA are originally independent of intelligence as measured by STAT and RSPM. There was also a significant interaction between VI style and the type of ability. The Bimodals were superior in creative and practical ability, while the Verbalisers were superior in analytical ability. Bimodal style is more related to creativity than the other styles are. This result may suggest that the creative persons have a cognitive flexibility to move from one mental process to another. They are neither Verbalisers nor Imagers but rather they can flexibly operate using either style when the situation calls for it. However, this result requires further investigation to clarify this relationship .

Key Words: Cognitive Style, Gifted students, Raven's Standard Progressive Matrices, Sternberg's Triarchic Ability Test.

INTRODUCTION

Although researchers interested in cognitive style have asserted that cognitive style is not ability, the relationship between style and intelligence has always been a problem. Measures of cognitive style, which only measure one end of the dimension positively while treating the other as

interference, represent one reason for this assumption of relationship. The researchers have repeatedly reported the relationship between GEFT and intelligence as an example of this problem (see Messick, 1984, 1994; Riding and Rayner, 1998).

Riding and Pearson (1994) with 12-to 13-year-old pupils investigated the relationship between cognitive style as measured by the Cognitive Style Analysis (CSA) and intelligence as measured by the short form of the British Abilities Scales. This later scale comprises subtests, which assess the speed of information processing, matrices, similarities and the recall of digits. Near zero correlations were found between these subtests and the CSA. Riding and Agrell (1997) have observed similar results from a study in Canada of the relationship between style and the Canadian Test of Cognitive Skills (CTCS) with 14- to 16-year-old students. This study revealed an interaction between cognitive style and intelligence in their effect on school achievement, such that style was more critical where pupils were of lower ability and the subject did not ideally suit their style.

It appears from these results that cognitive style as measured by CSA seems to be unrelated to intelligence. Riding and Pearson (1994) reported that there is a need for further work comparing style with different abilities. The current study will try to explore the relationships between cognitive style as measured by CSA and intelligence as measured by STAT (Sternberg, 1993b) and Raven's Standard Progressive Matrices (RSPM).

The Concept of Cognitive Style

Cognitive style is neither ability nor a personality trait but rather it has been considered as a subtle mediator between cognition and personality (Baron, 1982; Grigorenko and Sternberg, 1995; Kogan, 1983; Messick, 1984, 1994; Witkin and Goodenough, 1981). Riding and Rayner (1998: 11) stated that, "*Both style and ability will affect performance on a given task. The basic distinction between them is that performance in all tasks will improve as ability increases, whereas the effect of style on performance for an individual will be either positive or negative, depending on the nature of the task.*" It has become clear that cognitive style deeply affects a wide range of learning performance (see Ibrahim, 2004; Riding, 2002; Riding and Rayner, 1998).

Although the work in the field of cognitive style was active and creative between the 1940s and the 1970s, it has withered away, possibly because the leaders in the field have either died or moved on to other things (Kogan, 1983). "*This waning of interest left the whole field of investigation fragmented and incomplete, and without clear usefulness for the central*

concerns of education" (Riding and Cheema, 1991: 194). Riding and Rayner (1998, 8) point out that: "*the researchers worked in their own context, in isolation from one another, developed their own instruments for assessment and gave their own labels to the styles they were studying with little reference to the work of others. Not surprisingly, this led to the development of a large and confusing variety of style labels.*"

The large number of construct labels which emerged led to a great deal of conceptual confusion, since the same labels have been used for indicating behaviours which are qualitatively different, and conversely similar behaviours have been given different labels. Consequently, the term *cognitive style* has been seen as somewhat problematical and elusive. More recently, there has been greater awareness of these problems on the part of a number of theorists (e.g., Miller, 1987; Tiedemann, 1989). Hence, some researchers have endeavoured to conceptualise the different cognitive styles into a number of schemes (Curry, 1987; Grigorenko and Sternberg, 1995; Miller, 1987; Riding and Cheema, 1991). One of the best attempts is Riding and Cheema's (1991) which introduces a *higher-order classification* of the various constructs. Furnham (1995: 410) described this attempt as '*long overdue*'.

Reviewing 30 models identified by the researchers in the cognition-centred tradition, Riding and Cheema (1991) concluded that they could be organised into two *orthogonal* cognitive style dimensions; a Wholist-Analytic dimension (WA) and a Verbal-Imagery dimension (VI) (Fig. 1). The WA describes whether an individual tends to *organise* information into wholes or parts. The VI describes whether an individual during thinking is inclined to represent information verbally or in mental images. Further reviews by Rayner and Riding (1997) have supported this conclusion.

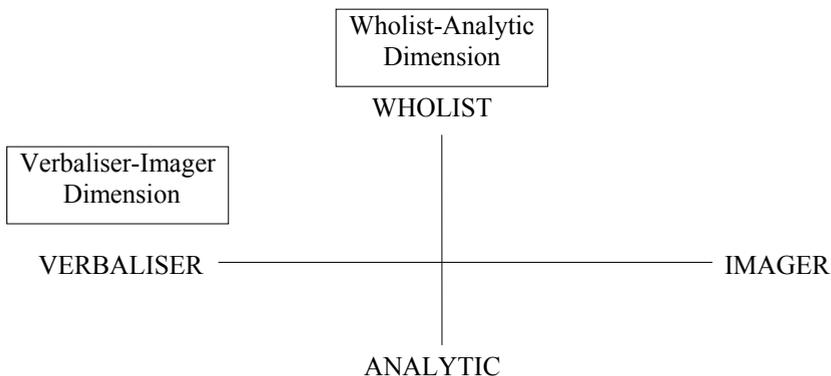


FIG. 1: The Cognitive Style Dimensions

Source: Riding and Cheema (1991)

While both styles and intelligence affect performance on problem solving tasks, cognitive styles were found to be unrelated to intelligence (Riding and Pearson, 1994). They were also found to influence learning processes and outcomes (Riding and Sadler-Smith, 1992; Riding and Caine, 1993; Riding and Douglas, 1993; Riding and Read, 1996). Many studies made by Riding and his co-workers supported the existence of the two dimensions of cognitive style (see Riding, 2000; 2001; Riding and Cheema, 1991; Riding and Rayner 1998).

The identification of distinct families of cognitive style, the Wholist-Analytic and Verbal-Imagery, led to the need for a satisfactory and efficient means of assessing both dimensions of style. The attempts resulted in the Cognitive Styles Analysis (CSA) developed by Riding (1991).

INTELLIGENCE

The concept of intelligence is very broad. Some researchers see it as a single factor, while others see it as encompassing multiple abilities (e.g., Gardner, 1983; Sternberg, 1985). Intelligence tests have been under debate since the last century (see Sternberg, 2000; Sternberg and Kaufman, 1997; Stemler, *et. al*, 2009). Dissatisfaction with the existing psychological concepts of the nature of intelligence and intellectual giftedness was the first factor leading researchers to recognise a need for an innovative approach to intelligence testing (Shavinina, 2001; Shavinina and Kholodnaya, 1996).

There has been an increasing interest in the identification of students who are intelligent in ways which go beyond IQ. The reason is in part that IQ tests do not explain much of the variance in students' performance (Sternberg, 1995; Chart, Grigorenko, and Sternberg, 2008). The shortcomings of traditional theories of intelligence have been discussed frequently in the literature (e.g., Neisser, 1998; Sternberg, 2000). In general, the traditional psychometric approach has regarded intelligence as synonymous with IQ. However, many contemporary theorists, such as Carroll (1993), have recognised that there is probably more to intelligence than merely the general factor and they suggest some kind of hierarchical theory. Sternberg (1999: 437) argues that the problem with theorists who support the existence of a general factor is that they tend to restrict the range of participants, tasks and situational context in which they have studied intelligence. He argues that when the range of such variables is expanded, the claim that a general factor of intelligence characterises all of cognitive functioning becomes more doubtful.

According to (Chart *et. al*, 2008; Sternberg ,1995), the weakness of these tests does not lie in the kind of items they contain, but rather their lack of a viable basis in theory. These tests tend to be based upon traditional psychometric notions of intelligence rather than on more recent theoretical notions of what makes someone intelligent.

Recently, theorists in the field of intelligence have been interested more in theory-based assessments whereby they can explain and predict intelligent performance in school as well as other settings. Sternberg proposes a new approach to the psychological assessment of intellectual abilities which is based on his triarchic theory of successful intelligence and intellectual giftedness. The triarchic theory of intellectual giftedness is a special case of a more general triarchic theory of human intelligence (Sternberg, 1986: 224). According to the theory of human intelligence (Sternberg; 1997a; 1997b; 1997c; Mandelman *et al.*, 2010; Stemler *et al.*, 2009; Sternberg *et al.*,2008), there are three main kinds of intellectual giftedness (or three kinds of intelligence):

Analytic Giftedness:

Giftedness in analytic skills involves being able to dissect a problem and understand its parts. It involves when the components of intelligence are applied to analyse, evaluate, judge or compare and contrast. It is typically involved when components are applied to relatively familiar problems where the judgements to be made are of an abstract nature. People who are strong in this area of intellectual functioning tend to do well on conventional tests of intelligence, which place a premium on analytical reasoning. Sternberg (1998: 20) believes that children develop in ways beyond merely what is tested by conventional psychometric intelligence tests.

Synthetic Giftedness

Synthetic giftedness is seen in people who are insightful, intuitive, creative or adept at coping with relatively novel situations. People who are synthetically gifted may not earn the highest IQ scores on conventional measures of intelligence, but they may be the ones who ultimately make the greatest contributions to such pursuits as science, literature, art, drama, and the like. Sternberg (1997c) believes that to be successful in life requires the use of creative and practical skills, but because these skills have not been actively encouraged, students tend not to develop them.

Practical Giftedness:

Practical giftedness involves applying the analytic and/or synthetic abilities which individuals may have to the kinds of problems which confront them in daily life. Practical giftedness involves applying the components of intelligence to experience so as to (a) adapt to, (b) shape and (c) select environments. Adaptation is involved when one changes oneself to suit the environment. Shaping is involved when one changes the environment to suit oneself. Selection is involved when one decides to seek out another environment which is a better match with his/her needs, abilities and desires. People differ in their balance of adaptation, shaping and selection, and in the competence with which they find a balance among the three possible courses of action.

Combining Analytic, Synthetic and Practical Giftedness

It is probable that people do not possess only one of these kinds of skills. Rather, they represent some blend of the three different kinds, and this blend can change over time. According to (Sternberg, 1997a; Sternberg, 2010) the central part of giftedness is co-ordinating the three skills and knowing when to use which one. Giftedness is viewed as a well-managed balance of the three abilities, and a gifted person is a good "mental self-manager".

The Aim of the Study

The aim of the present study is to investigate the relationship between cognitive style, the three abilities derived from STAT, and RSPM. The construct validity of the Triarchic Abilities Test (STAT) will be examined. The results are divided into three parts. The first part presents a factor analysis of STAT. The second part examines the relationship between cognitive style and STAT. The third part examines the relationship between cognitive style and RSPM. The relationship between style and intelligence will be considered in two ways: correlations and, in order to look for possible interactive effects of style on cognitive abilities, by means of analysis of variance.

METHOD

Participants

The sample of the study involved a cohort of 400 16-year-old students from 10 secondary schools of Sohag province (Egypt), of whom 230 were males and 170 females. All of them were nominated as gifted by their teachers using behavioural rating scales and the total score of academic achievement with a minimum GPA of 4.5 (out of 5).

MEASURES

Cognitive Styles Analysis (CSA)

The computer-presented Cognitive Styles Analysis (CSA) (Riding, 1991) was used to determine the students' position on the two fundamental cognitive styles (WA and VI). The Wholist-Analytic dimension indicates whether a person tends to process information in wholes or parts, while the Verbal-Imagery dimension indicates whether a person is inclined to represent information during thinking either verbally or in mental images (Riding and Douglas, 1993).

The CSA instrument comprises three subtests. The first consists of a set of 48 verbal questions which assess the verbal-imagery dimension. The second two subtests consist of 40 diagrammatic problems which assess the Wholist-analytic dimension. Each of the cognitive style dimensions is a continuum and independent of the other (Riding and Rayner, 1998: 44-45). Simply pressing one of two designated keys on the keyboard to indicate 'True' or 'False' to each question activates the response mode. The ratios of response times is calculated by the software to indicate to the subject whether they tend to be 'Wholist' or 'Analytic', 'Verbaliser' or 'Imager' or somewhere in between. Accordingly, a subject is allocated to one of the nine main CSA types: Wholist/Intermediate/Analytic on the WA dimension, and Verbaliser/ Bimodal / Imager on the verbal dimension.

The questions related to the verbal aspect on the verbal-imagery dimension are straightforward statements which sample a subject's capacity to recognise category, similarity or difference between pairs of concepts. The statements are in the form, '(X) and (Y) are the same type' to which the response is either true or false, indicated by pressing the appropriate key. The set of questions related the imagery style is based primarily on whether a subject can visualise the colour similarity or difference between two named objects. The questions of this type are written in the form '(X) and (Y) are the same colour'. Similarly, the response is either true or false.

Riding's aim was to overcome assessment problems and avoid many of the criticisms levelled at other instruments especially those associated with the GEFT and the traditional self-report rating scales used to assess imagery performance. The CSA has several advantages (Riding, 2000: 318-319) in that it is an objective test because it positively assesses both ends of each style dimension and hence measures style rather than ability. It is context free and can be used in a wide range of situations.. It is a direct measure of

cognitive processing and hence is less susceptible to the effects of social desirability.

Sternberg's Triarchic Abilities Test (STAT)

Researchers in the 80s and 90s (e.g., Gardner, 1983; Sternberg; 1991; 1992) perceived a need for a different way of assessing intellectual development. They felt that reliance on tests comparing people against a standard or norm prevented researchers from developing measures that are more useful. They believed that researchers must discover which activities or skills usually appear. From that information, they could set up criterion measures which would tell them not only the present level of a child's development, but also which experiences would best challenge further growth.

Sternberg (1995: 2) argues that the tests used today are little better than tests used four decades ago and are, in many cases, the same tests. He believes that the conventional standardised tests measure analytic abilities fairly well, but fail to measure synthetic abilities - those allowing for invention, creativity and personal contribution. Sternberg asserts that traditional tests benefit students who can solve problems quickly in the intermediate range of difficulty and penalise those who can solve very difficult problems, for such problems have been eliminated. Further, the kind of planning and evaluating needed for good performance in everyday life differs from the kind of planning and evaluating assessed by these traditional tests.

The STAT (Sternberg, 1993b) is based on the triarchic theory of intelligence and constitutes one theory-based alternative to traditional intelligence tests. As mentioned above, the triarchic theory views intelligence as comprising three aspects: an analytical aspect, a creative aspect and a practical aspect. The test has nine four-option multiple-choice subtests, each comprising four items, plus three essay subtests - each emphasising one aspect of triarchic theory. In the triarchic theory, as well as the test, these aspects of intelligence are viewed as distinct but not as independent. All depend on the same mental processes applied at different levels of experience and in different levels and kinds of contexts.

The STAT comprises a set of tests in three domains (verbal, quantitative, and figural) and two response modes (multiple-choice and essay). The test has a set of nine multiple-choice subtests, each consisting of two sample items and four test items (total=36 items). Sternberg (1994: 45) mentions that the abilities as well as tests measuring them are viewed as potentially correlated. They are not independent, as in psychometric theories

with orthogonal factors (e.g., Guilford) or in Gardner's theory of multiple intelligences.

Preliminary validation of the STAT (Sternberg and Clinkenbeard, 1995) has shown it to be appropriate for the intended purposes and correlated with but not identical to other tests. In 1996, the psychometric properties of the test were computed on a sample consisting of 326 high school students. The internal-consistency reliabilities of the subtests were computed for the multiple-choice items. These reliabilities were .63 for the analytical items, .62 for the creative items, and .48 for the practical items. The consistency of these internal reliabilities was considered as satisfactory (Sternberg et al., 1996). In 2001, Sternberg et al. used techniques of hierarchical confirmatory factor analysis of STAT in three international samples. The results provide some support for the structural validity of the STAT.

In another study supported by the College Board (Sternberg and the Rainbow Project Team, 2002), Sternberg and his colleagues used STAT on 1015 students at 15 different institutions (13 colleges and 2 high schools). Their goal was to devise tests that would supplement the SAT, measuring skills that this test does not measure. They found that STAT tests significantly and substantially improved upon the validity of the SAT for predicting first-year college grades (Sternberg and the Rainbow Project Collaborators, 2005; Sternberg, The Rainbow Project Collaborators, and University of Michigan Business School Project Collaborators, 2004). The test also improved equity: Using the test to admit a class would result in greater ethnic diversity than would use just the SAT or just the SAT and grade-point average.

The STAT (experimental Version) was translated into Arabic language with the permission of the author. The Arabic version of STAT was revised by some specialists in the Educational Psychology. Then, the STAT was translated back into English to ensure adequate translation. In addition, some words which did not apply to the Arabic context were modified to suit the Arabic culture. The Alpha Cronbach reliabilities of the subtests were computed for the multiple-choice items. These reliabilities were .69 for the analytical items, .65 for the creative items, and .60 for the practical items.

Raven's Standard Progressive Matrices (RSPM)

The RSPM is known as one of the most widely used intelligence tests in the world. It is commonly reviewed as a *culture-free* intelligence test. The Raven's Standard progressive Matrices may be described as consisting of 60 visual analogy problems, each having the form of a two-way Serial

Analogies Test. In each set the first problem is as nearly as possible self-evident. Each item consists of a matrix of geometric designs which are presented as the problem with one design removed from the sequence. The individual's task is to deduce the theme of relations expressed among the designs and choose the missing figure from among the options set. The items on the RSPM are divided among five sets (A through E). Items in a given set share a common theme of relations; however, the nature of the relations increases in complexity within a set as well as across the sets (i.e., set E is the most difficult set).

The items of the first set, set A, consist of "continuous patterns" (as Raven calls them). These are virtually one-by-one matrices, and thus not so much analogy tests as abstract geometrical versions of Binet's "missing feature" test. In the sets B-E each item consists of four (set B) or nine figures (set C-E) in which one figure is missing. At the bottom of the page, six (set B) or eight (set C-E) numbered figures (the response categories) are arranged in two rows. In all of these, only one completes the missing figure above it. Everyone, whatever his age, is given exactly the same series of problems in the same order and is asked to work at his own speed, without interruption, from the beginning to the end of the scale. As the order of the problems provides the standard training in the method of working, the scale can be given either as an individual, a self-administered or as a group test.

Procedures

After translating the STAT, some researchers in the educational psychology revised the Arabic version of STAT. Then, the STAT was translated back into English to ensure adequate translation. The study was conducted during the second semester of the academic year. Students were tested in their classrooms. The Sternberg Triarchic Abilities Test (STAT) was administered first and then the Raven's Standard Progressive Matrices (RSPM) with the standard instructions and under no speeded conditions. Finally, the Cognitive Styles Analysis (CSA) was applied individually in the computer laboratory of the schools. The students were informed that their participation would be entirely voluntary and were assured that the information they provided would be confidential and would be used for research purposes only. The tools were administered by the researchers.

RESULTS AND DISCUSSION

The results will be considered in three sections. Firstly, using factor analysis, the construct validity of the STAT will be examined. Secondly, the simple relationship between the CSA, STAT and RSPM using correlations

will be presented. Finally, the possible interactive effects of the two dimensions of the cognitive style, STAT and RSPM, will be explored.

Factor Analysis of STAT

In order to establish its factorial structure, a principal components analysis with Varimax rotation was performed with 852 students on the subtests of STAT (9 subtests). Table1 shows the subtest intercorrelation matrix which was subjected to a principal component analysis to determine objectively the number of the factors to retain.

TABLE 1.
The intercorrelations between the 9 Subtests of STAT

Variables	A-V	A-Q	A-F	P-V	P-Q	P-F	C-V	C-Q	C-F
A-V	1.000								
A-Q	.148**	1.000							
A-F	.131**	.217**	1.000						
P-V	.037	.042	.056	1.000					
P-Q	.103**	.160**	.119**	.138**	1.000				
P-F	.043	.089**	.054	.144**	.106**	1.000			
C-V	.162**	.067*	.105**	.047	.084**	.051	1.000		
C-Q	.093**	.189**	.149**	.052	.135**	.052	.041	1.000	
C-F	.162**	.120**	.143**	.037	.113**	.049	.177**	.093**	1.000

A = Analytic, P = Practical, C = creative, Q = Quantitative, V= Verbal and F= Figural

The initial statistics of the Principal Components Analysis yielded three factors with an Eigenvalue greater than one and these accounted for 45.3 % of the total variance (Table 2). For the extraction of factors, the criterion of Eigenvalue greater than or equal to 1 was adopted. Also, a subtest was assigned to a factor if it had a loading ≥ 0.40 on that factor and accounted for $\geq 10\%$ (calculated by squaring the appropriate factor loading) more of variance on that factor than on any other.

Table 2 presents the loadings for the three-factor solutions produced by the Principal Factor Analysis with Varimax Rotation, with factor loading 0.40 and above shown in italics and bold face.

Factor I, II and III accounted for 21.0%, 12.9% and 11.3% of the total variance, respectively. Based on the order of extraction and minimum loading criterion, Factor I represented the creative ability and was composed of C-V, C-F and A-V. Factor II, which was labelled analytic ability, consisted of A-Q, A-F and C-Q. Finally, factor III, which was labelled practical ability, was made up of P-V, P-Q and PF. In the lower portion of

Table 2 appear the Eigenvalue and the percentage of explained variance for each factor. This result supports the hypothesis of the construct validity for the STAT.

TABLE 2.
Rotated Factor Matrix for STAT

Variables	Factor 1 Creative	Factor 2 Analytic	Factor 3 Practical
A-V	.45	.30	.01
A-Q	.30	.61	-.05
A-F	.30	.60	.01
P-V	-.00	-.04	.70
P-Q	.17	.28	.51
P-F	-.11	.20	.41
C-V	.68	-.18	.18
C-Q	.13	.45	.08
C-F	.63	.19	-.02
Eigenvalue	1.89	1.07	1.02
% of explained variance	21.0	12.9	11.3

The Cognitive Style, STAT and RSPM

The possible relationships between cognitive style, STAT and RSPM were examined both in terms of a simple form using correlation and also by means of analysis of variance to consider the possible interactive effects of the two dimensions and the STAT as well as RSPM. The correlations between the two dimensions of cognitive style and type of abilities derived from the STAT and RSPM are shown in Table 3. Correlations of 0.33 and above are shown in bold face.

TABLE 3.
Correlations between Style, the STAT and RSPM

VARIABLES	WA	VI	ANALYTIC	PRACTICAL	CREATIVE	STAT	RSPM
WA	1.000						
VI	0.08	1.000					
ANALYTIC	0.021	0.005	1.000				
PRACTICAL	-0.056	-0.003	0.193**	1.000			
CREATIVE	0.064	-0.033	0.336**	0.197**	1.000		
STAT	0.014	-0.018	0.762**	0.642**	0.704**	1.000	
RSPM	0.120*	0.004	0.415**	0.232**	0.331**	0.457**	1.000

* P = 0.05; ** P = 0.00

Inspection of Table 3 indicates *firstly* that the correlations between the two style dimensions was very low ($r = 0.08$) and non-significant, which supports the previous findings that the correlation between the two dimensions were found to be consistently low and typically $r = \pm 0.1$ (Riding and Douglas, 1993).

Secondly, the correlations between the two style dimensions and the analytic, creative and practical abilities, as well as the total score of STAT, were roughly zero. Also the correlations between WA dimension and RSPM and between VI dimension and RSPM were low ($r = 0.120$; 0.004 respectively) although it was marginally significant in the case of WA ($P = 0.05$). These low coefficients suggest that style is independent of intelligence as measured by STAT and RSPM and this also supports previous findings (Riding and Pearson, 1994; Riding and Agrell, 1997).

Thirdly, there were statistically significant correlations between analytic, creative and practical abilities. In keeping with the triarchic theory, the levels of intercorrelation between the three abilities of STAT are sufficiently *significant* to suggest that there are at least some common mental processes underlying the three kinds of functioning which it is supposed that the STAT measures. However, they are at the same time sufficiently *low* to suggest the discriminant validity of the three kinds of subtests (Sternberg, 1995).

There were also significant correlations between RSPM and analytical ability as well as the total score of STAT ($r = 0.415$; 0.457 respectively). The lowest correlation of RSPM with the STAT was with the practical subtest ($r = .232$), which is the part whose content differ most d from that of traditional tests, while the highest correlation of RSPM was with the analytical subtests ($r = .415$). This result generally is consistent with the results from Sternberg's study (1995). The more conventional the test that he used, the higher the test tended to correlate with the analytical subtest of the STAT and the lowest with the creative subtest.

The Cognitive Style and STAT

In considering the relationship between cognitive style and intelligence, it is possible that the two style dimensions interact in their effect on cognitive abilities, and to check this, an analysis of variance was performed of WA style (3) by VI style (3) with repeated measures on the type of ability (3) and the mode of presentation (3). The type of ability refers to the

analytical, practical and creative abilities which the STAT measures, while the mode of presentation refers the verbal, quantitative and figural modes of presentation of the subtests of STAT.

The mean untransformed Wholist-Analytic ratio was 1.46 (SD 0.50) and the mean Verbal-Imagery ratio was 1.21 (SD 0.32). The sample was divided into three equal groups on each dimension, to allow for the possibility of non-linear relationships while keeping a reasonable cell size. The ranges of the ratios were: Wholist-Analytic dimension, Wholist 0.53-1.21, Intermediate 1.22-1.60, Analytic 1.61-3.86; Verbal-Imagery dimension, Verbaliser 0.57-1.07, Bimodal 1.08-1.24, Imager 1.25-3.38.

The results indicated that there was no significant effect of the two dimensions of style on the STAT. But, the results showed that Wholists were the most superior group in the practical subtests which depend heavily on understanding the situation as a whole. This could be reasonable because the positive strength of the Wholists is that when considering information or a situation they see the whole 'picture' Consequently, they can have a balanced view and can see the situation in its overall context (Riding and Caine, 1993: 61). Similarly, the results show that the Analytic position were superior in the analytical subtests, and this could be because the Analytics are good at seeing similarities and detecting differences. Anyway, the differences were marginally insignificant.

The results showed that there was a significant interaction between VI style and the type of ability ($F = 2.86$; $df 4,1702$; $P = 0.023$). The Bimodals were superior on creative and practical abilities, while Verbalisers were superior on analytical ability (Figure 2).

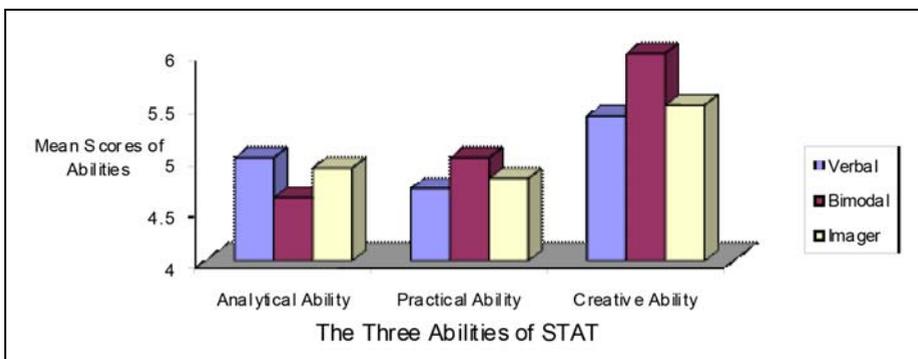


FIG. 2: Verbal – Imagery Style and Type of Ability

It is worth mentioning here that describing someone as a Verbaliser does not mean that he or she has more verbal ability than someone who is an Imager. It means only that the Verbaliser tends to represent information

verbally while the Imager tends to do so in images. An individual with a Bimodal style has the ability to handle information with greater flexibility than a person who habitually uses one style or another. It is very interesting to know that the Bimodals were more creative than the others. This result suggests that the creative persons have a *cognitive flexibility* to move from one mental process to another. They are neither Verbalisers nor Imagers but rather they can flexibly operate in either style when the situation calls for it. However, within each type of ability the differences between the style groups were small, and this may require further investigation to clarify this relationship.

The Cognitive Style and RSPM:

In this section, analysis of variance was used to test the difference between the two dimensions of cognitive style (VI and WA) on RSPM. The results showed that there was a significant interaction between the two dimensions of styles on the RSPM ($F = 4.42$; $df.4,308$; $P = .002$). The Analytic-Imagers were the highest while the Wholist-Verbalisers were the lowest. The other groups achieved similar scores. The interaction is shown in Figure 3.

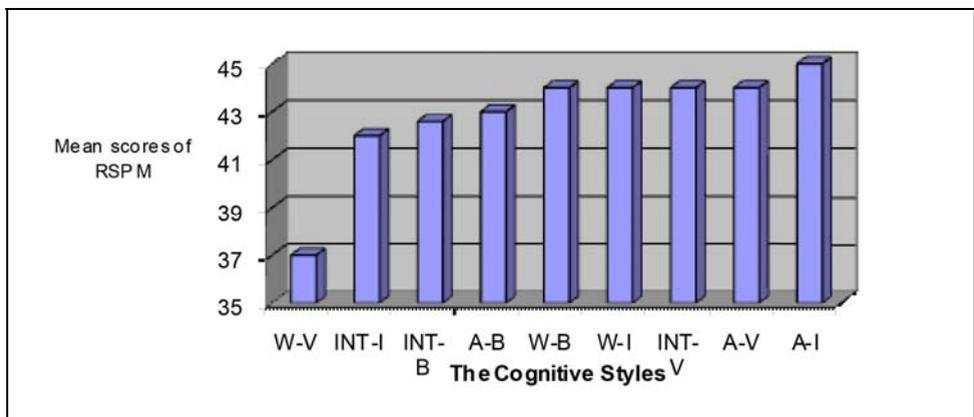


FIG. 3: The Cognitive style and RSPM

One explanation of this result is that the RSPM test is a non-verbal test and depends largely on visual analogy problems. These reasons may reflect that these differences appeared because this kind of item was more suitable to the Analytic-Imagers than it was the Wholist-Verbalisers. These results may also reflect the fact that when there is a match between the cognitive style and the type of presentation of information, there is a liberating effect on the individuals' natural ability.

The finding of no relationship between style and the overall RSPM scores suggests that they are generally independent in origin, as found by Riding and Pearson (1994) and Riding and Agrell (1997).

CONCLUSIONS

Two main revelations ensue from the findings of the current study that may add to the existing literature on cognitive style and intelligence.

First, the findings of the present study show that cognitive style as assessed by the CSA is independent of intelligence. The correlations between the two dimensions of cognitive style and analytic, creative and practical abilities, as well as the total score of STAT, were roughly zero. Also, the correlations between RSPM and WA and VI dimensions were also very low. These low coefficients suggest that style is originally independent of intelligence as measured by STAT and RSPM, as found by Riding and Pearson (1994) and Riding and Agrell (1997).

Second, the factor analysis has shown that the STAT measures the three abilities supposed to measure and this supports Sternberg's claim that when the range of variables used to assess intelligence is expanded, the claim that a general factor of intelligence characterises *all* of cognitive functioning becomes dubious. But the factor analysis of the STAT leaves much of the variance in performance unexplained (54.7%). This means that the test is not yet perfect. However, it should be kept in mind that this test has been constructed particularly to identify gifted students, so it seems that it is difficult for normal students.

Much works are needed to improve the STAT to be valid to use in the field of identification of gifted students. The future research on the new version of this test, known as *Rainbow* and *Aurora batteries* (Chart, *et al.*, 2008; Sternberg, 2007, 2009; Sternberg, *et al.*, 2006; Tan *et al.*, 2009), need also to explore to what extent different cognitive styles that students prefer or adopt can affect their performance on different formats of *Aurora* battery subtests.

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دراسة العلاقة بين الأسلوب المعرفي والقدرات العقلية الثلاثية واختبار رافن لدى الطلبة الموهوبين

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الملخص

هدف البحث الحالي إلى دراسة العلاقة بين الأساليب المعرفية وبين القدرات العقلية الثلاثية (كما تقاس باختبار ستيرنبرج للقدرات الثلاثية) وبين اختبار رافن للذكاء. تم تطبيق النسخة العربية من اختبار تحليل الأساليب المعرفية (CSA) واختبار القدرات الثلاثية (STAT) (بعد تعريبه)، ومصنوفة رافن للذكاء (RSAM) على ٤٠٠ طالب وطالبة من الطلاب الموهوبين بالمرحلة الثانوية تم اختيارهم بناء على ترشيحات المعلمين باستخدام قوائم تقدير الخصائص السلوكية ونسبة التحصيل العام. وقد أظهرت النتائج صدق التكوين العامي لاختبار القدرات الثلاثية وإن كانت النتائج تشير إلى أن الاختبار ما زال يحتاج إلى مزيد من البحث والتطوير. وقد أشارت النتائج إلى أن معامل الارتباط بين الأساليب المعرفية (الكلي التحليلي، واللفظي التصوري) والقدرات العقلية الثلاثة (التحليلية والتركيبية والعملية وكذلك الدرجة الكلية) كانت تقريباً صفر، كما كان معامل الارتباط بين الأساليب المعرفية منخفضاً جداً. وهذه النتائج تقترح أن الأساليب المعرفية محل الدراسة مستقلة عن الذكاء كما يقاس باختباري STAT وRSPM.

وأشارت النتائج أيضاً إلى وجود تفاعل دال إحصائياً بين الأساليب المعرفية ونمط القدرة، حيث كان النمط الثنائي أكثر تفوقاً في القدرة الإبداعية والقدرة العملية، بينما كان أصحاب الأسلوب اللفظي أكثر تفوقاً في القدرة التحليلية. وإلى أن الطلاب ذوي الأسلوب الثنائي كانوا الأكثر تفوقاً في القدرة الإبداعية بين جميع الطلاب، وقد تشير هذه النتيجة إلى أن الطلاب المبدعين لديهم مرونة معرفية تسمح لهم بالتحرك من معالجة معرفية إلى أخرى، فهم ليسوا لفظيين ولا تصوريين، ولكن يمكنهم أن يعالجوا الموضوعات بمرونة باستخدام كلا الأسلوبين وفقاً للسياق. عموماً هذا الافتراض أو العلاقة في حاجة إلى مزيد من البحث والدراسة.

الكلمات المفتاحية: اختبار رافن، الأسلوب المعرفي، الطلبة الموهوبين، القدرات العقلية الثلاثية.