VERBALIZING-VISUALIZING COGNITIVE STYLES

AND USE OF IMAGERY IN UNIVERSITY STUDENTS

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LIST OF ABBIREVIATIONS

CSA	Cognitive Style Analysis
E-CSA-WA	Extended Cognitive Style Analysis Wholistic-Analytic
Mean Exp 1	Mean Exposure 1
Mean Exp 2	Mean Exposure 2
Mean I	Mean Imagery
Mean Pic	Mean Picture
Mean V	Mean Verbal
Med IRT	Median Imagery Reaction Time
Med VRT	Median Verbal Reaction Time
RT	Reaction Time
V/I ratio	Verbal Imagery Ratio
VICS	Verbal Imagery Cognitive Style
VVLSR	Verbal-Visual Learning Style Rating
VVQ	Verbalizer-Visualizer Questionnaire
W/A ratio	Wholistic Analytic Ratio

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All work that is futuristic in nature requires support of a very unique nature. When research resumes a path that is new territory the supervisor assumes importance for the innovations that one seeks to work on requires no ordinary mind. In that sense I was extremely fortunate in having Dr. Muhammad Pervez supervise my work. In new efforts in psychology one perforce has to perform at levels where one is likely to make mistakes. These were converted in to opportunities and his efforts at doing so are to be appreciated. Innovative efforts have that caveat and ultimately the guardian of such work and such development of abilities has been Dr. Pervez. When the beaten path is not to be taken the pitfalls and dangers are many. I never found him wanting when the trials seemed insurmountable. I have been fortunate in having his advice especially when one suffers from doubts and setbacks. Dr. Seema Pervez was a beckoning force always cushioning difficulties and always affectionate. The two individually and collectively created an environment in which the mind was not only disciplined but was also synthesizing and these two aspects created what one hopes is creative and meaningful work.

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with the taught virtues that come from the home university-the first university that one goes to. The analysis carried out by the ethical mind is based on unwavering honesty and is beyond self interest. The taught virtues from the first university remain at the conceptual level as well as the practical level. We may never be aware of these two seemingly contradictory aspects of life.

The students that are in path breaking areas should take heart from that knowledge cannot be taught, it can only be experienced and acquired, the most significant lesson I experienced from my supervisor.

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ABSTRACT

The present research explored the individual differences in verbalizing-visualizing cognitive styles of university students in Pakistani culture. This represents the fundamental knowledge on cognitive styles in Pakistan. Study I (phase I) was conducted to establish the evidences of test-retest reliability of Verbal-Imagery Cognitive Style Analysis (VICS; Peterson, 2005) test. The sample for test-retest reliability was 81. The test-retest coefficient showed stability at re-test ($r = .58$, $p < .01$) on the verbal tasks and ($r = .71$, $p < .001$) for the imagery task on the VICS test. In phase II (part I), alpha coefficient was computed on a sample of 427 students for the VICS and Extended Cognitive Style Analysis-Wholistic-Analytic (Extended-CSA-WA; Peterson, 2005) tests. Alpha coefficient was much satisfactory showing internal consistency of .81 for the VICS and .82 for the E-CSA-WA. Phase II (Part II) of the present study was conducted to explore individual differences in verbalizing-visualizing cognitive styles. The association and difference of the cognitive styles with variables like gender, age, subject groups and academic achievement were explored. The findings revealed allocation of cognitive styles. Styles were allocated through verbal-imagery (V/I) ratios and wholistic-analytic ratios. Ratios were calculated on median reaction times. Individual differences in cognitive styles emerged as verbalizer-visualizer and little style. Significant gender differences were identified as verbalizing-visualizing and little style, and nonsignificant gender differences on wholistic analytic cognitive style dimension. Style combination and association was explored between verbalizing-visualizing, little style and wholistic-analytic, little style. There were nonsignificant associations between verbalizer-visualizer, little style and wholistic-

analytic, little styles. Individual differences measuring specific information processing underlie verbalizing-visualizing cognitive styles was assessed by VICS task. The results revealed that student scored significantly different on median and mean reaction times of VICS tasks. This study further explored that male and female students would differ significantly on median and mean time taken on different VICS tasks. The hypothesis was partially supported on median reaction time of imagery tasks. The association between age groups and cognitive styles showed nonsignificant association between age groups and VICS tasks. Present study also explored mean difference of subject groups on VICS tasks. The association of subject groups (management sciences, social sciences, and natural sciences) with cognitive style (verbalizer-visualizer, little style) were explored. Results showed nonsignificant differences. Furthermore, the cognitive styles of high and low achievers were identified on cognitive styles. Results showed nonsignificant association between level of achievement and cognitive styles. Study II explored differential memory performance of the concrete and abstract sentences on a sample of 200 university students. Results showed that there is highly significant mean differences beween concrete and abstract sentences. Furthermore, this study revealed nonsignificant differences on an independent sample of 200, between instructional group (imagery instruction groups, n = 100) and non-instructional groups (instruction not given, n = 100). This research also explored a relationship of concrete and abstract sentences with cognitive style measures. This research would provide a fundamental knowledge on cognitive styles in Pakistan.

Chapter-I

INTRODUCTION

The Origin of Cognitive Style

Researchers explored the origins of cognitive styles, Martisen (1994) cited Vernon and traced cognitive styles to Greek and Roman literature. Rayner and Riding (1997) relate cognitive style to the work of Galton and Pinpoint the work of Bartlett (1932) and his research on individual differences in cognition. Riding and Cheema (1991) and Grigereneko and Sternberg (1995) agree that Allport (1937) was probably the first researcher who deliberately used the 'style' construct in association with cognition, referring to an individual's habitual or typical way of perceiving, remembering, thinking and problem solving. Messick (1976, 1996) describes that cognitive style reflect consistent individual differences in the manner or form of cognition which is distinct from the content or level of cognition. As such cognitive styles are often viewed as performance variables rather than as competence variables.

Human personality is defined as a system that operates as a whole through its interdependent parts. Personality influences organization of cognition, dimensionality and stability of structure, nature of cognitive processes and the level of measured ability. According to Messick (1996), styles cannot be considered as cognitive, affective, or behavioral variables rather should be considered as expressions of form which give personality structures in cognition, affect and behavior.

According to Witkin, Moor, Goodenough, and Cox (1977) cognitive style is "… Characteristic approach the person brings with him to a wide range of

situations…" (p.4) and this approach involves the person's perceptual and intellectual activities. Styles probably has a physiological basis and are fixed for an individual.

Vernon (1963) relates the early work of cognitive style with the efforts of Gestalt psychologists. She explained that subsequent work generated from the experiments, "… a considerable number of experiments…devoted to studying individual differences in perception" (p.221). She asserted that cognitive style has been evolved from the theories which are generalized from single experiment and from less empirical evidences. Three different traditions of style-based work are described by Grigereneko and Sternberg (1995). The first is named as cognitive centered approach, began in 1940s, evolved the development of cognitive styles, and experimental psychologists explored the area of individual differences in cognition and perception. The second research tradition began in 1970s, activity-centered theories of learning styles worked with the educationists and process-based issues of individual differences in the class room. The third tradition is described as learning centered approach, which emphasized on educational perspectives (as cited in Rayner & Riding, 1997).

The research literature on cognitive style is vast, and has been a very controversial area of research. In spite of the criticism, the research work has continued and researchers explored the origin of cognitive styles, and there has been a renewed interest in cognitive style research in recent years. Riding and Cheema's (1991) research on cognitive style and Paivio's (1971, 1988) work on Dual Coding Theory (DCT) underpins empirical research on verbalizing-visualizing cognitive styles. The resurgence of interest in this area, difficulty in conceptualizing and measuring the underlying construct of verbal visual cognitive style (Cronbach, 2002;

Jonassen & Grabowski, 1993; Sternberg & Zhang, 2001, Peterson, Deary, 2006) reinforced researchers to explore further, it has been criticized for lack of theory and isolation from main stream psychology and cognitive science (Kozhevnikov, 2007; Coffield, Eccleston, Hall, Meagher, & Moseley, 2004).

Defining the concept. Considerable debate emerged in defining cognitive style. Different researchers have different definition, and conducted researches from different perspectives. Confusion and contradiction with style definitions is frequently criticized (Armstrong & Rayner, 2002; Rayner, 2007). However, findings of qualitative and quantitative research have indicated several consistent dimensions of individual differences. (Dunn, DeBellow, & Bernnan, 1981; Riding & Cheema, 1991). Goldstein and Blackman (1978) defined it as a hypothetical construct that has been developed to explain the process of mediation between stimuli and responses. Research on cognitive styles has revealed that people exhibit significant individual differences in cognitive processing styles that they adopt in problems solving and in decision making activities (Robertson, 1985). Cognitive styles are psychological dimensions which represent consistent approach in an individual's manner of cognitive functioning, in particular with respect to acquiring and processing information (Ausburn & Ausburn, 1978; Messick, 1976; Witkin, Moore, Goodenough, & Cox, 1977). Tennant (1988) defined cognitive style as "an individual's characteristic and consistent approach to organizing and processing information" (p.89).

Riding, Glass, and Douglas (1993) explained cognitive styles as "a fairly fixed characteristic of an individual" (p. 265) and "are static and are relatively in built

features of the individual" (p.268). "Cognitive style is seen as an individual's preferred and habitual approach to both organizing and processing information" (Riding & Rayner, 1998, p.8).

Grigerenko and Sternberg (1995) mentioned that several efforts have been made to integrate the various aspects of style theory. Kogan (1980), Messick (1976, 1984), and Miller (1987) attempted to produce an integrated model and Messick's work provided an early foundation in which the typology of cognitive abilities, control, and styles were identified. He drew a distinction between 'style' and 'strategy'. Messick (1976) explained that cognitive styles "… appear to serve as high level heuristics that organize lower-level strategies, operations and propensities …..after including abilities ….. in such complex sequential processes as problem-solving and learning" (p. 9).

Peterson, Rayner, and Armstrong (2009) argued that "the prospects of identifying a consensus in theory, constructs and future direction of style research would be virtually impossible …but it should be possible to integrate researcher's ideas into a more cohesive, meaningful and workable framework, benefiting new, and established style researchers entering the field" (p.518).

Peterson et al. (2009) conducted a study on 94 styles researchers for conceptual confusion, contested definition, poor measurement and lack of validity. In this study the consistent features of cognitive styles emerged as stable, innate and closely linked to underlying information processing mechanisms.

Models of Cognitive Styles

Since research began in 1940s, a variety of cognitive style dimensions have been proposed. (Keffe, 1979; Messick, 1976). However, these researchers worked in isolation and over the years different models of cognitive styles have been developed. Some styles were conceptualized as typical responses to particular stimuli; some described that cognitive principle underlie complex behavior. Therefore, a long list of style labels appeared in the empirical findings.

The characteristic ways of perceiving and organizing experience, which is represented in cognitive style constructs has not only been significant for understanding individual differences but it provided foundational elements for the development of theories. The experimental work, which emphasized on information processing were derived from the Germans' gestalt school of perceptual psychology. This led to the development of the style construct of field dependence-independence (Witkin, Oltman, Raskin, & Kidd, 1971).

Individuals were found in different experimental situations, to rely on their surrounding field or context to a greater extent or to a less extent. Witkin, Moor, Goodenough, and Cox (1977) suggested that individuals are different in the extent to which they adopt for the internal and external factors in decision making and learning. In problem solving situations field dependent are sensitive to clues from the surrounding environments. These individuals learn best when external structure is provided and social environment reinforce the individual. Field dependence-independence has important implications for an individual's behavior and for an interpersonal behavior. Antonietti and Gioletta (1995) explores that field-independent individuals are analogical solvers than field dependents. Bennink (1982) describes

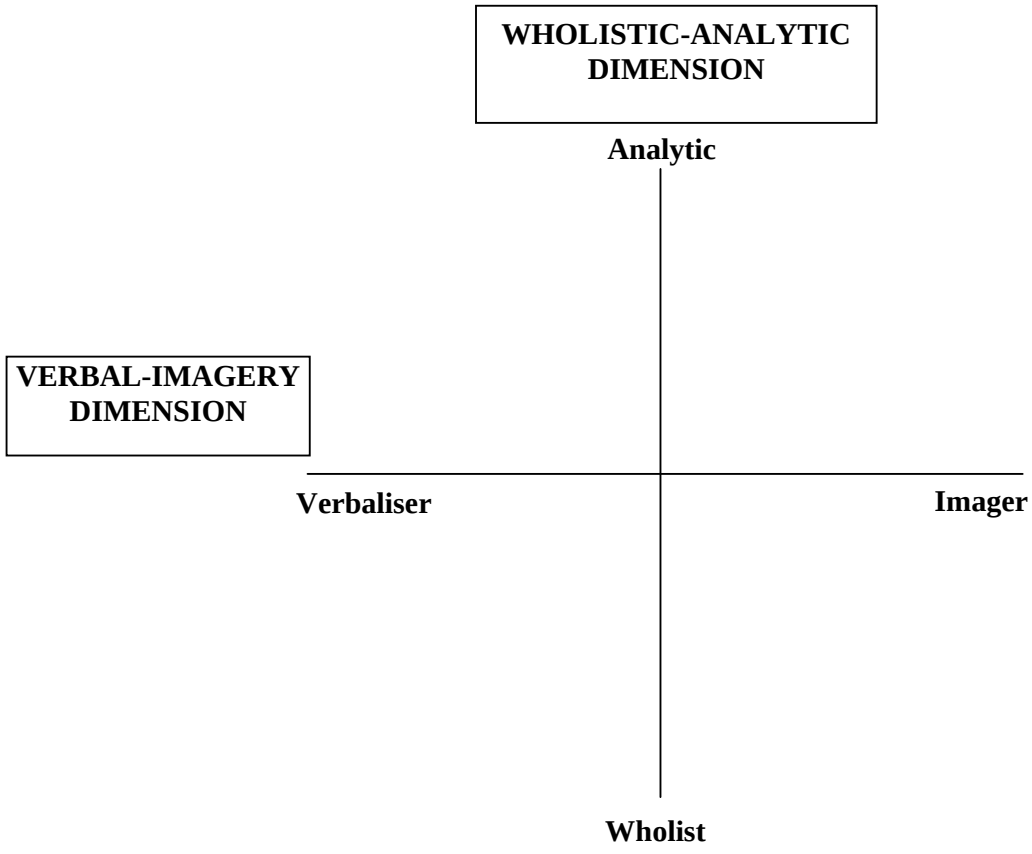
that high and low field articulation show differences in integrating a set of semantically related sentences to answer inference question, and in remembering the actual properties.

Impulsivity-Reflectivity dimension was introduced by Kagan, Rosman, Day, Albert, and Philips (1964). This cognitive style model generated research in education, it is derived from early research, investigated tempo, which measured the rate at which an individual makes decisions under conditions of uncertainty. The Matching Familiar Figure Test (MFFT) developed by Kagan and Wallach (1964), the subject is first presented with a picture of common object. The picture is then removed and the subject is asked to identify the original picture from among a group of distracter pictures. The time of the task is measured, error and latency scores are used to identify a reflective or impulsive cognitive style.

Convergent-Divergent dimension was introduced by Guilford (1967) and theory was developed by Hudson (1966, 1968). This dimension reflects thinking and then the strategies used for problem solving. The learner will deal with a problem or task by thinking in a way which is either open-ended or exploratory, or close ended and highly focused (as cited in Rayner & Riding, 1997).

Therefore many style labels have been proposed. The wholistic analytic dimension appeared with different style labels and models in the history of cognitive style research. As mentioned earlier these labels are field-dependence dependence researched by Witkin and Asch (1948a, 1948b); Holist-Serialist researched by Pask and Scott (1972). Levelers and Sharpeners researched by Holzman and Klein (1954); Diverging-Converging researched by Hudson (1966). Pleaders of the wholistic-analytic style are in line that all the tests have a common foundation, which link them together (Peterson & Deary, 2006).

Riding's model of cognitive style. Riding and Cheema (1991) extensively reviewed the literature on cognitive style theory, identified over 30 style labels, and concluded that various styles labels could be accommodated within two fundamental dimensions. These are wholistic-analytic dimension and verbal-imagery dimension. Riding and Rayner (1998) gave a new cognitive style model. The model is presented as a two vertical dimensional illusion, showing the bi-polar nature of the construct. The model is shown in Figure 1.



(Source: Riding, 1997)

Figure 1. Two dimensions of Riding's Model.

Two fundamental dimensions of cognitive style. The two fundamental dimensions of cognitive styles are:

1. The wholistic–analytic style, which determines whether an individual tends to process information as a whole or in parts.
2. The verbal-imagery style, which determines whether individual process information during thinking verbally or by means of mental images. (Riding & Rayner, 1998).

Riding and Cheema (1991) subsequently developed a test, which measured the two dimensions of the cognitive styles (Riding, 2005). The test is named as the Cognitive Style Analysis (CSA), which provides a score for each dimension in the cognitive style model. On the wholistic-analytic dimension, a low ratio indicates to a wholistic and high ratio to an analytic. The individuals who fall in the middle are considered as intermediate. The verbalizer-visualizer dimension is measured with ratios, the low ratio represents to a verbalizer and high ratio to an imager, the intermediate position is described as bimodal. Riding further elaborated that each dimension is continuous, and the labels which attached to the continuum are for the descriptive purposes (Riding, Grimley, Dahrael, & Banner, 2003).

The two dimensions, wholistic-analytic and verbal-imager are independent of one another, the position in one dimension of cognitive style does not affect the position of an individual on the other dimension. Researchers empirically supported the independence of the position (Rezaei & Katz, 2004; Riding & Grimley, 1999; Riding & Rayner, 1998; Riding & Sadler-Smith, 1992; Riding & Mathias, 1991; Riding & Staley, 1998).

Wholistic-analytic cognitive style. Wholists are those who tend to process information as a whole and are habitually consistent in any context, condition or situation. The ability of an individual to see the whole picture gives a balanced view and is one of the strength of this style. The negative attributes of this style is described that such an individual find it difficult to separate information into its constituent logical parts (as cited in Strehler, 2008). Analytics tend to process information in parts. The preferred way of an individual is to see the situation as a collection of parts, by analyzing information into its constituent parts.

The wholistic-analytic dimension frequently emerged in models of cognitive style with different names, and measurements have been constructed from the psychometric practices rather than information processing practices, which engage higher order processing like reasoning, recognition, and problem solving. Therefore, the task shows performance correctness as a dependent variable and endless time is given to the students for the decision making. Therefore, these kinds of tasks explain little about information processing, which generate the individual differences in wholistic-analytic dimension (Peterson & Deary, 2006).

According to Peterson and Deary (2006), a task which measures lower level processing would be a more accomplished way of measuring consistent individual differences in wholistic-analytic cognitive style dimension. This approach of measuring might be more manageable giving an understanding of wholistic-analytic style dimension at a theoretical and informative level.

It was hypothesized by Peterson, Deary, and Austin (2005a, 2003a, 2003b) that individuals will process information in their preferred cognitive style in a shorter span of time than with the opposite style preference, the reductionistic approach

which study the information processing is the inspection of time. According to Vickers, Nettelbeck, and Wilson (1972), inspection of time is a psychophysical approach. This approach recognizes limitations in basic processing speed. Vickers and Smith (1986) argues that performance on inspection time task gives an index of the rate at which a participant process sensory information. The inspections of the speed not only measure the speed of a single mechanism but Nettelebeck proposed that inspection of time measures the speed of a signle mechanism, selective attention, attentional capacities, central of rapid scanning, visualization, and spatial abilities may also be involved (as cited in Peterson & Deary, 2006).

The Extended Cognitive Style Analysis Wholistic-Analytic (E-CSA-WA) was developed by Peterson, Deary, and Austin (2003a), to measure wholistic-analytic dimension and it was a furtherance on the Ridings's (1991) Cognitive Styles Analysis Wholistic-Analytic (CSA-WA) test. The CSA-WA was found unreliable (r = .30, p = .04), then Peterson, Deary, and Austin (2003a, 2003b) researched that their E-CSA-WA has progressed the test's reliability to a satisfactory level and improved its internal consistency (r = .72) and test re-test reliability (.55). The E-CSA-WA is being used in the present study to measure wholistic-analytic dimension of the students.

Verbal-imagery cognitive style. Verbalizers are those who tend to process information in words. Verbalizers learn better from text. Visualizers are those who tend to process information in images, they learn best from pictorial presentation (Riding & Douglas, 1993; Riding & Rayner, 1998).

Individual differences in cognitive styles and extreme positions on the verbalizing-visualizing dimension and existence of two codes (words and pictures) can be traced back since 1883. Francis Galton in England and Jean Charcot in France explored imagery types (as cited in Richardson, 1977). The importance and significance of these two styles can be explored from the literature. Research evidence comes from factor analytic studies of human abilities. Several factor analytic studies have pointed towards the existence of separate factors for verbal and visual processing (Paivio, 1986).

Bartlett (1932), Paivio (1971), and Richardson (1977) suggested that individuals can be classified as verbalizers versus visualizers. According to this conception, verbalizers rely on verbal-analytical strategies and visualizers rely on imagery when attempting to perform cognitive tasks. Researchers have provided empirical findings that visualizers are expected to be more field independent than wholist, whereas, verbalizers are more field independent and analytic (Kirby, Moore, & Schofield, 1988).

Verbalizer prefers to use verbal-logical strategies whereas visualizers show a preference for imagery to process information (Kozhevnikov, Hegarty, & Mayer, 2002; Mayer & Massa, 2003; Plass, Chun, Mayer, & Leutner, 1998; Sadler-Smith, & Riding, 1999). When verbalizers-visualizers are examined in a learning situation, imagers easily cope with concrete and readily visualized information rather than semantically and acoustically complex details (Riding & Calvey, 1981).

Researchers have explored that whether matching instructional mode to the individuals' cognitive style improves learning outcome, Riding's (1991) CSA is used in most of the studies to explore the preferred cognitive style, and concluded that

imagers preferred and learned best from pictorial information, whereas verbalizers preferred and learned best from verbal information (Riding & Ashmore, 1980; Riding, Buckle, Timpson, & Hugger, 1990; Riding, Glass, & Douglas, 1993; Riding & Watts, 1997). Thomas and McKay (2010) re-examined the hypotheses that students learn best when instructional material matches their cognitive style. Strehler (2008) investigated the relationship between cognitive load and cognitive style when using animation and static images in instructional material.

Riding and Mathias (1991) explored the effect for the two-way interaction of wholistic-analytic style and verbalizer imager style and their effect on the mode. The wholistic preferred word formats when they had a verbalizer style and imagers preferred pictures. For the analytic, preference was inclined to the pictorial. The verbal imagery style had little effect on their preferences. They concluded that lack of interaction with the verbal-imagery dimension could be explained by the fact that analytics are able to adopt strategies that utilize the strengths of their style. Early researchers (Richardson, 1969; Roe, 1951) explored experiential, physiological and behavioural evidences to verbal imagery dimension. Riding and Read (1996) worked at two levels of control of verbal and imagery performance (voluntary control and involuntary control). In this study, verbalizer never used images to a great extent during involuntary information processing, although they can generate them with conscious efforts. Imagers used involuntary imagery for representing information.

Cognitive Styles and Debate on Assessment

Historically, the difficulties of reliably assessing cognitive style have been a challenge, due to theoretical and methodological difficulties (Kozhevnikov, 2007). Tests have been devised to measure cognitive styles but most of these tests have been constructed on the psychometric traditions, and information processing underlying the cognitive style dimensions has not been investigated.

Several methods for the measurement of cognitive styles have been developed more than a century since the discovery of the construct (Jonassen & Grabowski, 1993). The frequent methods of assessing cognitive styles are self-report questionnaires and behavioral measures. Riding (1997) explains that two approaches for the assessment of style have been broadly used. The introspective self-report and test of information processing.

Self-report measurements. The verbal-imagery dimension was first developed by Paivio (1971) and he subsequently developed the Individual Difference Questionnaire (IDQ). It consists of 86 true/false item statements (47 for assessing the strength of preferences in the verbal mode and 37 for the imagery mode) which were updated by Richardson (1977) as the Verbalizer-Visualizer Questionnaire as a self-report measurement.

According to Richardson (1977), "a research instrument (VVQ) is reported which measures individual differences on a verbalizer-visualizer dimension of cognitive styles… This questionnaire shows statistically significant and theoretically important associations with other experiential, behavioral, and physiological events" (p. 109). The VVQ is not affected by social desirability, has an acceptable degree of

test-retest reliability and differentiates between the two groups on vocabulary and imagery test (Richardson, 1977).

The self report measures and several of the premises underlying the visualizer-verbalizer model have been criticized. Green and Schroder (1990) criticized the validity of the questionnaires. The research findings of Edwards and Wilkin (1981), Lorenz and Neisser (1985), McGrath, O'Malley, Dura, and Beaulieu (1989), Parrott (1986), Antonietti and Gsioretti (1998), and Green and Schroeder (1990) have raised questions.

The assumption that visualizer and verbalizer exist on a single continuum, where strength in one dimension shows weakness in the other dimension; whereas visual and verbal dimensions are independent qualities. This assumption has been questioned on several grounds. First, it is possible that an individual may be strong or weak in both dimensions. Second, verbalization and visualization may represent independent dimension rather than extremes of a single dimension (Edwards & Witkins, 1981; MacGrath et al., 1989). Furthermore, these self-report measures have weaknesses. The subject may have an inability to report their behavior accurately and pressure of social desirability may create biases (Kline, 2005).

Mayer and Massa (2003) conducted a research on different facets for cognitive style, learning preferences, and cognitive abilities. They used self report measures and Ridings' CSA out of 14 cognitive measures, Mayer and Massa developed seven measures for the study. These new measures included two cognitive style measures, namely the Santa Barbara Learning Style Questionnaire (6 items) and the Verbal-Visual Learning Style Rating (1 item). The researchers explored whether the verbalizer-visualizer dimension is unitary or multifaceted, secondly to develop valid and economical measures of cognitive style and ability as well as valid and

behavioural measures of learning preferences. Corelational analysis of the cognitive style measures showed that three of the four cognitive style measures, named, Verbalizer-Visualizer Questionnaire, Santa Barbara Learning Style and Verbal-Visual Learning Style Rating correlated highly with each other, however, the CSA did not correlate significantly with other self report measures. These correlations of self report measures with information processing measure suggest a different interpretation of the results as well as these tests show little about information processing underlying the cognitive style dimension.

Information processing and measurement underlying the cognitive style dimension. Information processing approach to explore consistent individual differences can be detected using inspection time task. Inspection of time is a reductionistic approach which determines limitation in basic processing of speed by measuring how long a stimulus requires to be presented and discriminated at a criterian level of rightness (Peterson & Deary, 2006).

Reaction time is the distance between the stimulus and start of the response. It involves information processing, stimulus identification and selection of the response (Alikhani, Mousavi, & Makhtari, 2011).

Majority of the cognitive style tests have been developed on psychometric tradition and the information processing undertaking the cognitive style has not been considered. These measures involve higher order processing such as recognition, reasoning, and problem solving.

In these tests, tasks have performance accuracy as the dependent variable and therefore unlimited time is given to the participant for decision making. These types of tasks give a little information about the information processing to identify

individual differences in cognitive styles. A task which measures lower level of processing would be a reliable measure to identify individual differences in cognitive styles. The reductionistic approach to study the information processing is inspection of time. In the studies which measure inspection of time, the researcher is interested to find out at what stimulus exposure duration the participant's response accuracy increases above the chance, and reaches at a given level of accuracy.

Therefore, performance on inspection of time provides an index of the rate at which an individual process sensory information (as cited in Peterson & Deary, 2006). According to Nettelbeck (2001), inspection of time not only measures a single mechanism but it also involves attentional capacities, selective attention, control of rapid scanning but visualization and spatial abilities may also be involved. The cognitive style tests which identify performance of the individual on inspection of time is Riding's CSA and Peterson's (2005) VICS and E-CSA-WA.

Riding's cognitive style analysis and psychometric debate. Riding's Cognitive Style Analyses (CSA) is a test which measures information processing underlying the cognitive style dimensions. This is a computerized test and takes approximately 20 minutes to complete, and measures an individual's position on both the wholistic-analytic and the verbal-imagery dimension, comprises three sub-tests (Riding, 1997).

CSA was developed to overcome two problems of the cognitive style measures, first is associated with the instruments developed by Witkin, which were used to test a field dependence independence, and secondly those associated with the self report measure used to assess imagery performance (as cited in Riding & Rayner,

1998). CSA has been under substantial investigation, and well described in the literature (Graff, 2003; Riding & Cheema, 1991; Riding, 1997; Riding & Grimley, 1999; Riding & Rayner, 1998). This frequently used measure has strong theoretical support for its structure and background (Rezaei & Katz, 2004).

It has three sub-tests, the first sub-test (12 min duration) assesses verbal-imagery dimension and the other two sub-tests assess the wholistic-analytic dimension. The computer scores the response time to the various statements in the test and calculates the corresponding ratios. Half of the statements or items are of conceptual categories (type) and the other items are of colour. The assumption is that the imagers would respond faster to the appearance statements. The appearance statements readily evoke mental pictures, and information for comparison is obtained directly and immediately from the images.

For the conceptual category (type items), the assumption is that the verbalizers would have a short response time because the semantic conceptual membership is verbally abstract in nature and cannot be represented in visual forms. A low ratio indicates a verbalizer and a high ratio to an imager (Riding & Wigley, 1997).

The second two sub-tests (about 3 min. each) assess the wholistic-analytic dimension. This sub-test contains twenty items. The items containing pairs of complex geometric figures and an individual is required to judge as these figures are same or different. In this task, an individual gages the similarity of the two figures. This task involves judgment about the overall similarity of the two figures (Rezaei & Katz, 2004).

The third sub-test presents twenty items, each consists of a simple geometric shape (e.g., a square or triangle) and a complex geometrical figure. The subject is

asked to indicate whether or not the shape one (simple) is contained in the complex shape by pressing the one of the two response keys. This task requires a degree of disembodying of the shape within the complex geometrical figures in order to establish that it is the same as the stimulus simple shape displayed (Riding & Wigley, 1997). A low ratio indicates to a wholistic and a higher ratio to an analytic. The background is elaborated in Riding and Cheema (1991).

The CSA gives a simple, quick and convenient ways of assessing an individual's cognitive style and his/her position on the two fundamental cognitive style dimensions (Riding, 1991). The usefulness of the CSA is investigated by many researchers. The author Riding (1997) provide following advantages of the instrument.

- The method of assessment is not apparent to those who are being assessed.
- It positively assesses the verbal-imagery and wholistic-analytic dimension.
- It is a performance test, unlike a questionnaire items, and it is used for wide population.
- It is context free and can be used in a wide range of situation, such as schools, industry and health services.
- It is culture free and has been used in different countries (Riding, 1997).

The structural and theoretical support of CSA is most powerful as compared to the cognitive style inventories but question has been raised about the reliability of the CSA. No research has been conducted on the stability and internal consistency of CSA (Peterson, Deary, & Austin, 2003b). Empirical findings on the validity of CSA

provide evidences as a valid measure (Riding & Agrell, 1997; Riding & Craig, 1999; Riding, Glass, Butler, & Pleydell-Pearce, 1997).

Rezaei and Katz (2004) gave suggestions to improve the validity and reliability of CSA. Peterson, Deary, and Austin (2003a) investigated the reliability of CSA, it was examined by comparing performance on the original CSA test and a new parallel version. The research was conducted on fifty subjects, the participants completed the original CSA and a new parallel version. Reliability was estimated using parallel forms and test-retest, and split-half analysis. Correlation of the verbal-imagery (VI) and wholistic-analytist (WA) ratios were low (range $r = 0.07$ to .0.36).

The internal consistency of CSA-A and CSA-B was examined. Peterson, Deary, and Austin (2003a) examined responses on even and odd items on each section of the test by creating two halves (odd, even) and re-analyzed the median reaction times on each half of the split data which was not significantly different for the version, test sections and test sessions.

"In considering psychological assessments the most important feature of a test is its construct validity. If there is no evidence that it assesses what it purports to measure then it is of no use" (Riding, 2005, p.6).

The Riding and associates, who developed CSA tried to demonstrate its validity. Riding and Rayner (1998) summaries the evidence for validity as follows:

- The independence from other variables: Gender, intelligence, common personality measures.
- The relationships between wide ranges of behaviours: learning, subject preferences, social behaviours, occupational suitability.
- Evidence of physiological basis.

- Conformity to the requirements of style.

Riding's CSA and especially the verbalizer-imager dimension, has been criticized for its low reliability, stability and internal consistency (Ong & Milech, 2004, Peterson, Deary & Austin, 2003a; Rezaei & Katz, 2004). The validity of the verbalizer-imager dimension of CSA was also criticized (Massa & Mayer, 2005).

Peterson et al. (2003a) investigated the reliability of Ridings CSA by using parallel form, test-retest and split-half design methods, but the reliabilities were low. Riding (2003) responded to the work of Peterson et al. (2003a) by giving limitation of the study, and asserted that there is no need for more investigation to determine the reliability of the CSA. Peterson et al. (2003b) again responded to Riding's criticism and answered that this criticism is merely distraction from the issue. Many attempts have been made to address the reliability of the CSA.

Parkinson, Mullay, and Redmond (2004) tried to improve on the study of Peterson et al. (2003a) by increasing the time interval of the reliability of CSA into 14 days in the first study and 23 months for the second study. Parkinson et al. give the opinion that low reliability continues to raise concern about the validity of the CSA test despite Riding's assurance about the validity of the CSA. Rezaei and Katz gave suggestions for the improvement of CSA by addressing the limitations (as cited in Strehler, 2008).

This led Peterson et al. (2003a, 2003b, 2005a, 2005b) to develop new tests of cognitive style. These tests are named as Verbal Imagery Cognitive Styles (VICS) test and Extended Cognitive Style Analysis-Wholistic Analytic (E-CSA-WA) test. The new measures are being used in the present study and licence agreement to use these tests is given in Appendix A.

The Verbal Imagery Cognitive Styles (VICS) Test and Extended Cognitive Style Analysis-Wholistic Analytic (E-CSA-WA) Test

The construction of the VICS test and conclusions of the two studies which examined the reliability of the VICS test with the CSA's imagery dimension suggested that verbal-imagery cognitive style's ratios are used in the tests to assess an individual's verbal-imagery cognitive styles. Results exhibited high internal consistency ($r > .72$) and satisfactory stability at re-test ($r = .56$) on the VICS test. Peterson and associates reconfirmed the results on another sample of 100 participants. The results revealed that VICS test is reliable test for the measurement of verbal-imagery dimension of cognitive styles (Peterson, Deary, & Austin, 2005a).

The VICS test takes approximately 25-30 minutes to complete and extended CSA-WA takes approximately 15 minutes to complete. The number of task used in the verbal imagery cognitive styles test are 232, which include 116 verbal task and 116 imagery task. The number of stimuli used in the extended CSA-WA are 80, which has 40 wholistic task and 40 analytic task.

The VICS test was constructed for the betterment on the CSA-VI by avoiding the limitations of the CSA. For the verbal-imagery dimension, the appropriate task has been to present the participant with two objects and it required the participants to judge which object is bigger in the real life (judgement of size is based on Paivio's 1975a research). It is advocated that task requires the participant to imagine the object by comparing the size. Mayer and Bayer's (1976) experiments on the symbolic distance effect concluded that judgement of size requires the participant to generate an image.

According to Peterson et al. (2005a), the imagery questions used has two edges. Firstly, the objects used in the test are of different sizes and secondly, the same

verbal tasks (i.e., natural, man-made tasks) are used for the imagery tasks, which are employed for the judgement of size. These verbal and imagery tasks are similar and compares the performance on each task. The VICS test uses the same stimulus for verbal and imagery tasks and reduces the differences between verbal and imagery items in word agreement (the rate at which an image generates a particular word) and image agreement (the rate at which a word generates a peculiar image), word frequency and word familiarity. In the VICS test, each stimuli is presented in both picture and words forms, which enable a researcher to explore the style preferences across the verbal and imager tasks and also between the picture-based items and word-based items within these tasks.

Riding (1997) assumed that individual differences can be identified by comparing the speed of response to verbal and imagery questions. Therefore Peterson et al., hypothesized that VICS will be able to identify individual differences in verbal and imagery processing and these individuals will be more reliable than those measured by the original verbal-imagery dimension of the CSA.

In order to investigate whether style contribute something more to our understanding of self than the established, existing, and consturcted measures like abilities and personality traits, there has been very little research which explores the overlap between cognitive styles, ability, and personality (Peterson, Deary, & Austin, 2005b).

In the subsequent section, the relationship between cognitive style and ability, cognitive style and personality, cognitive style and behavior, cognitive style in relatoin to gender and age, cognitive style in relation to academic achievement, discipline of study, and learning preference is described.

Cognitive Style and Ability

Cognitive styles have consistent characteristics which are distinguished from ability. Cognitive ability refers to things that people are capable of doing and cognitive styles are an individual's mode of processing and representation of information (Mayer & Massa, 2003). The difference between cognitive ability and cognitive style is that the performance on task will improve as the ability increases and for a style performance on a task will be either positive or negative. If an individual performs on verbal-imagery style, the verbalizer would be poor in visual tasks and verbalizers would find it difficult to perform on a task. However, for the verbal task, the verbalizer would find it easier than the imagers. For a cognitive style dimensions, a person is both good and poor at tasks depending on the nature of the task (Riding, 1997).

Guilford (1980) proposed that cognitive styles relate to abilities and they act as executive purpose and control intellectual functions. Messick (1976, 1984) argued that abilities are unipolar, domain specific, enabling variables that are interested in how much and what is done. Cognitive styles are explored as bipolar or bifurcate styles cut across domains. Cognitive styles and abilities are conceptually different (Peterson, Deary, & Austin, 2005b).

In a style perspective, for the verbal-imagery dimension, the information can be represented either verbally or in mental pictures, and people consciously choose one. Verbalizer prefer and are comfortable on verbal tasks, while visualizers are comfortable on tasks in pictorial forms. In an environment where cognitive styles are

mismatched, for example giving a verbalizer an image task, the performance would decrease (Riding & Caine, 1993).

Style is different from ability or intelligence in that it does not measure how well an individual do something but how an individual approach something. Grigerenko and Sternberg (1995) explained that styles are not abilities, but rather how these abilities (and the knowledge through them) are used in day to day interactions with the environment. Simply put, styles are not how much intelligence we have, but how we use it.

Cognitive Style and Personality

Researchers explore the overlaps between cognitive style and personality, and whether style is just a facet of personality or whether it is different from construct. Very little research work has been found on cognitive style and personality (Riding & Wigley, 1997).

The criticism on the cognitive styles are that styles are not different from mental abilities. Peterson, Deary, and Austin (2005b) conducted a research on a sample of 100 subjects, and explored the relationship of two performance based computerized cognitive style tests, named Verbal-Imagery Cognitive Style (VICS) test and Extended Cognitive Style Analysis Wholistic-Analytic Test (Extended CSA-WA) with eight tests of mental abilities, which were selected from the validated kit of factor referenced tests to find out the relationship between the style and personality tests. The findings revealed that no mental ability score on personality trait correlated more than .33 with the cognitive style differences. The findings suggest that the

Extended CSA-WA and VICS contributes something more than personality and ability to the measurement of individual differences.

Furnham (1995) explores that, cognitive styles has been well founded, researched, and researchers relate it to larger theoretical systems in their intelligence or personality, but very rarely both.

There is very little research available on relationship between style and personality. Research literature depicted that cognitive styles are often conceptually positioned within the general family of personality traits (Eysenck, 1978; Furnham, 1995; Guilford, 1980; Messick, 1984).

Riding and Wigley (1997) explored the relationship between cognitive style and personality on a sample of 340 students, who received the cognitive style analysis which assessed their position on two style dimensions; the wholistic-analytic and the verbal-imagery. The sample completed personality tests which provided measures of extroversion neuroticism, psychoticism, impulsiveness, venturesomeness, empathy state and trait anxiety. The interactive effects of style on measures of the factors showed relationship with neuroticism, impulsiveness and psychoticism.

The results revealed that cognitive style and personality are not the same, but finding of interaction between the style dimension and their effects on neuroticism and impulsiveness and a new-linear relationship between wholistic-analytic style and psychoticism raises the question of how personality sources and style combine to affect behavior (Riding & Wigley, 1997).

The research literature explores that style measures often show some degree of associations with personality traits. As Witkin and Asch's research on field dependence-independence, Kagan's research on impulsivity and reflectivity, Honey

and Mumford's investigation on Learning Style Questionnaire, Whetten and Cameron's exploration on Cognitive Style Instrument, Kolb's research on Learning Style Inventory, and Sternberg's research on thinking styles have shown correlations with Personality Tests (as cited in Peterson, Deary, & Austin, 2005b). The advocates of cognitive styles provide evidences that the link between personality and cognitive style is to the extent that they execute underlying personality trends (Messick, 1984) but they do not measure the same thing.

According to Riding and Wigley (1997), personality and cognitive style sources are not the same, cognitive style affect personality but the low correlations between them propose different elaborations.

Cognitive Style and Behavior

Cognitive style has its effect on behavior. The relationship of style to observed behavior is reflected as learning performance, learning preference, subject preference and in social behavior (Riding, 1997). Empirical researches provide evidences that an individual's position on the wholistic-analytic dimension interacts with the structure of the learning material to affect performance. Thomas and McKay (2010) explored that students learn best when instructional material matches with their cognitive style. In a research on 41 university students of psychology, they studied information on three personality theories presented in text only, text and picture, or text and schematic diagram format, demonstrated recall and comprehension of each theory, and completed an adapted Cognitive Style Questionnaire.

Results provided evidences that learning outcome improves when instructional material is matched to student's cognitive style. The learning will be enhanced when there will be a high level of congruence between the attributes of the individual and the characteristics of the environment (Reynolds & Vince, 2007). There are evidences that matching material to a students' cognitive style improves performance (Ford & Chen, 2001; Riding & Watts, 1997).

There are also mixed evidences for matching and mismatching materials on a learning environment. Few researchers advocate that learning is beneficial as it helps students to develop a more balanced approach. Sternberg, Grigerenko, and Zhang (2008) explains implications of cognitive style for instruction and assessment. These evidences support that people learn better from a broad instructional methods and it is sensitive to multiple cognitive style than narrow instructional methods, which address to one cognitive style.

Several studies investigated that an individual's position on the wholistic-analytic dimension interact with the structure of the material. Douglas and Riding (1993) found on students that wholist were best when the title of the passage was given before the passage was presented. The result was interpreted as the wholist take the situation as a whole and less able to structure the material, being helped by the title.

Ghinea and Chen (2003) investigated the impact of cognitive styles on perceptual multimedia quality. Different preferences demonstrated by verbalizers and imagers while watching multimedia content were observed. Results showed that multimedia content influenced the levels of information assimilated by imagers. While black and white presentations are shown to be beneficial for both bimodal and imagers in order to experience enhanced levels of information assimilation.

Cognitive Style in Relation to Gender and Age

Cognitive style has been researched and identified as an important mediator in the processing of information (Riding & Rayner, 1998). A number of research evidences have shown sex differences in the performance on information processing tasks. The review of literature on information processing have provided a logic to use inspection of time on task performance, therefore, the present research aimed to study gender differences with respect to reaction time. Previous researches on information processing are interpreted that males process information faster than females but less thoroughly than females who process more thoroughly (Riding & Vincent, 1980; Riding & Smith, 1981; Riding & Egelstoff, 1983).

Riding and Sanabani (1998) explored the effect of cognitive style, age, gender, and structure on the recall of prose passages. The results revealed significant interaction between gender and wholistic-analytic style in the effect on recall $F(9.95)$, $df = 1,168$; $p = .002$. For the females, recall was higher for the analytics than the wholist, but for the males the difference was small. There was also a significant difference of age $F(12.92)$, $df = 1,168$; $p = .001$ with the older students, who recalled more than the younger students. The results were discussed in terms of style effects on developmental trends in strategy development and gender differences in information processing. A statistically significant interaction was found between age and wholistic-analytic style dimension in their effect on recall. Analytics recalled better with age than the wholists. The researchers discussed that with the older students each style group improved with age on the recall of passage. This was naturally in accordance to their style. The rationale for the improvement in recall was discussed in terms of verbal-imagery dimension as well. Similarly, for the verbalizer-

visualizer dimension, the concrete narrative was recalled better by the older imagers, who improved reading fluency as an enhanced quality of mental pictures. Similarly with passage 3 the older verbalizers were better in recall due to passage's technical vocabulary.

In another study Riding and Calvey (1980) explored that verbalizers were better to imagers to cope with acoustically complex and unfamiliar terms and imagers were better with concrete narratives. Overall the gender differences with respect to cognitive styles are mostly small and nonsignificant (Riding et al., 1990; Riding, 2000).

Cognitive Style in Relation to Academic Achievement, Discipline of Study and Learning Preferences

Educational achievement in relation to cognitive styles has been explored but educational achievement and style revealed problems in a way how it has been taught and how it is assessed (Riding, 1997).

Evans and Waring (2010) explored the student teacher assessment feedback preference, cognitive styles and gender-cognitive styles and assessment feedback preferences of 108 student teacher were identified, and there were similarities and differences in assessment feedback preferences between males and females. Researchers are giving importance that cognitive styles and gender adds to the richness of debates on how assessment for learners can be enhanced (Fearn, 2010). According to Ellery (2008), it is importance to have a strategic and well planned use of feedback in the assessment process to promote learning. Cognitive style has an impact on individuals in learning strategies.

Strategy development goes through a sequence of sensing, preferring and adapting (Riding & Sadler-Smith, 1997, p. 203). Cognitive styles are fixed, and there are possibilities that learning strategies to be developed to cope with situations in which individual's cognitive style is not naturally appropriate. According to Riding and Agrell (1997), intelligent students develop strategies which supplement their cognitive style than less intelligent students.

The mode of presentation and type of content of learning material were explored with cognitive styles. Visualizers showed superior learning from pictorial presentations and verbalizers learned better from verbal presentations (Riding & Ashmore, 1980; Riding, Buckle, Thomson, & Hagger, 1989).

Riding and Caine (1993) researched on 182 students for mathematics, English language and French. Intermediate-Bimodals performed superior in all three subjects. The results revealed significant interaction between style and subject on performance. Riding and Read (1998) investigated student's preferences in English language and science subjects with respect to mode of working and social context. High ability students having visualizing wholistic tendency used less writing and more pictures than verbalizers. The tendency to use picture by the visualizers and tendency to use writing by verbalizers increased with ability.

Sadler-Smith and Riding investigated instructional preferences in 245 in terms of locus of control. Results showed that analytics controlled themselves and wholists showed no such preference. Hayes and Allinson (1996) investigated numerous studies in educational settings and explored that accommodating individual differences in cognitive styles has a beneficial effect on learning performance.

IMAGERY AND DUAL CODING THEORY

The aim of this section is to provide research evidences on imagery and dual coding theory, which generated substantial research on verbalizing-visualizing cognitive styles. Study II of the present research is designed on Paivio's dual code model. The concept of verbal versus visual learning came from Paivio's dual coding theory, which addresses a person's preferred mode of processing information.

Dual coding theory (Paivio, 1971, 1986) provided empirical research evidences on verbalizing-visualizing cognitive styles, and it has its roots in the practical use of imagery as a memory aid 2500 years ago (Paivio, 2006). Application of imagery aimed at accelerating acquisition of knowledge. Language is involved as an educational partner and imagery began to be systematically externalized as picture.

Imagery

Scientific interest in the effects of mental imagery emerged with the founding of scientific psychology, disappeared with the rise of behaviourism, and re-emerged again by the cognitive revolution of the 1960s and 1970s. Imagery has been examined extensively in the cognitive psychology and in educational psychology (Lutz & Lutz, 1997). "Imagery is a process by which sensory information is represented in working memory" (MacInnis & Price, 1987, p.473). Therefore imagery can incorporate multisensory processing (i.e., sight, hearing, touch, taste, and smell), which may lead to better recall of information. Many factors that encourage imagery processing have

been suggested. It included concrete words, picture, instruction to imagine, familiarity with knowledge and the interaction between targets (Alesandrini & Sheikh, 1983; Bone & Ellen, 1992; Lutz & Lutz, 1997; MacInnis & Price, 1987).

The role of imagery in human cognitive processes has been ignored in favour of verbal processing, but the experiments conducted by Paivio (1986, 1991a) developed a research agenda which led to a theory that gave equal importance to verbal and nonverbal processing. Imagery has been recognized as an important means of encoding material for later remembering (e.g., Marschark & Hunt, 1989; Paivio, 1986; Richardson, 1998, 2003).

The imagery process is strongly related to memory, thinking and perception. Therefore, imagery research has developed in many different directions, with different approaches, methodologies types of observations and in different phenomena. Paivio researched on effects of imagery on memory performance (Paivio, 1971, 1986, 1991a) and Bower researched on imagery memories (Bower, 1972). A number of different interpretations of the concept of mental images have been proposed. Holt (1964) observed that a mental image refers to all the subjective awareness experiences with an almost sensitive modality that is not only perceptual. Differently from perception, imagery is a mental process, difficult to ascribe to an exact stimulus situation (Cornoldi, 1976).

Defining the mental images. Kosslyn (1980, 1994) defined mental images as representations of objects that are seen through the mind's eye in the absence of perceptual stimulus. Richardson (1999) proposed considering mental images as

complex mental products, inner representations where information on the actual perceptual appearance of objects can be described and transformed.

Shepard and Metzler (1971) and Shepard and Cooper (1982) experimented on mental rotation. Kosslyn (1973, 1980) experimented on mental scanning and developed a view of mental imagery on a "quasi-pictorial" form or representation which is analogous to perceptual experience.

Therefore, the controversy regarding the analogical versus the propositional situation of mental images emerged as the "imagery debate" (Tye, 1991).

Imagery and models of cognition. It is argued that storage models of Paivio gave images too central role in cognition. The popularity of the mental image as a cognition construct has experienced considerable ebb and flow throughout the history of psychology. From Aristotle through British Empiricism to Wundt's structuralism, images were of central concern to modelers of the mind, and were believed often to function as the elements of thought. During the positivistic era of American psychology, mental images were considered either nonexistent or functionally irrelevant. However, as the rigidity of behaviorism weakened, imagery once again began to be assigned a role in theoretical and empirical work (Holt, 1964; Paivio, 1971). Researchers have emphasized on the role of imagery in learning and memory, thinking, creativity, dreams, as a method of therapy. Now, the image is continuing to play a role in cognitive modeling, though considerable disagreement exists among psychologists concerning the importance of this role.

A large number of researchers believe that images have a central function in human learning and memory (e.g., Begg, 1973; Bower, 1972; Bugelski, 1970; Mayer

& Massa 2003; Paivio, 1971; Riding, 1991; Yuille, 1974). However, Allan Paivio has contributed more to this view than anyone else, through both observations and theory. Since his model is the most typical and the most extensive in the field of cognition. Paivio's model emerged in the course of a series of experiments concerned with memory for concrete and abstract nouns, in a variety of traditional verbal learning tasks (e.g., Paivio, 1963, 1965, 1967, 1986, 1991b). Paivio's proposal, that the active formation of images mediates learning, and memory was a radical departure from the theoretical knowledge held by his peers; and publication of his views required a conservative presentation, and extensive empirical support. He adopted a defensive stance concerning the appropriateness of imagery as a psychological concept: he argued that "the charge of mentalism, or subjectivity, has little force because implicit verbal responses (the popular S-R mediating mechanism) are very bit as inferential as mental images" (1970, p. 386). The pioneering efforts and the work of other researchers, the theoretical importance of images came to be widely accepted, and the role of images was explored in a variety of situations, not only in verbal learning.

Paivio's model, outlined and elaborated in a number of publications (e.g., 1970, 1971, 1975a, 1975b, 1991a), depends on the fundamental assumption of two major coding systems: imaginal and verbal. Although images are said to occur in all of the sensory modes, Paivio has concentrated on the visual modality, as the most frequent and most important imagery mode. Thus, images and words are postulated to be the elements of two distinct modes of cognition: concrete representational thought and abstract logical thought. Although independent, the two modes are linked; for, a word may evoke an image or vice versa. The implication for memory is this that any event evokes both codes will be remembered better than one that elicits only one

code. The hypothesis that two codes are better than one, has been employed to interpret a variety of findings; for example, concrete nouns are said to be easier to learn than abstract nouns because the concrete noun evoke both types of codes, while the abstract noun elicit only verbal coding (Paivio, 1971). A variety of subsequent results encouraged Paivio (1975a, 1975b) to elaborate this model and, in addition, to propose that the two systems possess different properties.

Thus, an additional distinction is proposed for the two systems: the imagery mode is specialized for parallel processing, and the verbal system for sequential processing. According to Paivio, integrated images can code multiple units of information, enhancing associative recall. Alternatively, the verbal system can retain information about the sequence of a set of items.

In summary, there are two critical aspects to Paivio's model: first, two coding modalities, which are independent but associatively related, are available to code experience, and coding in both modes leads to superior accessibility than storage in only one system; secondly, the imagery system permits simultaneous coding of multiple pieces of information, while the verbal mode employs sequential storage of input.

The images and words that form the cognition elements of the dual coding theory, are employed in what Furth (1969) calls the passive configurative sense. That is, there is a direct correspondence between the representation (i.e., image) and the object it represents. Although images have been added to words as another possible mode of representation, both modalities are still seen as internalized products of experience.

Knowledge is contained in the words and in the images, and it is assumed that the two modes are sufficient to describe the variety of cognitive functions to which they are applied.

Dual Coding Theory: Processing of Picture and Word

Paivio (1991a) proposed dual coding theory and later developed an empirical research agenda (Paivio, 1986, 1991b) which led to a theory that there are two mental systems in cognition, one is verbal and the other is nonverbal, one is specialized for the representation and processing of nonverbal objects and the other is specialized for dealing with language.

Paivio and Yuille (1969) conducted a series of studies to distinguish between verbal and imagery processes and tested the effects of imagery instructions, item attributes and learning strategies. They concluded, "the common effective process was indeed imagery, which was generated to word pairs during learning, and reactivated by a concrete stimulus word during recall so that the response word could be retrieved from the image" (Paivio, 1991a, p. 5).

The result of these series of studies led to the development of dual coding theory in which images and verbal representations are shown in two separate systems that complement and supplement each other in developing memory. This theory has been further extended in many areas of cognition through a systematic program of research over many years (Paivio, 1971, 1986, 1991b).

Dual coding theory represents assumptions, hypotheses and describes structural and functional properties of representational systems. These representational units are imagens and logogens (Paivio, 1978). The logogen concept

is barrowed from Morton (1969),who introduced it to account for perceptual word-recognition results.

Theoretical assumption. The theory is based on the assumption that there are structurally and functionally distinct system of mental representation in the origin in perceptual, motor and affective experiences and these are modality specific (Paivio, 1991a, 1991b).

According to Paivio, "Human cognition is unique in that it has become specialized for dealing simultaneously with language and with nonverbal objects and events. Moreover, the language is peculiar in that it deals directly with linguistic input in the form of speech and writing while at the same time serving a symbolic function with respect to nonverbal objects, events and behaviors. Any representational theory must accommodate this functional duality" (1986, p. 53).

The units of each system are modality specific. The functional structures are different in the manner that verbal systems are sequentially organized and nonverbal systems are synchronously organized. They are specialized and processed in different higher order structure but they are interconnected functionally and activity in one system can generate the representational units of the other system (Paivio, 1991a, 1991b).

The separate subsystem means that two systems are structurally and functionally different. The structural and functional distinction produce different kinds of processing. The theory assumes that there are two independent but partly interconnected memory systems in human cognition (Paivio, Khan, & Begg, 2000).

The structural assumptions which describes separate and interconnected systems is described in the Figure 2.

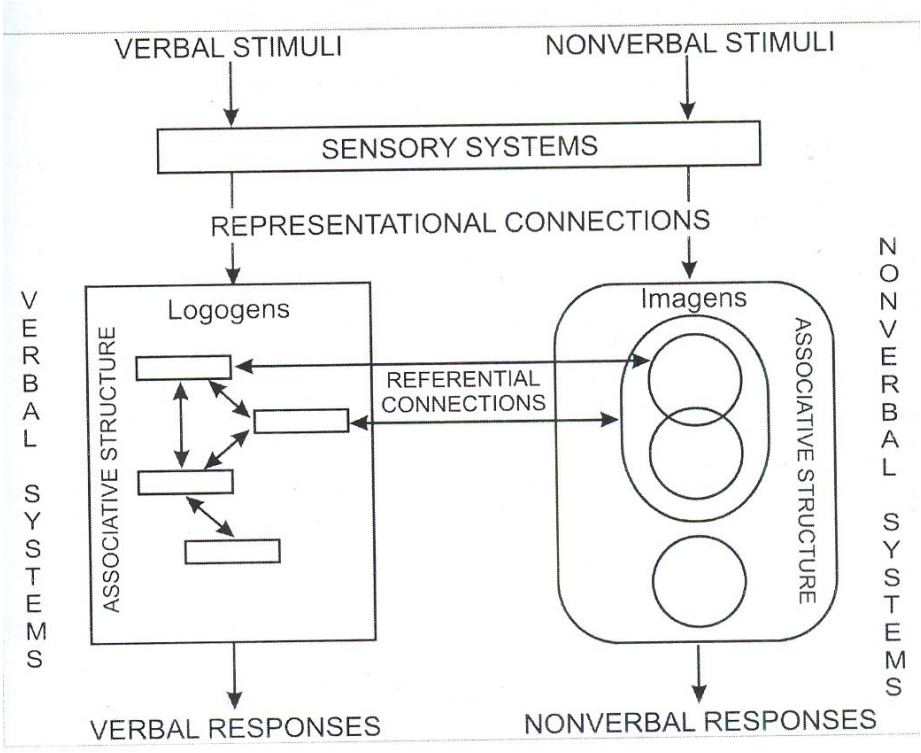


Figure 2. The verbal and nonverbal representation systems of the Paivio's (1986) Dual Coding Theory

The verbal and nonverbal processing. The dual coding theory hypothesize that information is mediated by dual route. The information is either coded in a network composed of language based information (the verbal sub system) or it is coded in a network composed of nonverbal information (the imagery sub system). The theory assumes that everyone codes information in both subsystems to some extent, individual differ in their preferred representational style.

The distinction between behavior verbal and nonverbal systems is based on the assumption that picture (images) and words are psychological correspondences to

the knowledge of the word or language (Paivio & Begg, 1981). Each system has its own characteristics units and hierarchical organization. Two mental codes and five sense are orthogonal in dual coding theory. Two codes have subsets of mental representations. The representation system includes a person's perceptual, affective, and behavioral knowledge. Mental representation have their developmental origin in perceptual, motor and effective experience. Sensory systems are linked to motor response system in perception (e.g., eye movements, listening attitudes, touch) these subsets have sensory qualities.

Similarly, visual representations are presented in the nonverbal code in nonlinguistic forms. Paivio labels nonverbal (symbolic) subsystem as the imagery system, its functions includes the analysis of the scenes and the generation of mental images.

The verbal system consists of representation named logogens, that correspond to linguistic units such as phonemes, and their combinations, morphenes, words and phrases (Morton, 1979). Thus logogens have associative connections as well with other units within the verbal system. These connections form larger linguistic and complex units.

Logogens are assumed to vary in size, but they differ from imagens in internal structure so that smaller units are organized into larger units in a sequential or successive fashion (Paivio, 1986). This structure is most apparent in the language, where phonemic units are organized in syllables, syllables into words and some upto sequential structure as extensive or entire plays.

Nonverbal entities, such as, objects, events and things are processed in cognition. The verbal connections cannot function without any connection with other

system. Then referential connections link the verbal systems with other system. The assumptions is that the two system are different, there is functional independence but interconnectedness of the two systems. The imaginal system is specialized for processing nonverbal information in the brain (Paivio, 1989). The term 'imagen' refers to representational units, generates images (e.g., shapes, sounds, visual and spatial transformation) in the nonverbal system.

The processing levels. Representation processing is a stable and long-term information processing. Representational processing is direct activation of verbal representation by linguistic stimuli and nonverb representation by non linguistic stimuli (Paivio, 1986). The probability activation and use of verbal and nonverbal representation is a function of the combined effect. The stimulus is such as, item to be remembered, and contextual stimuli is instructions to arouse a set of task in a given task. The representational processing of visual words takes less time and more direct than referential or associative processing.

Referential processing activate the nonverbal system by verbal stimuli or the verbal system by nonverbal stimuli. The activation of the verbal system by the normal system or vice-versa. The generation of complex and new images requires organizational processing of referentially activated image components to produce an integrated image (Paivio, 1986).

Associative processing is activation of representation within the same verbal or nonverbal systems. A task may require any kind of processing. Perceptual recognition or judgements of the stimulus requires representational processing. Naming a picture and imaging of a word requires referential processing. Free verbal

association starts verbal representational processing. For example, word knife generates an image of a knife which further generates an image of a fork (Paivio, 1986). Dual coding processing relates to other approaches and concepts as well (Craik & Lockhart, 1972; Craik & Tulving, 1975).

Organizational and transformational processing. There are differential specialization for synchronies (nonverbal) and sequential (verbal) interunit processing within system. This process was recognized by Bartell in his constructivist approach to memory and Bonsfield identified it in organizational processes in free recall (as cited in Paivio, 1986). The organization of verbal manner demands some kind of constructive process that operate on the input structure. The evidence for nonverbal organizational process is also compelling. Bazarre dreams differ in their organizational structures from perceptual experiences. The generation of mental images by mnemonic instructions is explained by Paivio (1969) in which subjects are asked to construct either interactive or noninteractive images of the referents of a pair of words or pictured objects such as free-window, with striking effects on recall. Imaging a tree out of a window is a constructive processes and verbal instructions to generate interactive image plays a part in initiating the constructive mental program.

Interconnections and dual coding theory. In the framework of dual coding theory, two kinds of interconnections link: the verbal and nonverbal (imaginal) system, which exists between and within the system. Between linking are called referential connections, and activate the symbolic transformations of one kind of information in and system to the other (Paivio, 1979, 1986).

Neurological evidences and dual coding theory. Dual coding theory provides neurological evidences concerning representational processes. The research findings on functional differences between the two cerebral hemispheres and regions within each hemisphere implicate verbal and nonverbal processes in different degrees (Bryden, 1982; Ley, 1983; Paivio & Beg, 1981; Paivio & Linde, 1982).

Functional asymmetries between the two hemispheres are described by the researchers on the results of intact brain studies. Patients with unilateral focal lesions and EEG studies by Ley (1983) suggests that left hemisphere is primarily in control of verbal processing, whereas, right and left hemispheres both contribute to performance in nonverbal tasks. Paivio (1986) claims that left hemisphere controls speech and efficiency of the left hemisphere is observed in tasks which include perceptual recognition, episodic memory performance, and comprehension. Whereas, the right hemisphere is efficient in nonverbal materials, such as face identification, recognition of nonverbal sounds and memory for faces and spatial patterns.

The neurological evidences are explored for representational and referential processing. The experiments by Paivio and Ernest (1971) were presented via tachistoscope to either the left or right visual fields. The results depicted that field had no effect on a recognition task. The research findings reveal that both hemispheres have representational and processing skills for the generation of images. The brain damage studies provide evidences for referential processing (Paivio, 1991; Luria, 1973; Beauvios, 1982).

The sequential and synchronous processing is supported by neurological evidences (Paivio, 1986). The studies implies that anterior regions of the left

hemisphere are dominant in tasks that are used in sequential processing such as speech. The left temporal lobe is crucial in the sequential organization of speech, probably with a combination of motor and acoustic control processes (Kimura, 1982).

These research evidences are inline with dual coding theory's assumption that verbal processing is sequential. The synchronous processing is generated from the posterior regions of both hemispheres. The patients with posterior brain damage revealed problems in spatial organization. This suggests that posterior region of the brain is associated with processing of spatial information.

Dual coding theory and criticism. The criticism on dual coding theory has been answered by Paivio and his associates. In 1981, Paivio reviewed the studies on dual coding theory, which provided positive and negative findings. Some of the findings were based on misinterpretations of the data, and according to them dual coding claims that picture naming is automatic, but Paivio replied that he has never claimed automaticity of picture naming (Paivio, 1982). Therefore, the dual coding theory is reshaped and it provided logical interpretations to human cognition. Dual coding theory provides the best framework for the processing of pictures and words, which are encoded into verbal and imaginal cognitive systems.

Bilingual dual coding model and second language. The people who have mastered two languages have two unique representational subsystems, and are able to deal separately with different acoustic and response patterns. Bilinguals have the efficiency to switch from one linguistic to another in bilingual context. Therefore, bilingualism involve productive representational system corresponding to the units

and structure of each language, and functional interconnections between them (Paivio, 1986).

Bilingual dual coding model (Paivio & Desrochers, 1980); Paivio & Lambert, 1981) is based on dual coding theory. According to this model, there are two independent and interconnected cognitive systems for processing of pictures and words. This model describes the mental structure of processing information in bilingual memory of bilinguals speaking Indo-European languages, and Japanese (as cited in Sham, 2002).

Dual coding and bilingual memory. Dual coding model has been extended to bilingual memory. The model suggest that learners not only remember words and their meanings, but also learn the form in which vocabulary is presented. This model depicts interdependent language-specific verbal systems that are interconnected via translation equivalents through a separate imagery system where perceptual information is encoded (Paivio, 1986; Paivio & Desrochers, 1980; Paivio & Lambert, 1981).

The bilingual researchers focused on Indo-European languages, French-English and Spanish-English bilinguals (Paivio, 1986, 1991a; Paivio & Desrochers, 1980; Paivio & Lambert, 1981; Vaid, 1982, 1988). The model provides a comprehensive account of links between two independent verbal systems corresponding to first language (Li) and second language (L2), which are partly interconnected between systems, connected with the imaginal system (as cited in Sham, 2002).

The theory is systematically represented in Fig.

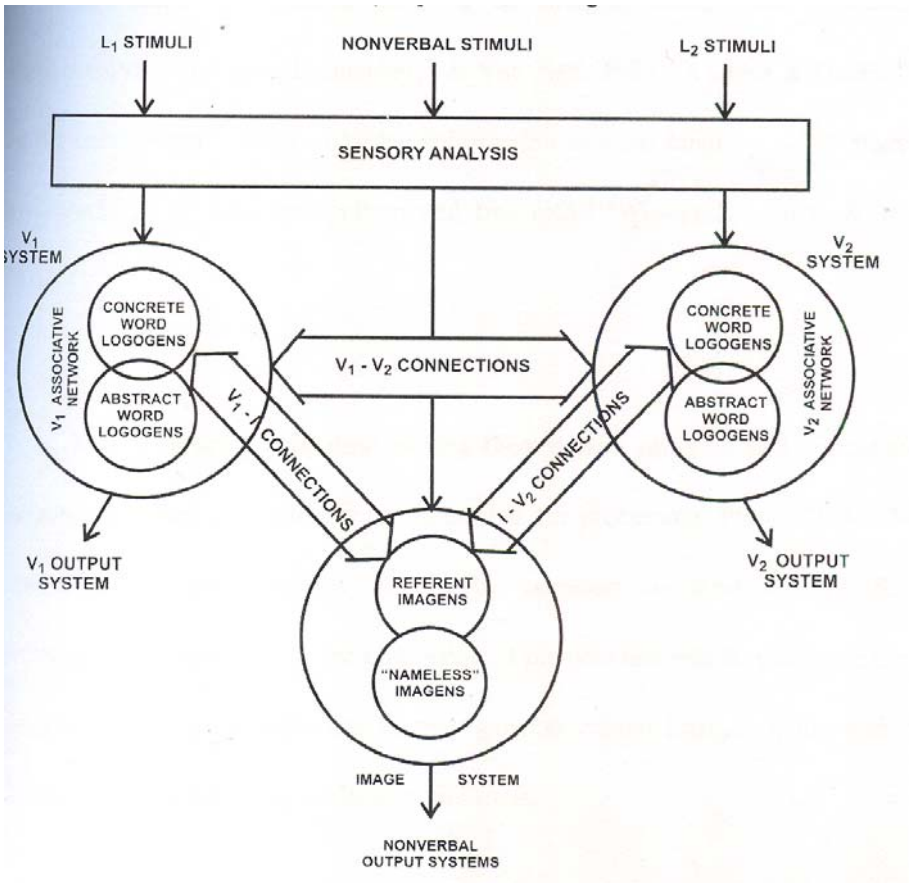


Figure 3. Bilingual Dual-Coding representation of the Paivio and Desrochers (1980)

Paivio and Lambert (1981) experimented on French-English bilinguals and suggested the participants to name pictures, translate French words and copy English words, and then observed the effects of bilingual dual coding. The picture labeling over the translated objects supported the image superiority, the pictures are encoded dually: a verbal code and a nonverbal code (Paivio, 1971, 1986).

The semantic repetition effects on free recall of concrete and abstract words of bilingual memory have been explored on French-English bilinguals by Paivio, Clark,

and Lambert (1988). A number of research extended to bilingual model was conducted by DeGroot, 1992; DeGroot, Dannenberg, & Van Hell, 1994; DeGroot & Hocks, 1995; on the concreteness effects of verbal information in cross language word processing and interlanguage word recognition and free recall (Winograd, Cohen, & Barresi, 1976).

Use of imagery and dual coding theory. According to dual coding theory, imagery value and concreteness are important for processing. Paivio (1986, 1991a) explains concreteness effects largely by recourse to modality specific and representational structure. In the processing of pictures and words, pictures have high imagery value and concreteness as they generate visual images in the non-verbal system and mental imagery in the consciousness.

Empirical evidence support the assumption that activation of non verbal representations as manifested in imagery processing is a function of concreteness or image arousing value of stimuli. This imagery is more likely to be evoked and used with objects and pictures as a stimuli than with words as a stimuli, and with concrete than abstract words.

When one encounters a concrete word it initially activities linguistic information, then subsequently begins to activate imagistic information via referential links that interconnect the language and image systems. Abstract words, on the other hand, lack of referential connections between systems and only activate the linguistic representations. Abstract information such as nouns, and abstracts evaluates and

abstract inputs are similar to verbal inputs and they are processed in the verbal system and then transformed to nonverbal codes to activate images in the imaginal system through mediating cognitive processing (Paivio, Clark, & Lambert, 1988).

The role of imagery in memory processes. Researchers explored the effect of imagery instructions and have found that these instructions were very effective in improving memory for list of words, and for text comprehensions and recall (Richardson, 1981). Paivio (1971) explored the role of imagery in human thought and memory. He proposed that a possible way to investigate imagery function could be based on the study of memory performance. Studies by Paivio and his associates (Paivio, Yuille, & Smythe, 1966; Paivio & Yuille, 1967; Paivio, 1969; Paivio & Yuille, 1969) focused on verbal and imaginal processes in paired associative learning. It has been found that instructions resulted in better learning than rote repetition (Paivio & Yuille, 1967**;** Yuille & Paivio, 1968).

Researches have been conducted (e.g., Jessen et al., 2000; Marshark & Hunt, 1989; Paivio et al., 2000; Sadoski, Kealy, Goetz, & Paivio, 1997; Sadoski, 2001) to investigate the effect of concreteness in relation to words, sentences, comprehension and composition.

Paivio, Khan, and Begg (2000) conducted experiments to test the concretences and relational effects on recall of adjective noun pairs. Imagery and concreteness of textual contents and text design was explored by Sadoski and his associates (e.g., Sadoski, 1983, 1984, 1985, 1999, 2001; Sadoski & Goetz, 1985; Sadoski & Goetz & Kangiser, 1988; Sadoski, Goetz, & Rodriguez, 2000; Sadoski & Paivio, 2001; Sadoski & Quast, 1990).

Using stories to test the effects of imagery, it was found that imagery played an important role in the comprehension and recall of highly emotional passages.

(Sadoski, 1983, 1985; Sadoski & Goetz, 1985). Concrete language has direct access to the imagens in the visual spatial area of the non verbal system in the human cognition which is suggested in the dual coding theory. Concrete nouns increased the memory recall as compared to abstract nouns.

Paivio's (1971, 1991) dual coding theory, explains that experience can be represented in a modality specific format corresponding to that of the original event. By consequence, a verbal system is responsible for the encoding and processing of verbal stimuli and non-verbal stimuli is responsible for the encoding and processing of non-verbal stimuli, the two representational systems are independent. The concept man with a high imagery value would be processed by both systems and this could explain the memory recall advantage of noun category (Paivio, Yuille, & Madgan, 1968). Paivio explored the relationship between imagery and memory processes, facilitative effects of imagery instructions on memory, and individual differences in imagery ability. De Beni and Moe (2003) investigated that individual differences in imagery ability influenced the beneficial effect of imagery strategies in memory recall, the high imagers benefited from imagery strategies and poor imagers benefited more from rehearsal or verbal strategies in the memorization of passages. These results suggest that imagery strategies for the memory performance are dependent on individual differences in imagery ability.

With reference to indigenous culture, so far very limited work has been explored on the cognitive styles and imagery domains. Batool (2002) investigated the role of imagery in classroom processes and its utilization in memorizing the text material. Chaudhry (2004) explored learning style preferences of university students. The results have been discussed in the context of prevailing educational system and culture of Pakistan.

Rationale of the Study

The significance of cognitive styles, individual differences in cognitive styles and dual coding model in research literature provided evidences for the present research to explore styles in a different culture, on a bilingual population. This research will bring in the fundamental information on the cognitive styles in Pakistan. According to Sternberg and Zhang (2001), "teachers who take styles into account can show sensitivity to cultural and individual diversity that is often absent in the classroom" (p.viii).

The rationale of the present research is based on the assumption that individuals are different in their cognitive styles and these individuals are quantifiable and knowledge of individual difference in styles are applicable on educational set ups. Every individual has a preferred, fixed and habitual ways of processing information, which are broadly categorized as verbalizers-visualizers, and wholistic-analytic cognitive styles. The perplexing differences in the performance of individuals across a variety of educational phenomena may be the mismatch effect of cognitive styles and it should be explored further.

The less established cognitive style measures are redundant (Peterson, Deary, & Austin, 2005a). Therefore new performance based cognitive style tests are applied to university students to provide psychometric equivalence on English second language population. Cognitive styles and its relation to gender, age, subject, and academic achievement is being explored in the present study. The style measures with more reliable properties would assess the individual differences in cognitive styles in the present study.

Further, the use of two codes, imaginal and verbal as explained by Paivio (1986, 1971) would be used in the present study. In a classroom, and educational settings broad instructional ways would cater to different cognitive styles than narrow instructional methods, which address to only one cognitive styles. Further use of two codes (imaginal & verbal) would have additive effect in learning. The knowledge of this research can be applied to pedagogical practices, learning strategies, and educational phenomena.

Chapter-III

OBJECTIVES, HYPOTHESES, OPERATIONAL DEFINITION, AND RESEARCH DESIGN

Present study was primarily conducted as a pilot study and then study I was explored. Study I was conducted in two phases, Phase I was designed for the establishment of test re-test reliability evidences for Verbal Imagery Cognitive Style (VICS) test and Extended Cognitive Style Analysis-Wholistic Analytic (E-CSA-WA) test. Phase II further consisted of two parts. Part I was designed for internal consistency reliability evidences for VICS test and E-CSA-WA test. Part II was designed to identify individual differences in cognitive styles.

Objectives

1. To identify the verbalizer-visualizer preferences for each gender.
2. To identify the wholistic-analytic style preferences for each gender.
3. To investigate the association between cognitive style (verbal-imagery, little style, and wholistic-analytic, little style) for the university students.
4. To compare the verbalizers-visualizers and little style with reaction time.
5. To explore gender differences with respect to reaction time.
6. To explore gender differences with respect to cognitive styles (verbalizers-visualizer and little style).
7. To explore the age differences with respect to reaction time.
8. To explore age differences with respect to cognitive styles (verbalizer-visualizer and little style).

9. To compare the reaction time of the students of natural sciences, social sciences and management sciences.
10. To compare the cognitive styles (verbalizer-visualizer and little style) with the students of natural sciences, social sciences and management sciences).
11. To explore the association of low and high achievers with cognitive styles (verbalizer-visualizer and little style).

Hypotheses

To achieve the objectives of the present study, following hypotheses were formulated.

1. There would be gender differences on cognitive styles (verbalizer, visualize, little style, wholistic, analytic, little style)
2. There would be an association between verbalizer-visualizer, little style and wholistic-analytic, little style.
3. There would be differences among verbalizers, visualizers and little style on reaction times.
4. Male students would be more visualizers as compared to female students on reaction time.
5. Male and female students would differ significantly on median and mean reaction time.
6. There would be an association between age and cognitive styles.
7. Adults under 23 years and over 23 years would differ on median and mean reaction time.

8. The students of natural sciences would be more visualizers as compared to social and management sciences.
9. There would be an association between subject groups and cognitive styles.
10. There would be differences between achiever groups on cognitive styles (verbalizer-visualizer and little style).
11. There would be differences between high and low achievers on median and mean reaction time.

Operational Definitions of the Variables

Cognitive styles. An individual's preferred and habitual approach to both organising and representing information (Riding & Rayner, 1998). In the present study, verbalizer-visualizer cognitive style was measured by Verbal-Imagery Cognitive Style (VICS) Test developed by Peterson (2005) with internal consistency (r = .72) and test re-test reliability (r = .56). Wholistic-analytic cognitive style was measured by Extended-Cognitive Style Analysis-Wholistic Analytic Test developed by Peterson (2005) with internal consistency (r = .72) and test-re-test reliability (r = .55).

Visualizer. Visualizers are those who tend to process information in images (Riding & Rayner, 1998). Visualizer is measured through imagery tasks of the Verbal Imagery Cognitive Style (VICS) Test.

Verbalizer. Verbalizers are those who tend to process information in words (Riding & Rayner, 1998). Verbalizer is measured through verbal tasks of the Verbal Imagery Cognitive Style (VICS) Test.

Academic achievement. Academic achievement for the present study is measured by overall Grade Point Average (GPA), obtained by the university students in their last two semesters of Bs Honors, Masters, and M.Phil. A 5 level grade point system (A = 4.0, B = 3.0, C = 2.0, D = 1.0, F = 0.0) was followed.

Wholistic-analytic cognitive style. Wholist are those who tend to process information as a whole and are habitually consistent in any context condition or situation. Analytics tends to process information in parts and are habitually consistent in any context, condition or situation.

Little style. Little style on verbal-imager dimension (Peterson, 2005) are those individuals who have little or no style. According to Peterson, "my research on 37 university students suggest that most students have V/I style ratio between .8 and 1.0 which suggest little or no style" (p.11). This criteria is followed for the present study.

Verbal versus imagery ratio (V/I ratio). Verbal versus imagery ratios are used to allocate an individual to style preference. Scores that are closer to 0 would indicate a tendency towards verbal preference, and scores that are closer towards 2 or above indicate a tendency towards verbal preference.

Wholistic-versus analytic ratio. Wholistic versus analytic ratio are used to allocate an individual to style preference. Scores that are closer to 0 would indicate a tendency towards a wholistic preference. Scores that are closer towards 2 or above indicate a tendency for an analytic preference. The little style on wholistic-analytic dimension shows an individual who has little or no style.

According to Peterson (2005), “my research on 276 university students suggest that most students have W/A style ratio between .97 and 1.25 and this suggest little style” (p.12). This criteria is followed for the present study.

Reaction time. The time taken to respond to the stimulus (Peterson, 2005). Reaction time is the distance between the stimulus and start of the response. It involves information processing, stimulus identification and selection of the response (Alikhani, Mousavi, & Makhatri, 2011).

Median verbal response time (Med VRT). Median reaction time on the verbal task.

Median imagery response time (Med IRT). Median reaction time on the imagery task.

Mean verbal (Mean V). Mean reaction time on the verbal task.

Mean imagery (Mean I). Mean reaction time on the imagery task.

Mean picture (Mean Pic). Mean reaction time on the picture items.

Mean words (Mean words). Mean reaction time on the word items.

Mean exposure 1 (Mean Exp 1). Mean reaction time on the items in exposure 1.

Mean exposure 2 (Mean Exp 2). Mean reaction time on the items in exposure 2.

Sample

Sample for the internal consistency reliability was 427 university students from University of the Punjab Lahore, University of Central Punjab, Lahore, Quaid-i-Azam University Islamabad, and National University of Modern Languages (NUML) Lahore. The initial sample consisted of 443 university students. The students who had an error rate of greater than 30% were excluded from the subsequent analysis (Peterson, 2005). Therefore, the remaining students consisted of 427 students. The mean age for 427 students was 23.46 and *SD* = 3.35. All spoke English as a second language. The students have their native languages used at home, English can be used as a third language, English is still treated as a second language because mother tongues and native languages may be presented auditorily at home only, and never presented in any social context or in written format. Therefore native languages are not learned and used in complete presentation without their orthographies. All students were literate in computer use. The inclusion criteria of the sample was those students who have done their Matric in English medium schools (medium of education was English). The sample belonged to different subject groups, which included natural sciences, social sciences, and management sciences.

Measures

The following measures were used in study I.

Verbal-Imagery Cognitive Style Analysis (VICS) Test. VICS test was developed by Peterson (2005). VICS test is able to explore individual differences in verbal and imagery information processing. This is a computerized test measuring cognitive style in seconds and their components break down is given below:

Verbal Imagery Cognitive Style (VICS) Test (232 Stimuli)											
Verbal Task (116)						Imagery Task (116)					
Words (58)			Pictures (58)			Words (58)			Pictures (58)		
N	*M*	*Mx*	*N*	*M*	*Mx*	*B*	*S*	*E*	*B*	*S*	*E*
(26)	(26)	(6)	(26)	(26)	(6)	(26)	(26)	(6)	(26)	(26)	(6)

Note. N = Natural, M = Man-made, Mx = Mixed, B = Bigger, S = Smaller, E= Equal

The verbal imagery cognitive style ratios (V/I) are used in VICS test to identify an individuals' verbal-imagery cognitive style. The verbal-imagery dimension is measured with ratios. The V/I ratios are computed through reaction time, the time taken by each participant on verbal and imagery task of the VICS test. The mean and median reaction times on VICS test are taken for the analysis in the present research (See Appendix A, page 6 of 6).

Scores that are closer to 0 would indicate a tendency for verbal preference. The scores that are closer to 2 or above indicate a tendency for an imagery preference. Peterson (2005) conducted a research on 376 university students which showed VI style ratio between .8 and 1 which is little style. The scores less than .8 are verbalizer, and greater than 1 are visualizers. This test revealed high internal consistency ($r > .72$) and acceptable stability at test retest ($r = .56$). For the present study, the reliability evidences were established again on English as a second language population.

Peterson, Deary, and Austin (2003b) conducted a research and used a mixed model of analysis of variance (ANOVA) on subject's mean and median reaction time

on each test section (verbal and imagery). Irrespective of whether the dependent variable was the mean or the median reaction time. Therefore subject's mean reaction time was taken as a mean of means.

Mean of means is calculated according to the properties of means. Combined mean can be calculated as some of all means/total number of means. It is necessary when more than one mean is observed in a sample (Gravetter & Wallnau, 2009).

Extended Cognitive Style Analysis-Wholistic-Analytic (Extended CSA-WA). Extended CSA-WA test was developed by Peterson (2005). This test is able to detect individual differences in wholistic and analytic processing, which are used in the present research to assess wholistic analytic dimension. The test measures reaction time in seconds. The wholistic-analytic dimension is measured with W/A ratios. The W/A ratios are computed through reaction time, time taken by each participant on wholistic and analytic tasks of the E-CSA-WA test (see Appendix A, page 6 of 6).

Scores that are closer to 0 indicate a tendency towards a wholistic preference, and scores that are closer to 2 or above denote a tendency for an analytic preference. Peterson (2005) conducted a research on 276 university students, who showed WA ratio between .97 and 1.25 which is named as little style, the scores less .97 are wholistics, and greater than 1.25 are analysts. This is a computerized test and their component breakdown is given in the table below:

Extended CSA-WA (80 Stimuli)			
Wholistic Task (40)		Analytic Task (40)	
Original CSA Wholistic Items (20)	New Wholistic Items (20)	Original CSA Wholistic Items (20)	New Wholistic Items (20)

For the present research, the reliability evidences were established again on English as a second language population.

Demographic Sheet. The students were also given a personal bio-data form to have their demographic information about the research. It included name, age, gender, name of university, discipline of study (subject groups), and province (see Appendix E).

Procedure for Administering VICS test and E-CSA-WA test for Study I

VICS test and E-CSA-WA test by Peterson (2005) were administered with two demographic sheets, one was administered electronically, and the other was filled manually.

Apparatus.

Settingup the computers . First of all, five computers with windows XP were selected and five moveable separate keyboards were prepared for the VICS and E-CSA-WA tests. The numeric pads, as shown in Figure 4 and 5 of the keyboards was used for the studies.

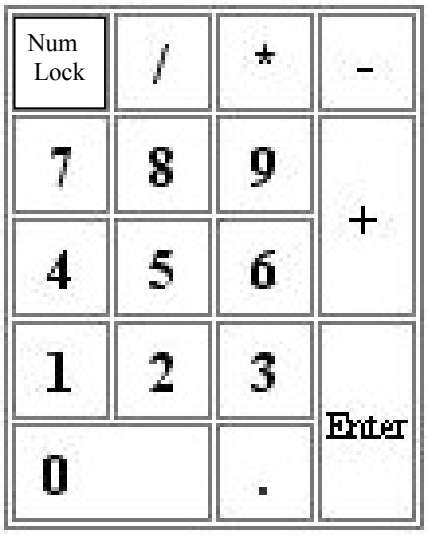


Figure 4. A standard numeric pad on a keyboard.

The numeric pads were prepared by covering the first three rows of the numeric pad with a white piece of paper on the keys as shown in the figure 5. The num lock, keys numbers 7, 8, 9, 4, 5, and 6 were covered with a white piece of paper. The keys number 1, 2, and 3 were covered with alphabet written on white paper as Y, N, and M respectively. After the preparation, the keyboard looked like the following figure.

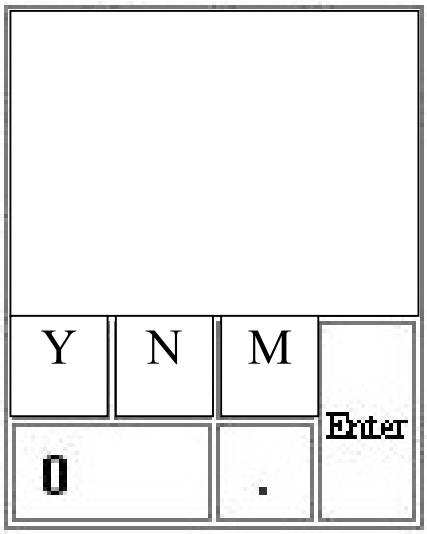


Figure 5. Figure shows how numeric pad looked like while administering the VICS test.

The numeric lock of the keyboard was activated. For the administration of E-CSA-WA test, the numeric pad was prepared by pasting alphabet Y and N on the keys 1 and 2 respectively. The key number 3 was covered with a white paper as shown in the Figure 6.

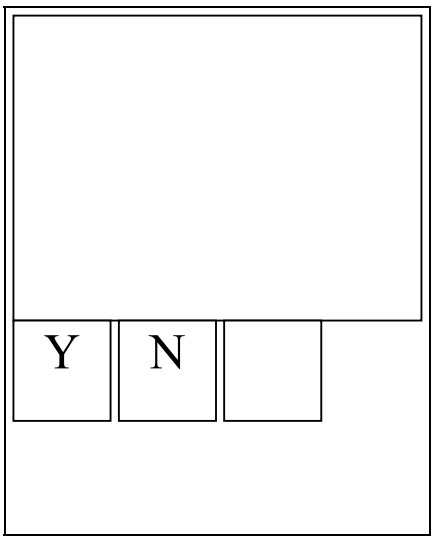


Figure 6. The numeric pad showing preparation for the E-CSA-WA test.

Setting up the Screen. The computer screen resolution was set on 1024 x 768, this was done to standardize the size of the images for the students.

Setting up the room. For a reliable assessment, every student was assessed individually and carefully so that the student would not be able to see or hear another person being tested. This was done so because the test measures the student's natural speed of response and this is likely to be altered if student see or hear someone answering more quickly than his/her, or if student see or hear someone finishing before his/her. Cell phones were turned off and the other distracters were removed.

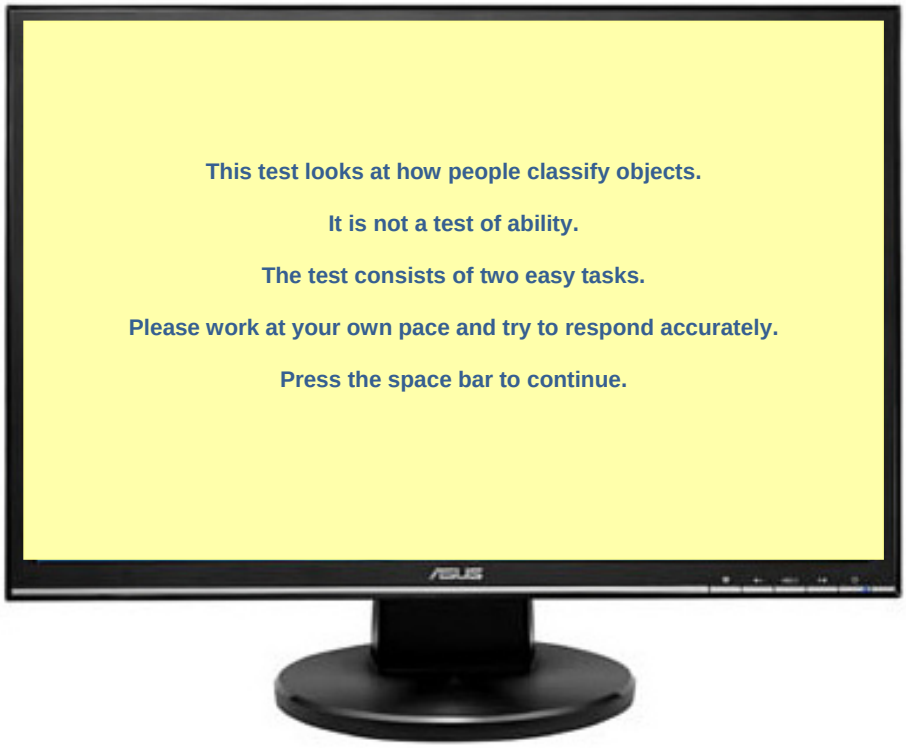
Administration of the VICS test and E-CSA-WA test.

Instructions for students. No information about how the test actually measures style was given to any student. No information was given to the student about the general field of the cognitive style until after the test is finished. The student was asked to sit comfortably on a chair in front of the computer and readily prepared keyboard was shown to each student and instructed that click the left side button of the screen, then the file program VICS and E-CSA-WA opens up.

The introductory/start of the screen for the VICS test and E-CSA-WA appears. It is instructed to the students that press 'OK' and then click on Test/New, then it was selected whether there is a new student or one already in the system. For every new student, the demographic details were entered with the help of the researcher. Once the student's demographic information of name, age, year of birth, handedness, and the student is dyslexic, colour blind or has any disability is entered, then VICS test starts up and it takes approximately 25-30 minutes to complete. The E-CSA-WA test takes approximately 15 minutes to complete. A set of information describing instructions was presented on the computer screen before each test.

The VICS test starts with the practice session for each student. The first information appeared on the computer screen, and explained about the test that this

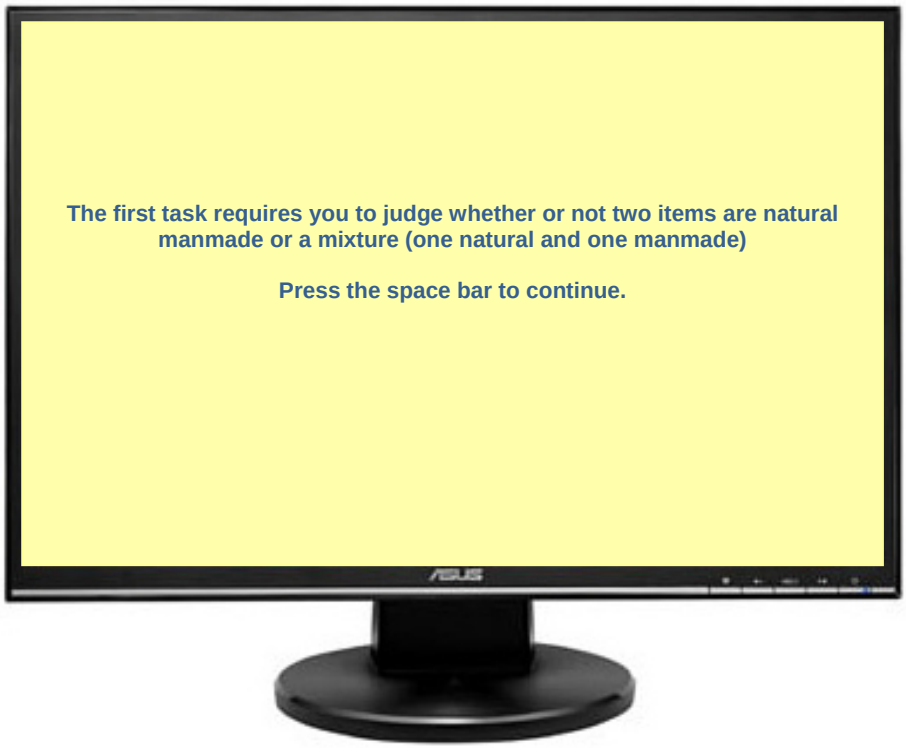
test is not a test of ability. The information appears on the screen are shown in the Figure 7.



(Source: Peterson, 2005)

Figure 7. Introducing about the two easy tasks, and instructions to work at your own pace

After carefully reading the instructions about the test, the student is instructed to press the space bar to continue the test. Then next information appeared on the screen which is shown in the Figure 8.



(Source: Peterson, 2005)

Figure 8. Instruction about the natural, manmade, and mixture items.

The student is instructed that you have to judge whether or not two items are natural, manmade or a mixture. The mixture item include one natural and one manmade stimulus.

For the subsequent screen shots (See Appendix I)

Retrieving the Results

After administering the VICS and E-CSA-WA tests, the results were retrieved from the computer. The VICS test and E-CSA-WA produced three types of reports, with the name of researcher's report, summary report, and summary report plus.

Researcher's report. This report was useful for the researcher who wanted to do an in-depth analyses of the result by using statistical package. The electronic file produced for each student was very long. The research report gave each student's response to every question and the attributes of that question. For the VICS test for each of the 232 responses per subject, there was a presentation task, type, form, exposure, correct answer, response and reaction time. Similarly on the E-CSA-WA test for each of the 80 responses per subject, the correct answer, reaction time were noted.

Summary report. For the VICS test and E-CSA-WA test, summary report gave each student's session number, the median and mean reaction times on the section of the test (verbal, imagery, wholistic, and analytic) and number of correct responses on each section of the test. The most important results in the summary report were the verbal-imagery ratio and wholistic-analytic ratio. These ratios were taken on median reaction times on verbal tasks (V) and median reaction time taken on the imagery tasks (I). This ratio gave an indication of the each student's verbal-imagery and wholistic-analytic style preferences.

Summary report plus. The summary report plus also provided the same basic summary data for each student as given in the summary report. This report also gave a few additional details such as name, age, gender, ethnicity and comments for each student. For the VICS test, the summary report plus also gave the details of the mean reaction times and accuracy for each task type, exposure, stimulus form, and type of item. The data generated through three types of reports (researcher's report, summary report, and summary report plus) were used in the present study to meet the objectives of the research.

Research Design

Present study was conducted in two studies, named as study I and study II. The study I was conducted as pilot study by involving a sample of university students ($N = 50$) aimed to test the research instrument, the reliability of the performance based cognitive styles tests and to identify potential problems that might arise during the study I. The phase II, part I of the present study was conducted to explore the evidences for internal consistency reliability. The sample consisted of 427 university students. The part II of the study I was conducted on the same sample ($N = 427$) to identify the individual differences in cognitive styles.

The study II was conducted in part I and part II. Part I explore the differences in memorizing the concrete and abstract sentences by involving a sample of university students ($N = 200$). Part II was aimed to explore the imagery inducing instructions for memorizing the concrete and abstract sentences. The sample part II was conducted on an independent sample of 200 university students.

Chapter-III

PILOT STUDY

This study was conducted to gain insight into the appropriateness of the cognitive style tests on English as a second language population. According to Dane (1990), pilot study is an abbreviated version of research project in which the researcher practices or test procedures to be used in the subsequent full scale project. Therefore the main objectives of the pilot study were to:

1. test the research instruments which were used in the study I.
2. test the reliability of the performance-based tests.
3. identify potential problems that might arise during the study I.

Sample

Sample for the pilot study was 50 university students from University of the Punjab Lahore, and Quaid-i-Azam University Islamabad. The inclusion criteria of the sample is same as described on page 56.

Results

The measure and procedure are described in method section (see pages 57-58). Pilot study was done to assess the workability of the measures and to find out the spread of data through histograms.

Table 1

Cronbach Alpha Coefficient for VICS and E-CSA-WA (N = 50)

Scale	No. of Items	Cronbach Alpha Coefficient
VICS	232	.88
E-CSA-WA	80	.88

The result in Table 1 shows alpha coefficient reliability for VICS test and E-CSA-WA, which is quite high and it is showing high internal consistency.

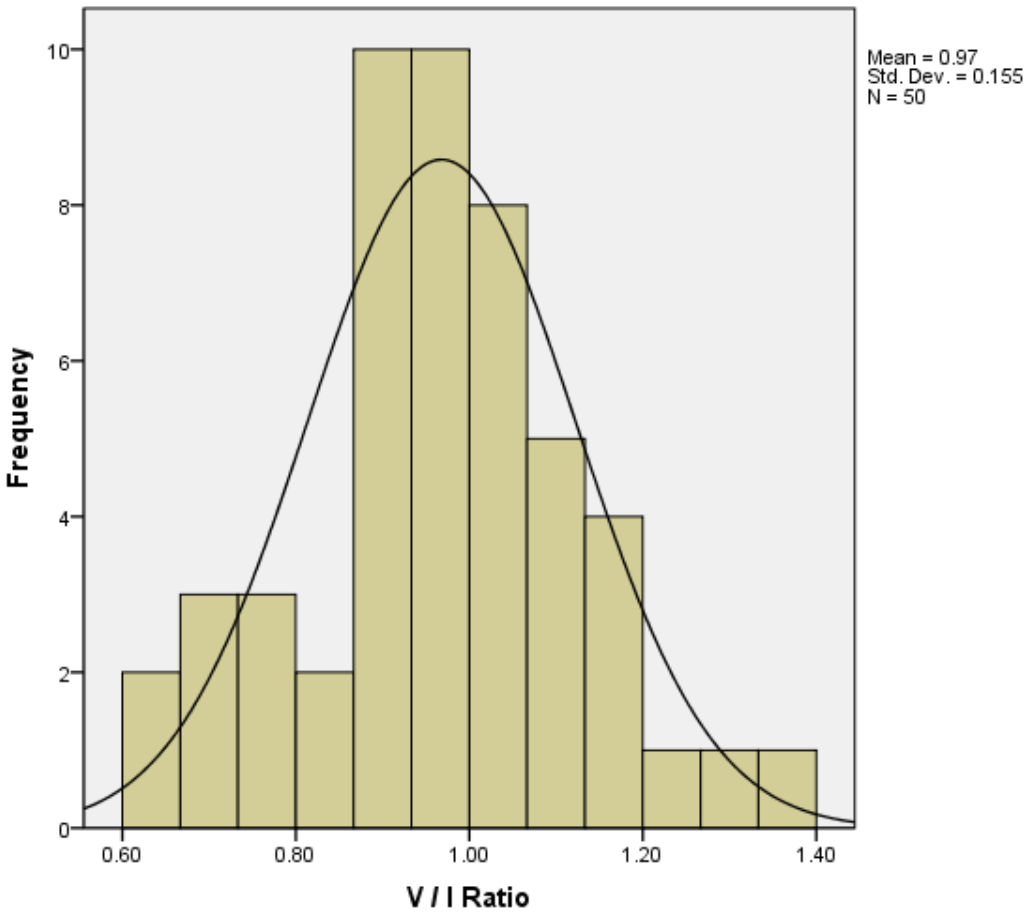


Figure 9. Histogram showing verbal-imagery ratio on the VICS test ($N = 50$).

The above figure is showing V/I ratio on the VICS test which is describing spread of data on median reaction time.

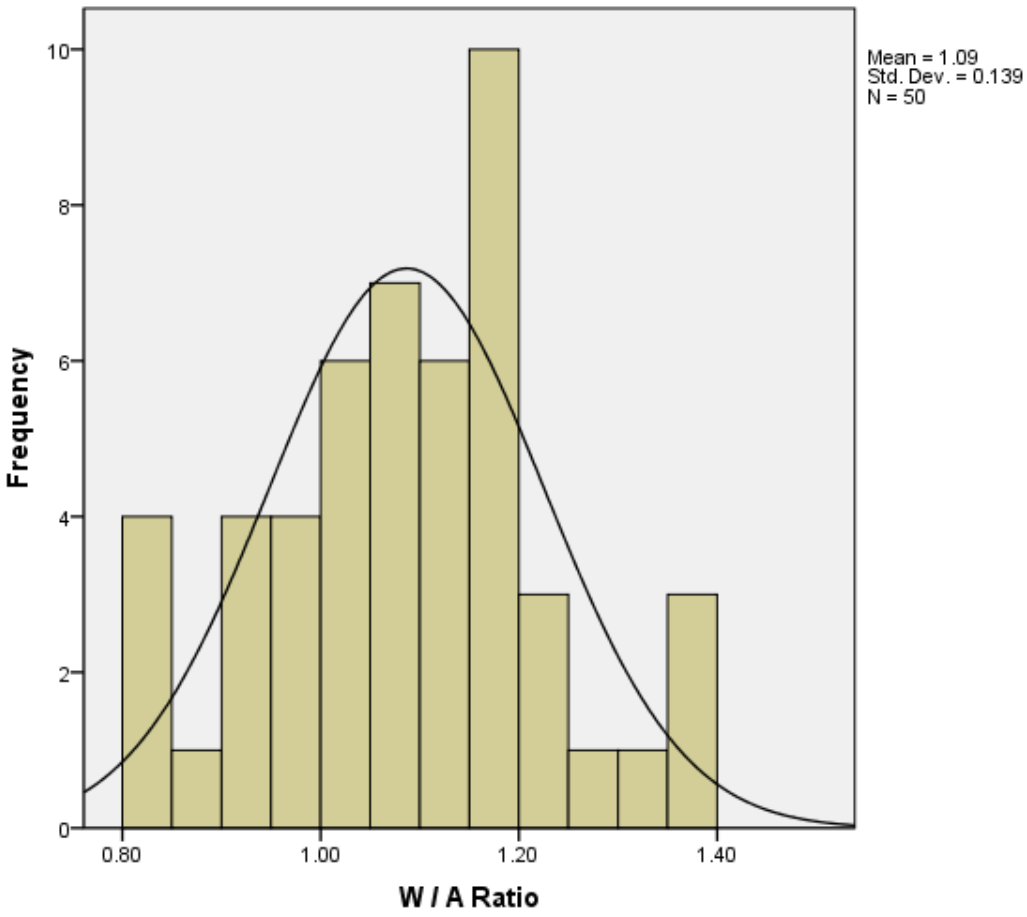


Figure 10. Histogram showing Wholistic-Analytic ratio on the E-CSA-WA test (*N* = 50).

The above figure is showing W/A ratio on the E-CSA-WA test which is describing spread of data on median reaction time.

Chapter-IV

STUDY-I

Phase I: Reliability of the Measures

Objectives

The objective of the phase-I is:

1. To establish the evidences of test-retest reliability of VICS and E-CSA-WA tests.

Sample

Sample for test-retest reliability was 81. The sample was taken from the University of Punjab, Lahore and University of Central Punjab Lahore. The inclusion criteria of the sample is same as described on page 56.

Measures

1. Verbal-Imagery Cognitive Style (VICS) test.
2. Extended Cognitive Style Wholistic-Analytic (E-CSA-WA) test.

The details of the measures are elaborated on (Pages 57-58) of the method section.

Results

Table 2

Test-retest Reliability for VICS and E-CSA-WA (N = 81)

Scales	Items	Reliability
VICS		
Verbal Tasks	116	.58*
Imagery Tasks	116	.71**
E-CSA-WA		
Wholistic Tasks	40	.54*
Analytic Tasks	40	.69**

Note. VICS = Verbal Imagery Cognitive Style, E-CSA-WA = Extended-Cognitive Style Analysis-Wholistic Analytic

*$p < .01$, **$p < .001$

According to Peterson, Dearty, and Austin (2005a), the development of VICS test and the findings of the two studies compared the reliability of the VICS with the CSA's verbal-imagery dimensions twice about a week apart. In Table 2, test retest reliability was measured for VICS and E-CSA-WA, with the second sitting after a week later. Accuracy and median reaction times were recorded for each test section (imagery, verbal), session (1 & 2), each stimulus form (words, pictures) and each stimulus exposure (verbal first and second exposure, imagery first and second exposure). The key variable was the reliability of the median reaction time. The number of errors made by every individual was also noted and those who had error rate of more than 30% on VICS test were excluded from the study. The order of the test sections (verbal, imagery, wholistic, analytic) for both the test remained the same.

Phase II

Part I

Internal Consistency of the VICS and E-CSA-WA. To examine whether VICS and E-CSA-WA were internally consistent, Cronbach alpha coefficient was computed.

Objective.

1. To explore evidences for internal consistency reliability

Sample. The inclusion criteria of the sample is same as described on page 56.

Table 3

Cronbach Alpha Coefficient for VICS and E-CSA-WA (N = 427)

Scale	No. of Items	Cronbach Alpha Coefficient
VICS	232	.81
E-CSA-WA	80	.82

Note. VICS = Verbal Imagery Cognitive Style, E-CSA-WA = Extended-Cognitive Style Analysis-Wholistic-Analytic

Part II

Part II was conducted to achieve the following objectives.

Objectives

1. To identify the verbalizer-visualizer preferences for each gender.
2. To identify the wholistic-analytic style preferences for each gender.
3. To investigate the association between cognitive style (verbal-imagery, little style, and wholistic-analytic, little style) for the university students.
4. To compare the verbalizers-visualizers and little style with reaction time.
5. To explore gender differences with respect to reaction time.
6. To explore gender differences with respect to cognitive styles (verbalizers-visualizer and little style).
7. To explore the age differences with respect to reaction time.
8. To explore age differences with respect to cognitive styles (verbalizer-visualizer and little style).
9. To compare the reaction time of the students of natural sciences, social sciences and management sciences.
10. To compare the cognitive styles (verbalizer-visualizer and little style) with the students of natural sciences, social sciences and management sciences).
11. To explore the association of low and high achievers with cognitive styles (verbalizer-visualizer and little style).

Hypotheses

To achieve the objectives of the present study, following hypotheses were formulated.

1. There would be gender differences on cognitive styles (verbalizer, visualize, little style, wholistic, analytic, little style)
2. There would be an association between verbalizer-visualizer, little style and wholistic-analytic, little style.
3. There would be differences among verbalizers, visualizers and little style on reaction times.
4. Male students would be more visualizers as compared to female students on reaction time.
5. Male and female students would differ significantly on median and mean reaction time.
6. There would be an association between age and cognitive styles.
7. Adults under 23 years and over 23 years would differ on median and mean reaction time.
8. The students of natural sciences would be more visualizers as compared to social and management sciences.
9. There would be an association between subject groups and cognitive styles.
10. There would be differences between achiever groups on cognitive styles (verbalizer-visualizer and little style).
11. There would be differences between high and low achievers on median and mean reaction time.

Sample

Sample. The inclusion criteria of the sample is same as described on page 56.

Measures

1. Verbal-Imagery Cognitive Style (VICS) test.
2. Extended Cognitive Style Wholistic-Analytic (E-CSA-WA) test.
3. Score on academic achievement.
4. Demographic Data.

The details of the measures are elaborated on (Page 57-58) of the Chapter II

Results

Table 4

Demographic Characteristics of Sample (N = 427)

Variable	*f*(%)	*M*(*SD*)
Age		23.46(3.35)
Gender		
Female students	267(62.5%)	
Male students	160(37.5%)	
Education		
Bachelors	171(40.0%)	
Masters	235(55.0%)	
M.Phil	21(4.9%)	
Departments		
Management sciences	74(17.3%)	
Social sciences	165(38.6%)	
Natural sciences	188(44.0%)	
Achievement score		73.74(9.59)
Academic achievers		
Low achievers	186(43.6%)	
High achievers	241(56.4%)	

Table 4 shows the frequency and percentage distribution for the demographic variables. It has been observed that female students were in majority as compared to the male students. For education most frequent category was master students and least frequent was M.Phil students. Department wise natural sciences students were most frequent and least frequent category was management sciences students. It was also observed that high achievers are most frequent as compared to the low achievers.

Histogram is shown in Figure 11, to examine the spread of data for the verbal-imagery ratios.

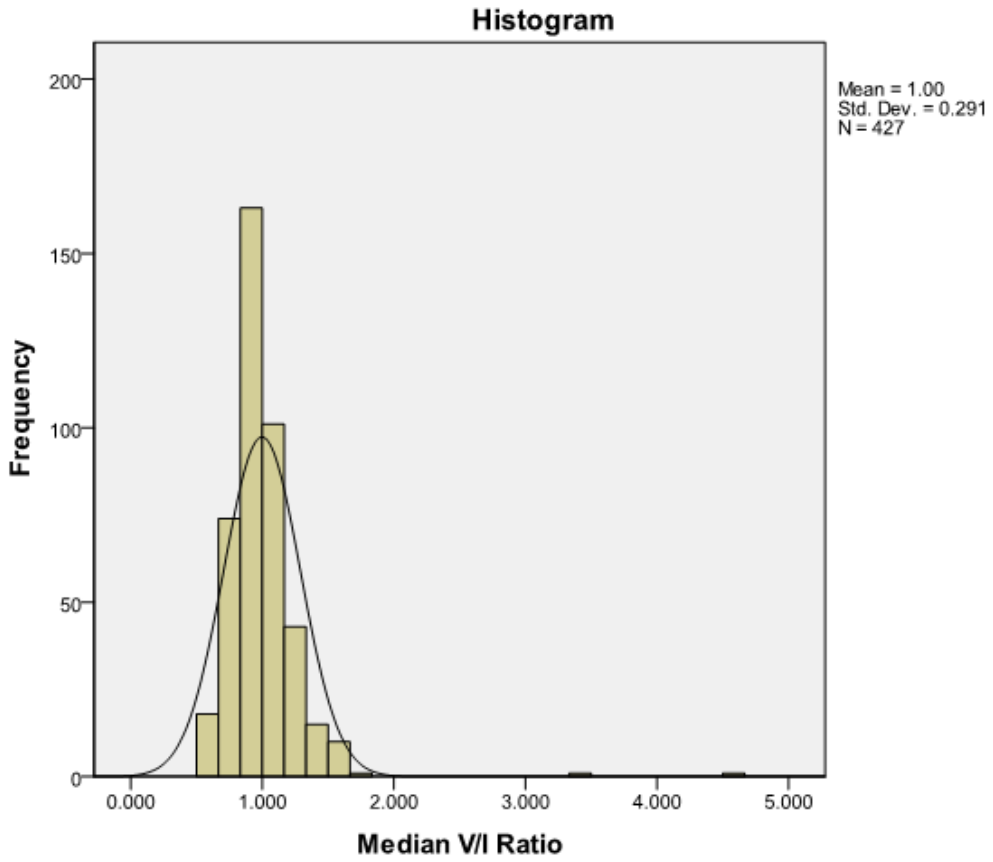


Figure 11. Histogram showing verbal-imagery ratio on the VICS test.

The above figure is showing V/I ratio on the VICS test which is describing spread of data on median reaction time.

The analysis (Table 5) included looking at individual differences in cognitive styles. The verbal-imagery dimensions was measured through VICS Test, which generated scores as median reaction time on verbal tasks and median reaction time on

imagery tasks. The cognitive style for each student was measured using V/I ratio, which generated three style groups as shown in table 5. The criteria of V/I ratio was followed as described by Peterson (2005), that V/I style ratios between .8 and 1.0 suggest little or no style.

Table 5 presents the analysis of the data to determine the verbal imagery profile of the sample used in the present study. Following table explains the frequency differences between male students and female students among three cognitive styles.

Table 5

Cognitive styles (Verbalizer, Visualizer, Little Style) versus Gender

	V/I ratio Range	Male Students *f* (%)	Female Students *f* (%)	Total
Verbalizer	< .8	14 (8.8)	49 (18.4)	63
Little Style	.8-1	61 (38.19)	131 (49.1)	192
Visualizer	> 1	85 (53.1)	87 (32.5)	172
Total		160 (100)	267 (100)	427 (100)

$\chi^2 = 19.39$; $df = 2$; $p < .001$

Note. V/I ratios are taken on median reaction time.

Table 5 indicates categories of verbal-imagery dimension as verbalizer, visualizer, and little style, distribution for gender. Results of chi-square tabulation indicated significant differences on cognitive styles ($\chi^2 = 19.39$, $p < .001$). The percentages in Table 5 are column percentages, reflecting distribution for gender per style sub-group. Male students are more visualizers as compared to female students, whereas female students are more verbalizer as compared to male students.

Histogram is shown in Figure 12 to examine the spread of data for the wholistic-analytic ratios.

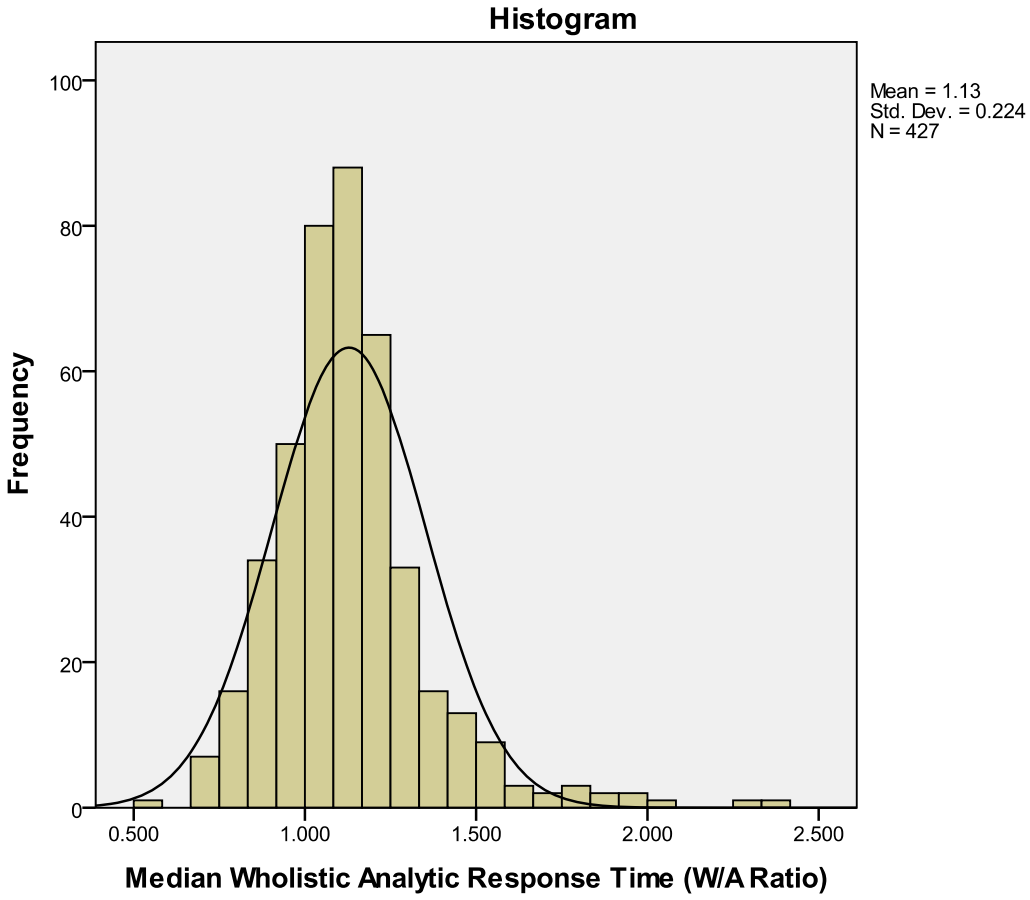


Figure 12. Histogram of the wholistic-analytic ratio on the E-CSA-WA test.

The above figure is showing W/A ratio on the E-CSA-WA test which is describing spread of data on median reaction time.

The wholistic-analytic dimension was measured through E-CSA-WA Test, which generated scores on median reaction time on wholistic task, and median reaction time on analytic task. The cognitive style for each students was measured

using W/A ratio, which generated three style groups as shown in table. The criteria of W/A ratio was followed as described by Peterson (2005) that W/A style ratios between .97 and 1.25 suggest little or no style. Table 6 presents the analysis of the data to determine the wholistic-analytic profile of the sample. Following table explains the frequency differences between male students and female students among three cognitive styles.

Table 6

Cognitive Style (Wholistic, Analytic, Little Style) versus Gender (N = 427)

	W/A ratio	Male Students	Female Students	Total
Wholistic	< .97	30 (18.8)	61 (22.8)	91
Little Style	.97-1.25	89 (55.6)	161 (60.3)	250
Analytic	> 1.25	41 (25.6)	45 (16.9)	86
Total		160 (100)	267 (100)	427 (100)

$\chi^2 = 4.98$; $df = 2$; p = n.s..
Note. W/A ratios are taken on median reaction time.

Table 6 shows three categories of wholistic-analytic dimension, as wholistic, analytic, and little style. Results of chi-square cross tabulation indicated nonsignificant gender differences on cognitive styles $\chi^2(2, N = 427) = 4.98$, p = n.s.

The percentages in Table 6 are column percentages, reflecting distribution for gender per style sub-group. Table 6 also provides a gender perspective of the cognitive style results.

The association of verbalizing-visualizing, little style with wholistic-analytic, little style are shown in Table 7.

Table 7

Association between Verbalizer-Visualizer, Little Style and wholistic-analytic, Little Style (N = 427)

		1 Verbalizer *f* (%)	2 Visualizer *f* (%)	3 Little Style (Verbal-Imagery Dimension) *f* (%)	Total
1.	Wholistic	17 (4.0)	29 (16.9)	45 (23.4)	91
2.	Little Style (Wholistic-Analytic Dimension)	37 (58.7)	105 (61.0)	108 (56.3)	250
3.	Analytic	09 (2.1)	38 (22.1)	39 (20.3)	86
	Total	63 (100)	172 (100)	192 (100)	427

$\chi^2 = 4.715$; $df = 4$; $p = n.s$

Table 7 shows association between verbal-imagery, little style (verbal-imagery dimension) and wholistic-analytic, little style (wholistic-analytic dimension) with reference to number of students.

The results in Table 7 show the independence of the two cognitive style dimensions. There is nonsignificant association between verbal imagery, little style (verbal-imagery dimension) and wholistic-analytic, little style (wholistic-analytic dimension).

The assumption is that individual differences in verbal-visualizing cognitive style can be identified by comparing the reaction time (speed of responses) to verbal and imagery tasks. Therefore reaction time is taken as a dependent variable.

Table 8

Analysis of Variance of Verbal-Imagery Cognitive Style on the VICS tasks (N = 427)

Variables	Verbalizer (n = 63)		Little Style (n = 192)		Visualizer (n = 172)			
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	η^2
Median Reaction Time on Verbal Task	2.13	.62	2.30	.66	2.88	.85	36.79***	.15
Median Reaction Time on Imagery Task	3.00	.89	2.56	.72	2.43	.72	13.50***	.06
Mean Reaction Time on Verbal Task	2.75	.90	2.93	.98	3.71	1.27	29.46***	.12
Mean Reaction Time on Imagery Task	3.80	1.23	3.20	1.01	3.12	1.04	10.13***	.05
Mean Reaction Time on The Picture Items	2.70	.90	2.47	.77	2.79	.97	6.04***	.03
Mean Reaction Time on The Word Items	3.86	1.26	3.67	1.26	4.04	1.31	3.94*	.02
Mean Reaction Time on the Items in Exposure 1	3.61	1.24	3.38	1.16	3.82	1.25	5.92**	.03
Mean Reaction Time on the Items in Exposure 2	2.95	.93	2.76	.82	3.02	.98	3.81*	.02

df = 2,424, ***p<.001; **p<.01; *p<.05

Table 8 presents significant differences in cognitive styles (verbalizer-visualizer, little style). The results show that students scored significantly different for median reaction time on verbal task (F (2,424) = 36.79, p < .001) and imagery task (F

(2,424) = 13.50, $p < .001$), mean reaction time on verbal task (F (2,424) = 29.46, $p < .001$) and imagery task (F (2,424) = 10.13, $p < .001$), mean reaction time on the picture items (F (2,424) = 6.04, $p < .001$), and word items (F (2,424) = 3.94, $p < .001$), mean reaction time on the items in exposure 1 (F (2,424) = 5.92, $p < .01$), and exposure 2 (F (2,424) = 3.81, $p < .05$) with respect to different cognitive styles (verbalizers, little style and visualizers). The small effect size was observed for all reaction time tasks except medium effect size was observed for median reaction time on imagery task. The Bonferroni post-hoc was used to find the significant mean groups (see Appendix L).

The Table 9 highlight the gender groups. The sample includes 160 male students and 267 female students.

Table 9

Gender differences on the VICS tasks (N = 427)

	Male (n = 160)		Female (n = 267)			95% CI		Cohen's
	M	*SD*	*M*	*SD*	*t*	*LL*	*UL*	d
Median Reaction Time on Verbal Task	2.56	.85	2.48	.77	.981	-.079	.236	.10
Median Reaction Time on Imagery Task	2.48	.80	2.63	.75	2.00*	-.306	-.003	.20
Mean Reaction Time on Verbal Task	3.34	1.24	3.15	1.12	1.591	-.043	.415	.16
Mean Reaction Time on Imagery Task	3.19	1.14	3.30	1.04	1.05	-.326	.098	.10
Mean Reaction Time on The Picture Items	2.55	.88	2.68	.89	-1.40	-.299	.050	.15
Mean Reaction Time on The Word Items	3.97	1.46	3.77	1.17	1.522	-.057	.449	.16
Mean Reaction Time on the Items in Exposure 1	3.63	1.32	3.57	1.17	.533	-.176	.306	.05
Mean Reaction Time on the Items in Exposure 2	2.89	.96	2.89	.88	.068	-.174	.187	.00

df = 425, *p < .05

Note. CI = confidence interval, LL = lower limit, UL = upper limit

The results in Table 9 indicate significant gender differences in the scores of VICS tasks as median reaction time on imagery task (t (425) = 2.00, p < .05). Male

students are more visualize as compared to female students because male students process visual tasks faster than female students.

Table 10

Age Groups versus Cognitive Style (N = 426)

Variables	< 23 Years *f*(%)	> 23 Years *f* (%)	Total
Verbalizer	40 (15.0)	22 (13.8)	62
Little Style	116 (43.4)	76 (47.8)	192
Visualizer	111 (41.6)	61 (38.4)	172
Total	267 (100)	159 (100)	426 (100)

$\chi^2 = 0.76$, $df = 2$, p = n.s

Chi-square test of independence was carried out to see the association between age and cognitive styles (verbalizer-visualizer & little styler). Table 10 shows that there is nonsignificant association between age and cognitive styles ($\chi^2 = 0.76$, p = n.s).

Table 11

Age differences on VICS tasks (N = 427)

	< 23 Years (*n*= 267)		> 23 Years (*n* = 160)			95% CI		Cohen's
	M	*SD*	*M*	*SD*	*t*	*LL*	*UL*	d
Median Reaction Time on Verbal Task	2.63	.81	2.31	.75	4.029***	.166	.473	.41
Median Reaction Time on Imagery Task	2.65	.72	2.43	.81	2.911**	.072	.372	.29
Mean Reaction Time on Verbal Task	3.41	1.21	2.91	1.02	4.361***	.275	.726	.44
Mean Reaction Time on Imagery Task	3.39	1.05	3.02	1.08	3.541***	.168	.588	.35
Mean Reaction Time on The Picture Items	2.76	.86	2.41	.88	3.903***	.169	.513	.40
Mean Reaction Time on The Word Items	4.04	1.32	3.51	1.15	4.234***	.287	.789	.42
Mean Reaction Time on the Items in Exposure 1	3.78	1.22	3.26	1.16	4.293***	.280	.753	.43
Mean Reaction Time on the Items in Exposure 2	3.02	.92	2.66	.86	4.007***	.184	.540	.40

Note. CI = confidence interval, LL = lower limit, UL = upper limit

Table 11 shows the independent sample *t*-test for median reaction time on verbal and imagery task, mean reaction time on verbal and imagery task, mean reaction time on the picture and word items, mean reaction time on the items in exposure I and 2, with respect to age groups (greater than or less than 23 years).

Results suggest that there is a significant mean differences between age groups (age less than 23 years and greater than 23 years) for median reaction time on verbal

task (t (425) = 4.03, p < .001), on imagery task (t (425) = 2.91, p < .01), mean reaction on verbal task (t (425) = 4.36, p < .001), mean reaction time on imagery task (t (425) = 3.54, p < .001), mean reaction time on the picture items (t (425) = 3.90, p < .001), mean reaction time on the word items (t (425) = 4.23, p < .001), items in exposure 1 (t (425) = 4.29, p < .001), and for exposure 2 (t (425) = 4.01, p < .001). All effect size (Cohen's d) were in acceptable range.

Table 12

Analysis of variance of subject groups on the VICS tasks (N = 427)

	Subject Groups						
	Management Science (n = 74)		Social Science (n = 165)		Natural Science (n = 188)		
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*
Median Reaction Time on Verbal Task	2.48	.825	2.44	.73	2.58	.84	1.252
Median Reaction Time on Imagery Task	2.49	.822	2.55	.78	2.63	.74	1.063
Mean Reaction Time on Verbal Task	3.22	1.26	3.11	1.05	3.32	1.22	1.339
Mean Reaction Time on Imagery Task	3.20	1.19	3.16	1.03	3.37	1.07	1.818
Mean Reaction Time on The Picture Items	2.50	.86	2.51	.83	2.79	.92	5.250**
Mean Reaction Time on The Word Items	3.92	1.61	3.76	1.19	3.90	1.23	0.675
Mean Reaction Time on the Items in Exposure 1	3.58	1.38	3.47	1.16	3.70	1.21	1.607
Mean Reaction Time on the Items in Exposure 2	2.86	1.00	2.80	.84	2.99	.94	1.825

**p < .01

One-way analysis of variance was carried out to find the mean difference among study groups (management, social and natural sciences) for median reaction time on verbal and imagery task, mean reaction time on verbal and imagery task, mean reaction time on the picture and word items, mean reaction time on the items in exposure I and 2. Table 12 suggested that mean reaction time on picture items significantly differ with respect to discipline of study (F (2, 424) = 5.25, $p < .01$), and nonsignificant results were obtained on other reaction time tasks. Further, to determine the significant mean group differences, post-hoc analysis was carried out. Bonferroni test suggested that social sciences and natural sciences have significant mean difference, but nonsignificant mean difference were found for social and natural sciences with management sciences (see Appendix M). The eta-square was .024 for mean reaction time on the picture items, which is small effect size.

Table 13

Cognitive Styles versus Subject Groups (N = 427)

Variables	Management Sciences *f*(%)	Social Sciences *f*(%)	Natural Sciences *f*(%)	Total
Verbalizer	9 (12.2)	20 (12.1)	34 (18.1)	63
Little Style	30 (40.5)	83 (50.3)	79 (42.90)	192
Visualizer	35 (47.3)	62 (37.6)	75 (39.9)	172
Total	74 (100)	166 (100)	166 (100)	427

$\chi^2 = 5.47$, $df = 4$, p = n.s

Chi-square independence was carried out to see the association between different groups of studies and cognitive styles (verbalizer-visualizer, little style). Table 13 indicates that there is nonsignificant association between subject groups and cognitive styles.

Table 14

Cognitive Styles versus Achiever Groups (N = 427)

Variables	Low Achievers	High Achievers	Total
Verbalizer	32 (17.2)	31 (12.9)	63
Little Style	89 (47.8)	103 (42.7)	192
Visualizer	65 (34.0)	107 (44.4)	172
Total	186	241	427

$\chi^2 = 4.279$, $df = 2$, p = n.s

Table 14 shows the chi-square between level of achievement (low and high achievers) and cognitive styles (verbalizer, little style and visualizer), and percentages and frequencies are presented in columns for low and high achievers. Results indicate that there is nonsignificant association between level of achievement and cognitive styles ($\chi^2 = 4.28$, p = n.s).

Table 15

Effect of Academic Achievement on VICS tasks (N = 427)

	Low Achievers (n = 186)		High Achievers (n = 241)			95% CI		Cohen's
	M	*SD*	*M*	*SD*	*t*(424)	*LL*	*UL*	d
Median Verbal/ Imagery Ratio	.95	.19	1.02	.34	2.44*	-.124	-.013	.25
Median Reaction Time on Verbal Task	2.44	.74	2.56	.84	1.57	-.276	.030	.04
Median Reaction Time on Imagery Task	2.58	.73	2.57	.80	.108	-.140	.156	.11
Mean Reaction Time on Verbal Task	3.13	1.08	3.29	1.23	1.40	-.384	.064	.02
Mean Reaction Time on Imagery Task	3.26	1.01	3.26	1.13	.015	-.209	.206	.00
Mean Reaction Time on The Picture Items	2.57	.83	2.68	.92	1.22	-.277	.064	.13
Mean Reaction Time on The Word Items	3.82	1.21	3.87	1.35	.439	-.303	.192	.04
Mean Reaction Time on the Items in Exposure 1	3.54	1.17	3.63	1.27	.792	-.330	.140	.07
Mean Reaction Time on the Items in Exposure 2	2.85	.83	2.92	.97	-.747	-.243	.109	.08

df = 425, *p < .05

Table 15 shows the independent sample *t*-test for median reaction time on verbal and imagery ratio, verbal and imagery task, mean reaction time on verbal and

imagery task, mean reaction time on the picture and word items, mean reaction time on the items in exposure 1 and 2, with respect to low and high achievers.

Results suggest that there is a significant mean difference between low and high achievers for median verbal and imagery ratio (t (424) = 2.44, $p < .05$), as high achievers (M = 1.02, SD = .34) as compared to low achievers (M = .95, SD = .15) and effect size (Cohen's d) was small.

Discussion

The aim of the present study was to investigate individual differences in cognitive styles. The information processing underlie the cognitive style measuring procedures are used to explore individual's differences in cognitive styles of the university students. Cognitive styles are an individual consistent (Tennant, 1988), habitual, fixed and preferred way of processing information (Riding & Rayner, 1998). The significance and importance of cognitive style is depicted in the Riding and Rayner's (1998) claim that styles are missing elements in the study of individual differences. Riding and Cheema's (1991) research findings concluded that different cognitive styles are accommodated in two broad style dimensions, which are labeled as verbal-imagery and wholistic-analytic dimensions.

The information processing underlie the method of measuring cognitive style has been developed by Riding's (1991) cognitive style analysis (CSA) test, which was found to be unreliable (Peterson et al., 2003a). Therefore, the problems of measuring the information processing underlying the cognitive styles was addressed by Peterson et al. (2005) by developing tests (Peterson, 2005) named as VICS and E-CSA-WA

tests. Present study has been conducted on English second language population in Pakistani culture, which is focusing on measuring information processing underlie the cognitive style dimensions. The VICS and E-CSA-WA are used in the present study and its reliability evidences are established.

In psychometric terminology, reliability is consistency in measurement and it is a synonym for dependability or consistency (Riaz, 2008). Test-retest reliability involves administering a test to a group of individuals and retesting them after a suitable interval (Domino & Domino, 2006). The phase I was designed to establish the evidences of test-retest reliability of VICS test and E-CSA-WA test. The sample for test-retest reliability was 81. Test-retest reliability assess changes in scores after a certain time duration, that may occur due to history or maturation effects. The main objective of the Study I (phase 1) was to investigate the test re-test stability evidences of the VICS and E-CSA-WA tests. University students completed the VICS test and E-CSA-WA test respectively. After eight days the same tests were administered on students with the different sequence. The order of the stimuli in the verbal section of the VICS test was randomized except for the following rule. Half of the verbal stimuli were presented to the participant in the word form first. The remaining verbal stimuli were presented in the picture form first. After all the verbal stimuli had been presented once, the stimuli were presented again (second exposure) in their alternative form. The same procedure was used in the imagery section (Peterson, Deary, & Austin, 2005a).

The test-retest coefficient showed (see Table 2) stability at re-test r = .58 on the verbal task and r = .71 for the imagery task on the VICS test. The test-retest reliability was computed on median reaction times, as Peterson et al. (2005) states that

the use of the median reaction time seems the most appropriate because the outliers do not effect as it happens in the mean. Test-retest reliability showed stability for the wholistic tasks, the reliability was .54 and for the analytic tasks, the reliability was .69 (See Table 2). The key variable was the median reaction time.

The findings of study I (Phase I) provided psychometric equivalence with Peterson et al.'s (2005a) findings. In Phase II (part I) internal consistency was calculated. For a test to be psychometrically sound, it should be reliable over time. As regards to psychometric properties of the tests, alpha coefficient was computed on a sample of 427 students. Alpha coefficient was much satisfactory showing internal consistency of .81 for the VICS test and .82 for the E-CSA-WA test (See Table 3). The finding are inline with the research findings, conducted on the reliability estimate of the VICS test by Peterson et al. (2005a). The present research concluded that VICS and E-CSA-WA are reliable psychometric instruments for the English as a second language population.

Phase II (Part II) of the study I was conducted to explore individual differences in verbalizing-visualizing cognitive styles. The association and difference of the cognitive styles with variables as gender, age, subject and academic achievement were investigated. The findings showed (see Table 5 & 6) the allocation of cognitive styles. The initial hypotheses explored by this study is to identify individual differences in cognitive styles, which emerged as verbalizer, visualize and little style. The distribution for gender per style sub group revealed 8.8% male students as verbalizers and 8.4% female students as verbalizers. 38.9% male students were named as little style and 49.1% female students were also of little style. (Little style are those individuals who fall at intermediate position of the verbalizer-

visualizer dimension). 53.1% of the male students were visualizes and 32.5% female students were visualizers. Therefore significant gender differences were identified as verbalizing-visualizing and little style. Previous research on cognitive style has revealed that people exhibit significant individual differences in cognitive processing styles, which they adopt in problem solving and in decision making activities. This study produced a number of findings that have a bearing on strategy development in educational set ups of Pakistan.

Styles were allocated through verbal imagery (V/I) ratios and the wholistic-analytic (W/A) ratios. Each student's verbal-imagery ratio was calculated on the median reaction time on the verbal tasks and imagery tasks. Each student's wholistic analytic ratio was calculated on the median reaction time of the wholistic tasks and analytic tasks. Wholistic-analytic cognitive styles (see Table 6) emerged as wholistic, analytic and little style. The distribution for gender per style group showed that 18.8% male students are wholistic and 22.8% female students are wholistic. Table 6 further indicated that 55.6% male students have little style and 60.3% female students have little style (little style are those students who fall at intermediate position of the wholistic-analytic dimension). Results (see Table 6) of the chi-square cross tabulation indicated nonsignificant gender differences on wholistic analytic cognitive style dimension.

To explore style combinations and style association it was assumed that there would be an association between verbalizer-visualizer, little style (on verbal-imagery dimension) and wholistic-analytic, little style (on wholistic-analytic dimension). The results (see Table 7) indicated that there are nonsignfiicant associations between verbalizer visualzier, little style and wholistic-analytic, little style. These findings are

consistent with Riding and Rayner (1998) model. This model explains the bi-polar nature of the construct and two dimensions of cognitive styles are independent of each others.

Present study measured the specific information processing underlie verbalizing-visualizing cognitive styles to identify individual differences which was assessed by different VICS tasks. According to Riding (1997) individual differences in cognitive style can be identified by the speed of responses to verbal imagery questions. The reaction time is measured from stimulus onset to stimulus responses for each tasks (Peterson, 2005). The accuracy, mean and median reaction time were calculated for verbal imagery tasks, session 1, session 2, picture items, word items, exposure 1 and exposure 2.

Therefore present study (see Table 8) indicated mean differences in cognitive styles (verbalizer-visualizer, little style). The result depicted that university students scored significantly different on median and mean reaction times of verbal tasks, imagery tasks, picture items, word items, exposure 1 and exposure 2. The reaction time is measured from stimulus onset to stimulus response for each task (Peterson et al., 2005a).

However, when the effect size was observed, it indicated small effect size for all reaction time tasks, but median effect size was observed for median reaction time on imagery tasks. The results suggest that individual differences in cognitive styles exists in university students of Pakistan. While designing learning materials for the students it is often assumed that all students would learn in a similar manner. This approach ignores the significance and importance of individual differences in cognitive style. The style do not related to personality or ability but it defines an

individual's consistent approach for organizing and processing information in thinking. In Pakistan conventional learning and teaching methodologies are used. But acknowledging significance of cognitive styles and learning strategies, there is a lack of theoretical and empirical knowledge and the role played by cognitive style in determining learning performance has not been researched. Present study would provide a fundamental knowledge on cognitive styles and that individuals are different in their styles.

This study further hypothesized that male and female students would differ significantly on median and mean reaction time taken on different VICS tasks. The results (see Table 9) provided nonsignfiicant findings. However, the hypothesis No. 5 partially supported on median reaction time of imagery tasks. Male students were more visualizers as compared to female students.

Human differentiation on the basis of gender is fundamental phenomenon that affect virtually every aspect of people's daily life. According to Riding and Grimley, the research on gender differences with respect to cognitive style are usually small and nonsignificant. This is partially inline with the present study. The findings of the present study can be discussed in two perspective. Firstly, the interpretation of sex differences is difficult to handle because the differences are biologically founded and the social life they persue are heavily prescribed by society gender typing (Bussey & Bandura, 1999). Secondly, as Riding and Sanabani (1995) said that there is a confounding of cultural and biological variables.

However, information processing style and gender interactions are well researched. Previous research findings have shown gender differences in the performance on information processing tasks (Riding & Vincent, 1980; Riding &

Smith, 1981; Riding & Egelstoff, 1983). Present study also showed significant gender differences on information processing tasks (see Table 9) and are consistent with previous research findings. Riding and Sanabani (1998) explored effect of cognitive style, age, gender and structure on the recall of prose passages. The results revealed significant interaction between gender and wholistic-analytic style in their effect on recall $F(9.95)$, $df = 1, 168$; $p = .002$. For the females, recall was higher for the analytics than the wholist, but for the males the difference was small.

The associations between age groups and cognitive styles (verbalizer-visualizer dimension) has been explored. Results in Table 10 revealed that there is nonsignificant association between age groups and cognitive styles, while results of Table 11 shows significant mean difference between age groups and VICS tasks. The results of these findings are discussed in different ways. Association in cognitive styles (verbalizer-visualizer dimension) depicts nonsignificant results. According to Riding and Sanabani (1998) and Riding (1997), longitudinal research is required to explore the relationship of age and cognitive styles. However, the developmental use of strategies to explore style potential requires further investigation. The results of Table 11 revealed the performance of all groups on median and mean reaction times of verbal task, imagery task, picture items, word items, items in exposure 1 and items in exposure 2.

The significant mean differences on these findings are discussed in terms of strategy development. Cognitive styles are fixed, but the developmental age patterns (two groups) may enabled them to develop learning strategies. According to Riding and Sadler-Smith (1997) research in this area is limited. In current study, age group less than 23 years and greater than 23 years performed significantly different. Overall

the older group took less time in processing information than the group younger than 23 years. The university students may improve their strategy with age. Therefore 23 years of age is used as a cut of score, because this is the age when the chances of improved strategy is greater. The students can develop strategies to make themselves as effective as possible.

Present study also explored the mean difference of subject groups on the VICS tasks (see Table 12) the associations of three subject groups (management science, social science and natural science) with cognitive style (verbalizer-visualizer, little style) were also carried out (see Table 13). Results revealed nonsignificant difference. The results of the subject groups are discussed in terms of educational processes and pedagogical practices.

In educational psychology, style has been identified as a key construct for describing individual differences in the context of learning processes. Previous research literature provide evidence that Roe (1951) researched on a sample of 61 known research scientists and described the typical ways in which they carried on their thinking. He was surprised to know that psychologists emerged as verbalizers, biologists and experimental physicists emerged as visualizers.

Present study hypothesized that the students of natural sciences would be more visualizers as compared to social sciences and management sciences. However, overall there are nonsignificant results. Results in Table 12 reveal that mean reaction time on picture items is significantly different with respect to discipline of study. Bonferoni test suggests that social and natural sciences groups differ significantly. Previous literature show association with cognitive styles and subject. Riding and Caine (1993) investigated the performance of 182 students in mathematics, English

language and French and found significant interactions between subjects and styles on performance. However there is a need to explore further in terms of subject preferences.

The assertions has been made that tailoring educational environments and materials to student's cognitive style increases academic achievement. Therefore, cognitive styles of high and low achievers were identified on cognitive styles (verbalizer-visualizer, little style). Current research further assumed that there would be significant differences on reaction times for VICS tasks.

Result indicated that there is nonsignificant association between level of achievement and cognitive styles. Similarly, effect of academic achievement on VICS tasks and V/I ratios were calculated. Results showed (see Table 15) that there is a significant mean differences between low and high achievers for median verbal and imagery ratio. The high achievers were in majority. This was because of the reason that universities selected for the present study usually gave admissions to students of A and B grades, further A and B grades were included in high achievers.

Hansen (1995) found that academic achievement is enhanced when students select courses which match their cognitive style. According to Hansen the students who entered in a program where the cognitive style are matched, students are likely to perform better than those students who select programs which are not matched to their styles. Pakistan is a developing country and assessment based learning is not frequently available. Students select the subjects without knowing the significance and importance of cognitive styles in education. The chances of nonsignificant results on academic achievement may be due to mismatched cognitive styles and subject preference.

This study (study I) provided evidences that individuals are different in their cognitive styles. Paivio (1971) first developed the verbalizer-visualizer cognitive style dimension and subsequently proposed that cognitive system divided into two components. The assumption that two codes are better than one code has been investigated in the next study. Dual coding suggests that two codes are interconnected but have independent mental systems—the verbal system and the new non verbal system which are related to educational phenomenas.

Chapter-V

STUDY-II

The role of concrete and abstract sentences in the retention of information from the sentences were explored on university student. This study consisted of two phases, phase I and phase II.

Phase I

Objective. Phase I is conducted to achieve the following objective:

1. To find the difference in memorizing the concrete and abstract sentences.

Hypothesis.

1. The memory would be better for concrete than abstract sentences.

Sample. Two hundred university students participated in study 2 (phase I). The mean age was 23 years, *SD* = 3.39. All spoke English as a second language. The inclusion criteria of the sample is described on page 56.

Stimulus material for phase I. Six concrete sentences were used in the present study, four of which were developed by Bransford and Franks (1971) and two were developed by Drose and Allen (1994). Six abstract sentences were taken from Richardson's (1985) study (see Appendix F). An answer sheet provided to the

students to answer the retrieved 12 sentences (six concrete & six abstract) through trial one and trial two (see Appendices J & K).

Procedure for phase I. To explore the differential memory performance of concrete and abstract sentences, a sample of 200 university students were taken. On arrival, every student is instructed to read and sign an informed consent form (see Appendix G) that described the purpose of the study. Each student was given a demographic sheet which required each student to give their name, age, and detail of home language. Each student was then instructed to remember six concrete and six abstract sentences (See Appendix F).

The procedure to remember sentences is divided into two phases: the acquisition phase, and retention phase. Every student was instructed as follows: you are going to be seen two types of sentences, six will be concrete sentences and six will be abstract sentences. I will show you an example of each. Each student was then presented a concrete sentence and told, this is an example of a concrete sentence and then presented an example of abstract sentence. Each student was presented with concrete and abstract sentences one by one. After ten seconds, each student has to write the sentence on the answer sheet.

Analyzing the Results. The data was analyzed by converting each student's ratings into numerical values. A response to produce the sentence after the retention phase received a plus and no response received a minus. Thus a 10 point rating scale emerged from plus five to minus five (excluding zero). Ratings for each sentence by each subject were summed algebraically for recognition trial I and trial II showing all

six concrete and six abstract sentences (see Appendix F). The mean rating for each sentence per trial was then computed as well as mean rating summed over both trial I and II. All data is reported in terms of means (which of course must fall within the range of +5.0 to -5.0). The student who produced exact sentence was given 5 points, and a sentence in which he/she produced approximately exact recognition and made exact combinations were given 4 points, 3 points were given on the sentence in which acquisition was shown and partially recognition was reproduced, 2 points were given to a sentence in which two or three words were missed, and 1 was given to a sentence in which recognition was not shown and a new combination was reproduced. The data got from the scoring of the sentences was used in study II.

Results

Table 16

Comparison of Mean between Concrete and Abstract Sentence Scores (N = 200)

				95% CI		
Variable	*M(SD)*	*t* (199)	*p*	*LL*	*UL*	Cohen's d
Concrete	25.93 (3.19)	25.11	.000	2.05	2.40	.74
Abstract	23.71 (2.84)					

Note. CI = confidence interval; LL = lower limit; UL = upper limit.

Table 16 shows the paired sample *t*-test for concrete and abstract sentence scores. Result indicates that there is highly significant mean difference between concrete and abstract sentence scores of university students ($t(199) = 25.11$, $p < .001$). It was found that ($M = 25.93$, $SD = 3.19$) sentences memorized better than abstract sentences ($M = 23.71$, $SD = 2.84$) as mean of concrete sentences was greater than abstract sentences. The effect size for this analysis was high.

Phase II

Objectives.

This study is conducted to achieve the following objectives:

- To explore the imagery-inducing instructions for memorizing the concrete and abstract sentences.

- To find the relationship between cognitive style measures (VICS, VVQ, and VVLSR), concrete sentences and abstract sentences.

Hypotheses

1. The imagery-inducing instructions would facilitate memory for concrete sentences than abstract sentences.
2. There would be a significant relationship between VICS subscales, VVQ, VVLSR, concrete sentences and abstract sentences.

Measures

Verbalizer-Visualizer Questionnaire (VVQ). Verbalizer-Visualizer Questionnaire (VVQ; Richardson, 1977) was used in the present research. VVQ is comprised of two factors, visualization and verbalization. This scale was translated by Batool (2002) and its psychometric properties were established on college students on a sample of 120 (see Appendix B & C).

Verbal Visual Learning Style Rating (VVLSR). Verbal Visual Learning Style Rating (VVLSR; Mayer & Massa, 2003) was used in Study II. It is one item scale with 7-point ratings (see Appendix D).

Demographic Sheet. The students were also given a personal bio-data form to have their demographic information about the research. It included name, age, gender, name of university, discipline of study, and province (see Appendix E).

Concrete and Abstract Sentences. Six concrete and six abstract sentences were used in Study II. Four concrete sentences were developed by Bransford and Franks (1971) and two were taken from Drose and Allen's (1994) research. Six abstract sentences were taken from Richardson's (1985) research.

Sample

Two hundred university students participated in the study. They were treated according to APA guidelines for participation in the research. All spoke English as a second language. The inclusion criteria of the sample is described on page 56.

Stimulus Materials

The Verbal-Imagery Cognitive Styles (VICS) test (Peterson, 2005); Verbal Visual Learning Style Rating (VVLSR; Mayer & Massa, 2003); Verbalizer-Visualizer Questionnaire (VVQ; Richardson, 1977); and six concrete sentences were used in the present study, four of which were developed by Bransford and Franks (1971) and two were developed by Drose and Allen (1994). Six abstract sentences were taken from Richardson's (1985) study (see Appendix F). An answer sheet provided to the subjects to answer the retrieved 12 sentences (six concrete and six abstract) through trial one and trial two (see Appendix J & K).

Procedure for Phase II

To explore the role of imagery in retention of concrete and abstract sentences, a sample of 200 were taken. The sample was divided into two groups. Demographic information sheet was given to 100 students and they were given imagery instructions (see Appendix H). The group which got imagery instructions during the acquisition phase was labeled as instructional group. The other group was labeled as non-instructional group and it consisted of 100 students. This group never received an imagery instructions. Each student was tested individually in a quiet room. On arrival, every individual is instructed to read and sign an informed consent form (see Appendix G) that described the purpose and procedure of the study. The VICS, VVQ and VVLSR tests were administered in a quiet room with two demographic sheets. One demographic information was administered electronically with the VICS test and other demographic sheet was provided with VVQ, VVLSR, which required each student to give their name, age, and detail of home language. Subsequently they were instructed to remember six concrete and six abstract sentences (see Appendix F).

The procedure to remember sentences is divided into two phases: the acquisition phase, and retention phase. Every student was instructed as follows: you are going to be seen two types of sentences, six will be concrete sentences and six will be abstract sentences. I will show you an example of each. Each student was then presented a concrete sentence and told, this is an example of a concrete sentence and then presented an example of abstract sentence. Each student was presented with concrete and abstract sentences one by one. After ten seconds, each student has to write the sentence on the answer sheet. Each student was given two trials to remember

every sentence. After 10 seconds delay each student had to write a sentence on the answer sheet.

The instructional group were instructed as follows: you are going to see two types of sentences, one sentence contain visual information, it is useful and try to remember the information. Try to form a clear visual image of everything described in the sentence. Try to form a clear mental picture of all the events described in the sentences, as if actually the pictures are occurring in your mind. Each student was then presented a concrete sentence, and elaborated that this is a kind of sentence that is useful to form a clear image. Practice this for few seconds. After a 10 seconds delay, each student has to reproduce the sentences on the answer sheet. Every individual was given two trials, then each student is presented an abstract sentence and informed that now look another sentence on the screen, if it is difficult for you to form an image of the abstract sentence, then use any means you normally use to retrieve these kinds of sentences. Go ahead and try to remember this for few seconds. Following a 10 seconds delay each student had to write the sentence on the answer sheet and asked if you find it difficult to form an image then use any strategy which is comfortable to you, and try to do your best. Each student was tested individually. The acquisition stimuli (concrete and abstract sentences) were presented through projector on the screen, and time was managed with the help of a stop watch.

Analyzing the Results

The data was analyzed by converting each student's ratings into numerical values. A response to produce the sentence after the retention phase received a plus and no response received a minus. Thus a 10 point rating scale emerged from plus five to minus five (excluding zero). Ratings for each sentence by each subject were summed algebraically for recognition trial I and trial II showing all six concrete and six abstract sentences (see Appendix F). The mean rating for each sentence per trial was then computed as well as mean rating summed over both trial I and II. All data is reported in terms of means (which of course must full within the range of +5.0 to -5.0). The student who produced exact sentence was given 5 points, and a sentence in which he/she produced approximately exact recognition and made exact combinations were given 4 points, 3 points were given on the sentence in which acquisition was shown and partially recognition was reproduced, 2 points were given to a sentence in which two or three words were missed, and 1 was given to a sentence in which recognition was not shown and a new combination was reproduced. The data got from the scoring of the sentences was used in study II.

Results

Table 17

Instructional and non-instructional group differences on concrete and abstract sentences (N = 200)

	Instruction Given (n = 100)		Instruction Non-given (n = 100)			95% C/I		
	M	*SD*	*M*	*SD*	*t*	*LL*	*UL*	Cohen's d
Concrete Sentences	26.00	3.23	25.87	3.16	.276	-.77	1.01	.04
Abstract Sentences	23.72	2.87	23.70	2.82	.037	-.78	.81	.01

Table 17 shows the independent sample *t*-test for concrete and abstract sentences between two groups. Result indicates that there is nonsignificant difference between instructional groups for concrete and abstract sentences score (t (198) = .28, p > .05 and t (198) = .04, p > .05). So, it is suggested that instructional groups did not affect in memorizing concrete sentences (with instructions given M = 26.00, SD = 3.23, with no instructions given M = 25.87, SD = 3.16) and abstract sentences (with instructions given M = 23.72, SD = 2,84, with no instructions given M = 23.70, SD = 2.82). The effect size (Cohen's d) for both results was low.

Table 18

Correlation between Study's Cognitive Styles Measures and Sentences (N = 200)

Scale	CS	AS
VICS	.28**	.26**
Imagery Tasks	.27**	.19**
Verbal Tasks	.09	.22**
VVLSR	.16*	.15*
VVQ	.06	.15*

Note. CS = concrete sentences. AS = abstract sentences. VICS = verbal imagery cognitive styles. Imagery and verbal are subscale of the VICS. VVLSR = verbal visual learning style rating. VVQ = verbal visual questionnaire.
*$p < .05$, **$p < .01$

Table 18 shows the correlation analysis between cognitive style measures and concrete and abstract sentence scores. Results suggested that there is significant positive correlation between VICS, VVLSR, and Concrete sentences, but concrete sentence is not significantly correlating with verbal tasks and VVQ. Concrete sentences correlate significantly with other measures. Abstract sentences significantly correlated with verbal and imagery sub scales of the VICS, VVLSR and VVQ scales.

Discussion

The aim of study II was to explore dual code processing through sentence recognition memory performance on concrete and abstract sentences. According to dual-coding model (Paivio, 1971, 1986), there are interconnected but independent mental systems. The verbal and non-verbal (imaginal). Verbal systems deals directly with linguistic input, therefore, verbal system provides the memory for verbatim sentence information. It is because verbatim information has its tie to auditory and motor systems. The information presented in imaginal system is processed as a flexible-visuo-spatial underlying structure, therefore it is presented as an integrated unit.

The results (see Table 16) revealed that there is highly significant mean differences between concrete and abstract sentence scores of the students. It was found that concrete sentences were memorized better than abstract sentences. The effect size was high. The specific assumption was that the memory performance would be better for all the students on the recognition memory for concrete sentences than the abstract sentences. The imagery value or concreteness of the concrete sentences and specific visuo-spatial pathways of the imaginal processes provide evidences for the superior recognition memory for the concrete sentences. According to dual coding theory, imagery value and concreteness are important for processing. The additive effect of concreteness that enhance the activation in the verbal and imaginal codes in the two systems. Contrary to concrete sentences, abstract sentences are kinds of abstract inputs and are processed in the verbal system and transformed to

the imaginal or non verbal codes to activate images in the imaginal system through mediating cognitive processes (Paivio, 1988).

The concrete sentence is similar to pictures and has higher imagery value than abstract sentence, which has lower imagery value and less concreteness. Therefore, abstract sentence is difficult to remember and it require longer coding time and thus lower the speed of processing.

According to Jessen et al (2000), concrete language is similar to picture, which has greater imagery value than abstract language. To facilitate the processing of concrete and abstract sentences, imagery instructions were used on an independent sample (see Table 17). The sample was divided into two groups (the instructional and non-instructional) . Imagery instructions were given to generate mental imagery, which activates the codes in the non-verbal (imaginal) system and evokes the arousal of the imagery. Abstract information is likely to be encoded into the verbal codes only (Paivio, 1971, 1986). Therefore, in order to transform a verbal code into a imaginal code, imagery instruction is sometimes necessary.

The results of Table 17 depicts that there is nonsignificant differences between instructional groups for concrete and abstract sentences. Results are not supportive of the hypothesis that imagery inducing instructions would facilitate memory for concrete sentences than abstract sentences. However, it is possible that students sponetenously used visualization strategies to memorize. These kind of research findings are reported by the researchers as well (Anderson & Kulnavey, 1972; Bower, 1970).

Overall, memory performance was better for all the students on the sentences containing concrete information than abstract information. According to Richardson

(1985), the instruction to visualize the sentence material should aid in the formation of two codes for the concrete sentences and presence of two codes in concrete sentences should be enhanced by creating visual images of the concrete sentences. However, research finding have shown consistent improvements in performance for imagery instructions on learning materials under free recall, and recognition (Richardson, 1980; bower, 1972; Richardson, 1985).

Results in table 18 showed correlation of concrete and abstract sentences with cognitive style measures. The correlation of VVQ with abstract sentences is lower, this is giving an interpretation that concrete sentences correlate significantly with imagery tasks, but abstract sentences are difficult for imaginal processing and it is possible that only one code is used.

Chapter-VI

GENERAL DISCUSSION

Present research explored individual differences in cognitive style. An individual's preferred way to process and organize information is known as his or her cognitive style. The research evidences for the existence of cognitive styles and renewed interest in cognitive style as a construct and its application in educational phenomenas gained momentum in 1980s and 1990s (Riding & Cheema, 1991). Riding further developed a model which explained two broad dimensions of cognitive styles as verbalizing-visualizing dimension and wholistic-analytic dimension. The verbalizing-visualizing cognitive style dimension is one in which an individual process information either verbally or in mental images during thinking. The wholistic-analytic cognitive style dimension is one in which an individual process information either as a whole or in parts during thinking. These two dimension are explored as bi-polar, and independence of the style dimension has been explored in different researches (Riding & Al-Salih, 2000, Riding & Duoglas, 1993). According to Riding (1997), the possible effect of culture on style is important, and similar style patterns should be demonstrated in a wide range of cultures, and this would contribute to the understanding of the nature of style.

Present research explored individual differences in Pakistani culture. Study I provided evidences for psychometric equivalence on university students in Pakistani culture. Test-retest reliability coefficient showed stability at retest for verbal, and imagery tasks. Alpha coefficient was much satisfactory.

Part II of study I explored individual differences in verbalizing-visualizing cognitive styles. This research further explored the association and differences of cognitive styles on English second language population. The variables explored with cognitive style were gender, age, subject (discipline of study) and academic achievement. Significant gender difference were identified as verbalizing-visualizing and little style. The styles were allocated through verbal-imagery (V/I) ratio and the wholistic-analytic ratio, which gave style preference for each student. Therefore, three style emerged as verbalizer-visualizer and little style on verbal-imagery dimension. Whereas, three style emerged as wholistic-analytic and little style on wholistic-analytic dimension. Little style preference are described to those students who were at intermediate position.

This research explored style combinations and association, but nonsignificant associations indicated the independence of the style dimensions. Previous researches provide logic that verbalizers and visualizers exist on a single continuum. It is further assumed that strength in one dimension implies a weakness in the other dimension. Antonietti and Gsiorgetti (1998) and Green and Schroeder (1990) criticized and provide evidences that verbalizing-visualizing dimensions are independent qualities and individuals process them at various degrees.

Present research measured the specific information processing underlie verbalizing-visualizing cognitive styles. The speed of responses of the students were measured through reaction time. The time started from the onset of the stimulus till the response of the task. It was hypothesized that whether university students show different cognitive styles. Statistically significant individual difference were identified. Previous researches explore individual differences in cognitive styles and

whether cognitive style of students affects their ability to learn different types of material. According to Casey, Winner, Hurwitz, and Dasilva (1991), students with strong visual tendency recall more details of figures.

Riding, Burnont, Rees, and Sharrati researched and provided evidences that individual with good visual skill prefer to learn from pictures and individuals with good verbal skills prefer to learn better with print. This research further explored gender differences on median and mean reaction time taken on different VICS tasks. Male students were more visualizers as compared to female students. The results of cognitive style versus gender are consistent with other research literature on style and gender. According to Riding and Grimley (1999), the gender differences in cognitive styles are small and nonsignificant. This suggest that cognitive style may be a universal phenomenon which is not culturally bound.

The association between age groups and cognitive styles provided evidences that there is nonsignificant association between age groups and cognitive styles. However, significant mean difference between age group and VICS tasks emerged. The theoretical knowledge on cognitive style claims that longitudinal research is required in this aspect. Cognitive styles are fixed characteristics of an individual but students may develop learning strategies to make the efficient use of the strengths and limitations of their consistent and particular cognitive style. Therefore, cognitive styles are fixed and consistent, and can not be changed but students can develop strategies to make themselves as effective as possible.

Current research explored the mean difference of subject groups on VICS tasks. Further, associations of these subject groups (management sciences, social sciences, and natural sciences) with cognitive styles were explored. There were

nonsignificant differences. Previous research literature provide a mixed findings on style versus subject preference and subject groups. Chen, Ghinea, and Macredie (2006) examined the relationship between cognitive style and the learner's quality to perceive multimedia. They included the nature of the content and information load as parameters in the research and investigated whether verbalizing-visualizing cognitive style influenced the level of information being assimilated from the two sources, video or audio. Research revealed nonsignificant factor.

Furthermore, current study also explored the cognitive styles of high and low achievers. Results revealed nonsignifciant association between level of achievement and cognitive styles. In previous research, Graff (2003b) used web-based lesson to explore the influence of segmentation of information and the extent to which an overview facilitated learning. His findings revealed that cognitive style and segmentation have an effect on performance.

The results of academic achievement and subject preferences should be elaborated in Pakistani perspective, where assessment based and aptitudes based education is not frequent. Furthermore, the cultural variability could not be ruled out. According to Freedman and Liu (1996) and Liang and McQueen (1999), despite the theoretical benefits of e-learning system, the difficulties occur when system are not designed according to learner's characteristics.

Furthermore, it is also theoretically possible that individual differences may occur cross-culturally because of differences in learning styles and cognitive styles. Research evidences suggest that East Asian learners show more effective learning style and academic performance than their western counterpart (Biggs, 1991; Watkins & Regmi, 1990; Kember & Gow, 1991).

Study I of the present research explored the preferred code in cognitive styles and study II explored the dual codes, which explain that verbal and non-verbal (imaginal) systems relate to educational phenomenas. This study explored differential memory performance for the concrete and abstract sentences. According to the dual coding theory, it is easier to process concrete sentences than abstract sentences because concrete sentences evoke both imaginal and verbal codes, whereas abstract sentences.

The dual coding theory suggest that verbal and imaginal systems are two inter connected but independent mental systems. Theory further describes that linguistic stimuli is processed in the verbal system and non-verbal are processed in imaginal system. This theory is supported by empirical evidences (Paivio, 1979, 1991a).

Study II explored dual code processing by using concrete and abstract sentences through sentence recognition memory performance. Results showed that there is highly significant mean differences between concrete and abstract sentence scores of the students. Further this study revealed nonsignificant differences between instructional (imagery instructions given) and non-instructional (imagery instruction not given) groups. The correlation of concrete and abstract sentences with cognitive style measured showed significant positive correlation. Overall, the memory performance on concrete sentences was better than abstract sentences.

According to dual coding theory, imagery value and concreteness is important for processing, as the imagery has unique theoretical and empirical properties (Paivio, 1991a). In the processing of pictures and words, pictures have greater imagery value than words, and generate visual images. Words can be divided into two types, the concrete words and abstract words, according to the strength of the word to image

referential connections. Therefore, concrete words, concrete sentences and concrete instructional materials are encoded more easily and images are aroused faster.

Contrary to the concrete languages, abstract sentences are similar to verbal input, and processed in the verbal systems, and transformed to the non-verbal codes to activate images in the imaginal system through mediating cognitive processes (Paivio, et al., 1988). It has been explored that concrete words (Batool, 2002) and sentences arouse visual images more directly (Sadoski, 2001; Paivio et al., 2000).

Therefore, present research explored individual differences in cognitive styles for the university students and concluded that every students has a specific cognitive style. In designing learning material in Pakistani educational phenomans, it is often assumed that all students would learn in a similar manner. This logic reduce the significance of cognitive styles. The preferred cognitive style and dual-code-dual coding theory's (Paivio, 1971, 1986, 1991) principles should be applied while designing the educational processes, pedagogical practices and learning strategies.

Significance/Implications of the Present Research

This research measured individual differences in cognitive styles of university students on English as a second language population. Empirical evidences of the research can be applied in educational and pedagogical practices and in understanding individual diversity that is often the missing element in educational practices. Within the context of learning, verbalizing-visualizing cognitive styles and wholistic-analytic cognitive styles can be quantified and measured through VICS and E-CSA-WA.

These styles explain an individuals' preferred and consistent ways of processing information during learning. The matched mode of presentation, which found verbalizer's comfortable with verbal mode and visualizers with pictorial mode would help in the improvement of the instructional material and improvement in learning and elimination of redundant information.

Future Directions

Although, this research has outlined fundamental information on cognitive styles of university students of Pakistani population, there is a need for further research on test's (VICS & E-CSA-WA) application to identify individual differences in cognitive styles in cross-cultural perspective. Moreover, the effect of Indo-Pak culture on cognitive styles.

The biological origins and developmental patterns of cognitive styles still needs to be investigated. Furthermore, there is a need to investigate cause and nature of individual differences in styles. The findings in the present study suggest other avenues for research. This study also implies that instructional material can be improved, placing more emphasis on a balance between verbal and imagery dimensions of the content to be taught. Teachers at all levels need to be made aware of the significance of the cognitive style and how to relate these to better learning. At the same time, a teacher must be aware of his/her own cognitive style as awareness always leads to better understanding. Special education can also benefit from such research findings. The visual mode of learning can be improved.

Limitations

- Different universities of the Pakistan could not be included in the sample.
- Longitudinal evaluation of the cognitive styles was not possible, as the local resources and research environment usually does not permit a time based analysis.

Impact of the Research

More work of one's personality are required if the research has to go to its logical conclusion. The present study can possibly go to determining the cognitive styles that determine the making of a personality. What makes for a personality that is aberrant? Is it the environment-nature-nurture argument? More research would also enable the calibration of tests for the cultural milieu that is Pakistan. What goes on to the making of a law and order person and on the other hand what cognition takes him to the other side of the fence. The pluralistic society that is Pakistan there is more work that is required for specific groups-which on the one hand will confirm the present work and seek and I dare say find new avenues to explore. In that sense this is the beginning of a new era in psychology, for not receiving knowledge from the west. Pakistan must and others should try and set up their own knowledge base. The first steps have been taken and although the tests applied are calibrated and tested in a totally different environment yet the possibility of further exploration and finding a new avenue cannot be discounted.

The Pakistani personality is full of contradictions at the moment. These very tests can be applied across the nation in a cross sectional manner or it can be

longitudinally applied. That is a quick survey and effort that is across the country for determining the cognitive styles that make for a certain kind of information processing. The longitudinal will determine the affect of time and space on specificities of the personality. It might well lead to a more informed public policy that is based on not some one's opinion but on cogent facts. This will have to be an ongoing research for the simple fact that many kinds of aspects of knowledge or non-knowledge impact a personality and what it carries. The material for this research would not only be age specific but also region specific and in some cases connectivity that is ethnic and based on castes of Punjab and the tribal belt.

If possible a hierarchy of cognitive-perceptive abilities can be evolved out of new work that has to be undertaken, the sooner the better. Current perception theories age not applicable to the Pakistani pluralistic society because of the nature-nurture argument.

Future academic work. This generation of knowledge can be furthered for the class room and our universities could go in to developing new teaching micro subject based on such and other PhD research. It may be that a new subject is created and the teaching of this could be the first step in the development of an exciting academic area where new knowledge is generated and then used by the country in public interest. It is going tube an uphill task but then all new work is such in nature.

The task ahead is not so easy and entails entering new areas where we can generate our own efforts and try and develop a means to explain our own characteristics. A new offer of a subject to students would be a new and independent effort and that is how new academic arrangements are made. Small steps that with continuous effort can be improved.

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Annexure B

VERBALIZER-VISUALIZER QUESTIONNAIRE

The statement shown below describe some aspects of the ways in which people think or of what seems to go on in their minds when studying or problem solving. Read each statement and decide whether or not it is true or false with respect to your own thinking.

If you agree with the statement or decide that it does describe you, answer TRUE. If you disagree with the statement or feel that is not descriptive of you, answer FALSE. Answer the statements as carefully and honestly as you can. The statements are not designed to assess the goodness or badness of the way you think. They are attempts to discover characteristics of the way you think in various situations. There are no right or wrong answers.

Please answer every statement either TRUE or FALSE, even if you are not completely sure of your answer.

1.	I enjoy doing work that requires the use of words.	TRUE	FALSE
2.	My dreams are sometimes so vivid I feel as though I actually experience the scene.	TRUE	FALSE
3.	I enjoy learning new words.	TRUE	FALSE
4.	I can easily think of synonyms for words.	TRUE	FALSE
5.	My powers of imagination are higher than average.	TRUE	FALSE
6.	I seldom dream.	TRUE	FALSE
7.	I read rather slowly.	TRUE	FALSE
8.	I cannot generate a mental picture of a friend's face when I close my eyes.	TRUE	FALSE
9.	I don't believe that anyone can think in terms of mental pictures.	TRUE	FALSE
10.	I prefer to read instructions about how to do something rather than have someone show me.	TRUE	FALSE
11.	My dreams are extremely vivid.	TRUE	FALSE
12.	I have better than average fluency in using words.	TRUE	FALSE
13.	My daydreams are rather indistinct and hazy	TRUE	FALSE
14.	I spend very little time attempting to increase my vocabulary.	TRUE	FALSE
15.	My thinking often consists of mental pictures or images.	TRUE	FALSE

Appendix-D

VERBAL-VISUAL LEARNING STYLE RATING

In a learning situation sometimes information is presented verbally (e.g., with printed or spoken words) and sometimes information is presented visually (e.g., with labeled illustrations, graphs, or narrated animations). Please place a check mark indicating your learning preference.

◯	◯	◯	◯	◯	◯	◯
Strongly more verbal than visual	Moderately more verbal than visual	Slightly more verbal than visual	Equally verbal and visual	Slightly more visual than verbal	Moderately more visual than verbal	Strongly more visual than verbal

Appendix-F

SIX CONCRETE AND SIX ABSTRACT SENTENCES USED IN EXPERIMENT-III

Concrete Sentences:

1. The ants in the kitchen ate the purple jelly which was on the table.
2. The old car pulling the trailer climbed the steep hill.
3. The tall tree in the front yard shaded the man who was smoking his pipe.
4. The rock which rolled down the mountain crushed the tiny hut at the edge of the woods.
5. The girl who lives next door broke the large window in the porch.
6. The black cat who limped into the alley scared the sleeping wino.

Abstract Sentences:

1. The arrogant attitude expressed in the speech led to immediate criticism.
2. The intense desire to be successful can determine all personal actions.
3. The emotional appeal for support elicited unselfish sympathy.
4. The unrealistic goals proposed by the leader resulted in frequent disillusionment.
5. The brilliant mathematician with a sense of humor proved the difficult theorem.
6. The official inquiry set up by the government ignored the central issue.

Appendix-G

CONSENT FORM FOR PARTICIPATION IN THE RESEARCH

A research is being conducted on the ways of learning of the University students. The researcher want to explore the individual differences in learning. You will be tested, and are required to read this document carefully and ask any questions you may have before agreeing to be in the study. If you have some queries, then please feel free to ask and contact the researcher.

Thank you

Statement of the Consent:

I have read the above information and give my consent to participate in the study.

Signature of the Participant

---------- Dated:----------

Researcher's Contact

Iffat Batool (Ph.D Scholar)
National Institute of Psychology
Quaid-i-Azam, University, Islamabad
Pakistan
Phone: 92-051-90644014 Mobile: 0300-4261146

Appendix-H

DEMOGRAPHIC SHEET AND IMAGERY INSTRUCTIONS

Demography Sheet:

Name : ……..

Age : ……..

Sex : ……..

Domicile : ……..

Mother Tongue : ……..

University : ……..

Department : ……..

Class : ……..

Date : ……..

Phone No. : ……..

Instructions:

You will be shown two types of sentences, one called concrete sentences and other abstract sentences. You are required to go through these sentences one by one thoroughly and carefully. Your task is to remember these sentences as quickly as possible, while remembering a sentence, you are required to form a clear visual image of everything described in the sentence. Try to form the picture of all the events described in the sentences as it is actually occurring in your imagination. Go ahead and practices this for few seconds. If you find it is difficult to form an image, then use any strategies to remember the sentences. The example of the sentences is given below. You will be given two trials to remember every sentence.

Example:

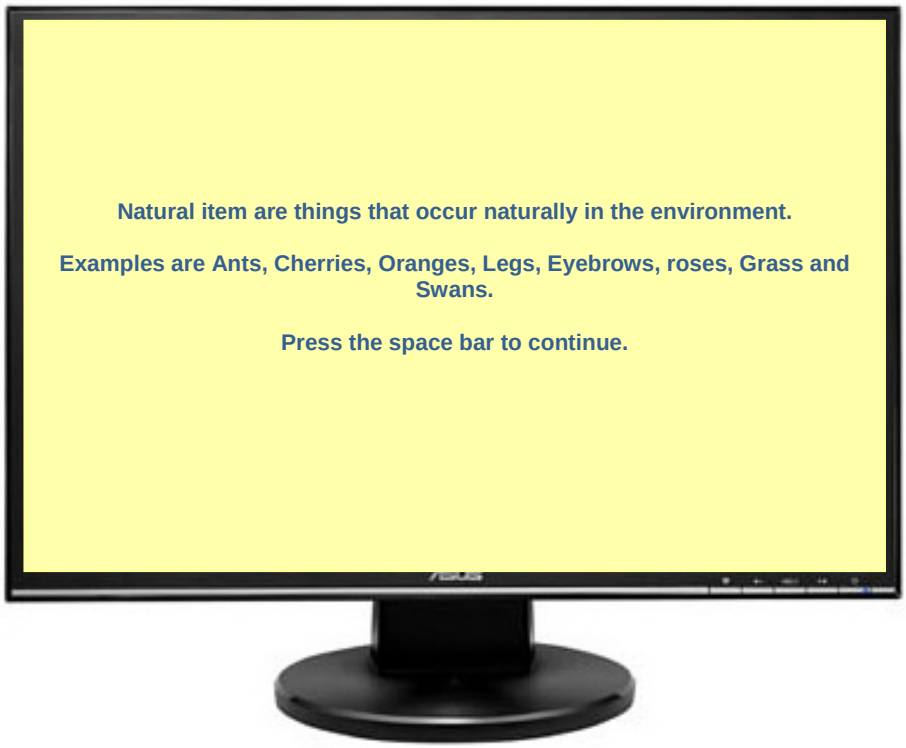
Sentence : ***Sun is a source of energy.***

Trial 1 :

Trial 2 :

Appendix-I

After giving information about natural, manmade and mixture stimuli, the participant is instructed to press the space bar to continue. The next information appeared on the screen which explained about the natural items as shown in Figure.

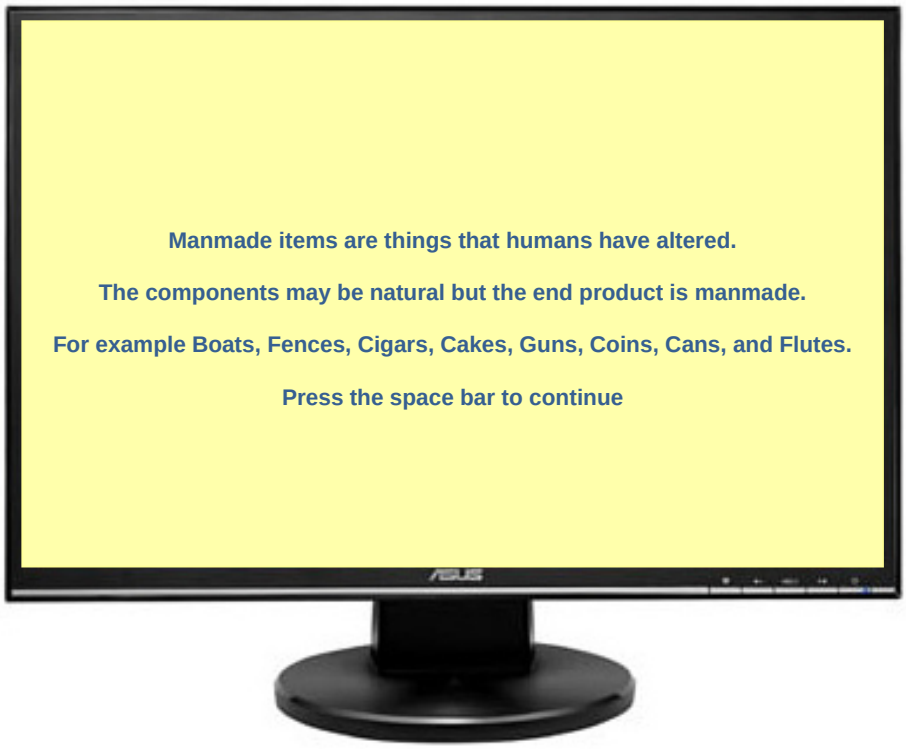


(Source: Peterson, 2005)

Describing about natural items.

The participant read the instruction about natural items on the screen, then presses the space to continue.

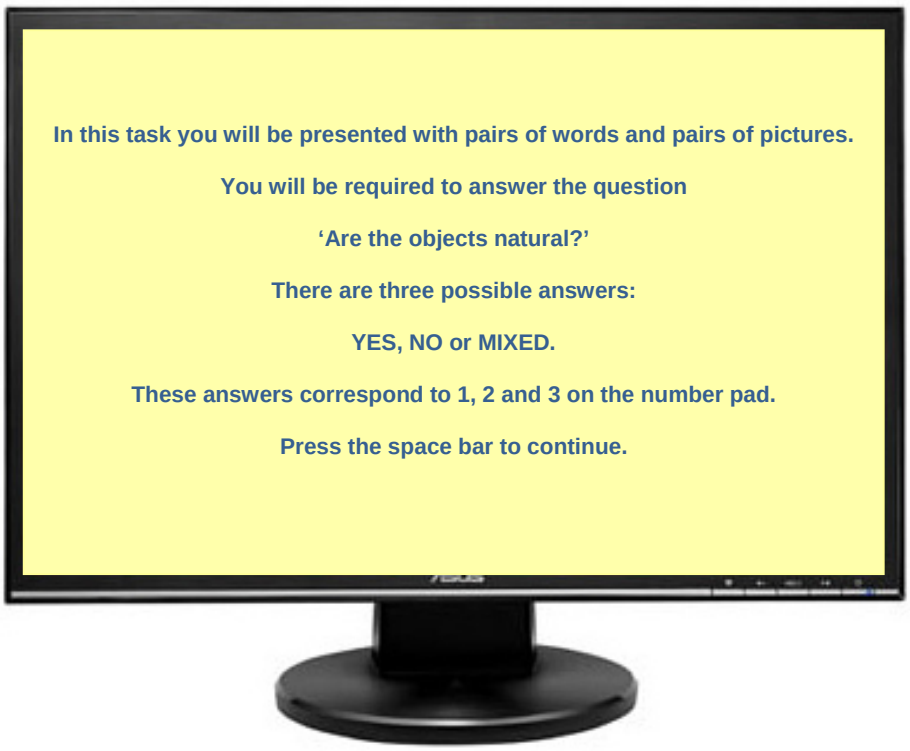
The instructions about manmade items appeared next as shown in the Figure.



(Source: Peterson, 2005)

Describing about manmade items.

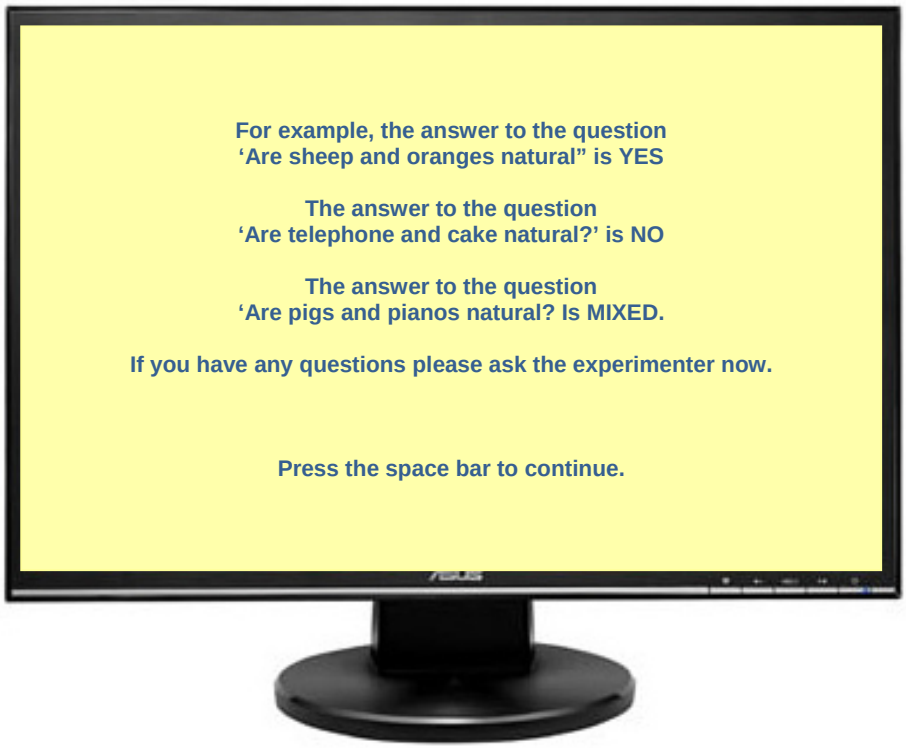
This screen explained about pairs of words and pairs of pictures and a participant is required to answer the question. There are three possible answers to these questions. After pressing the space bar to continue, the example of the tasks appeared on the screen as shown in Figure.



(Source: Peterson, 2005)

Describing the three possible answers.

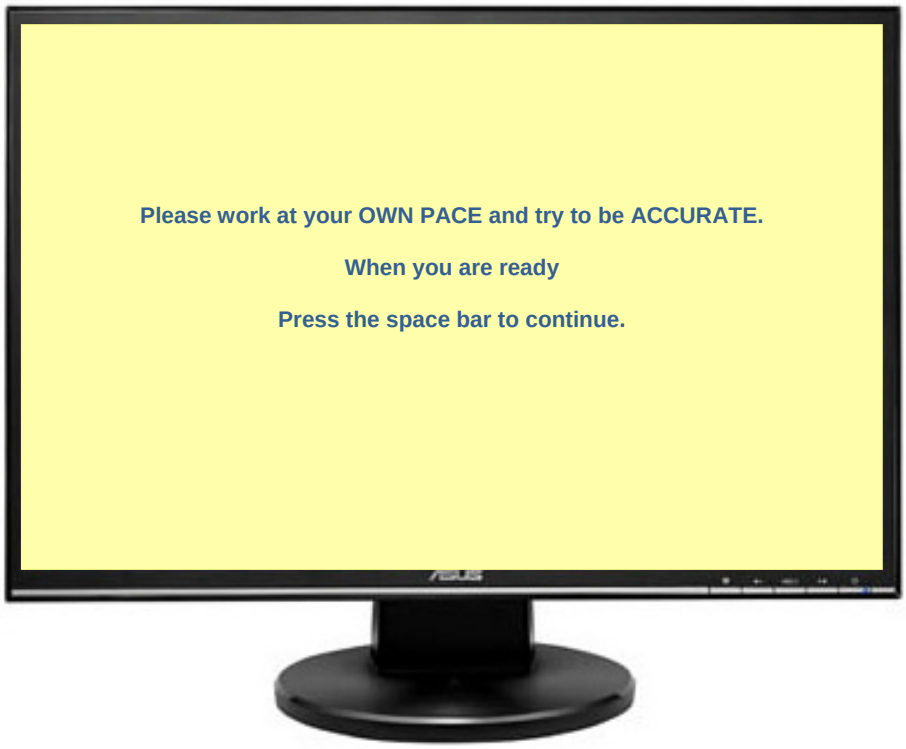
The instruction on the screen elaborated the examples of natural items, manmade items and mixture items. Then it was instructed by the experimenter that if you have any question please ask now. After explaining, it is instructed to continue the test by pressing the space bar. Then again it appeared on the screen that please work at your own pace and try to be accurate. When you are ready then press the space bar as shown in Figure.



(Source: Peterson, 2005)

Examples of natural manmade and mixed items.

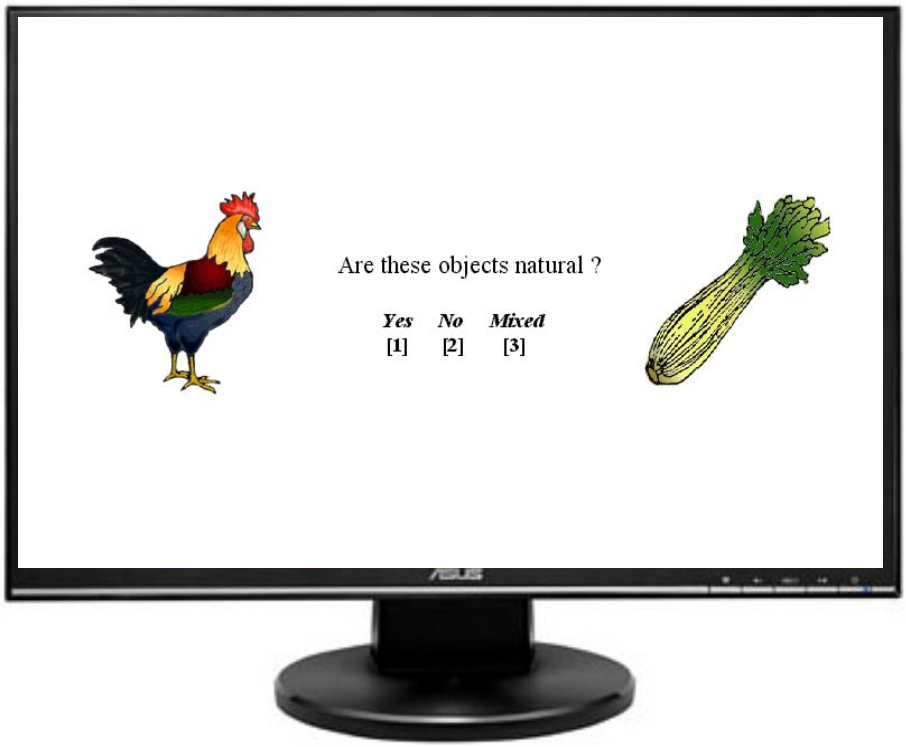
The researcher again suggests to the respondent that work at your own natural pace and try to be accurate.



(Source: Peterson, 2005)

Giving instructions to work at you own pace.

After pressing the space bar the next task appeared which is an example of natural items as shown in Figure.



(Source: Peterson, 2005)

Example of natural item described in the VICS test. The correct answer is ‘Yes’.

Then it is instructed to the participant that try to give correct answer by pressing one of the three keys of ‘Y’, ‘N’, and ‘M’ which describes Yes, No and Mixed. Feedback, as to whether the response of the participants was correct or not, was given after each response. This encouraged each participants to respond correctly rather than quickly.

If participant gives a correct answer then ‘correct’ automatically appears on the screen as shown in the Figure and if gives incorrect answer then incorrect automatically appears on the screen and participant himself/herself monitor the response, then it was instructed that try to be accurate.

(Source: Peterson, 2005)

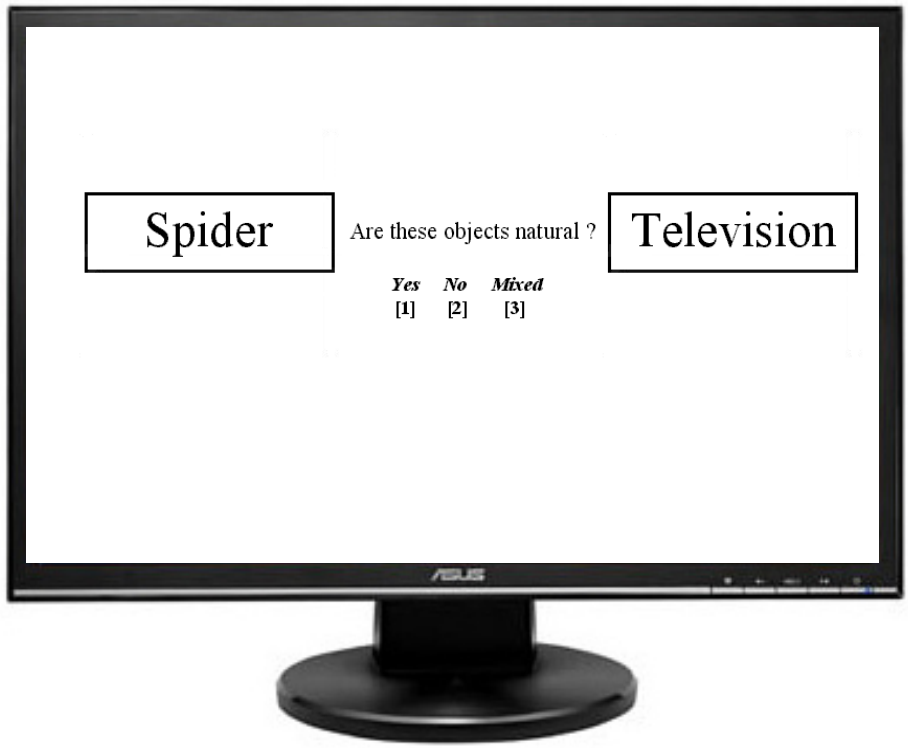
Showing correct response of the participant.

After pressing the space bar the next task appeared which is an example of manmade items as shown in Figure.

(Source: Peterson, 2005)

Example of manmade item on the VICS test. In this example of manmade task, the correct answer is ‘No’.

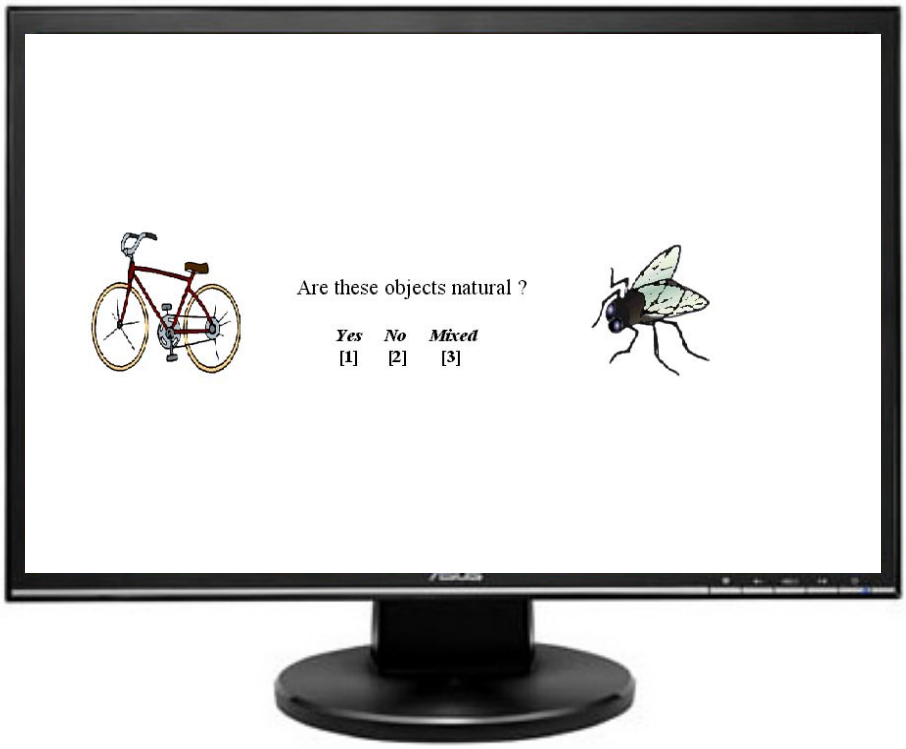
This is an example of mixed stimuli in the form of pairs of words.



(Source: Peterson, 2005)

Example of an item (task) from the Verbal section of the VICS test. In this example the correct response is 'Mixed'

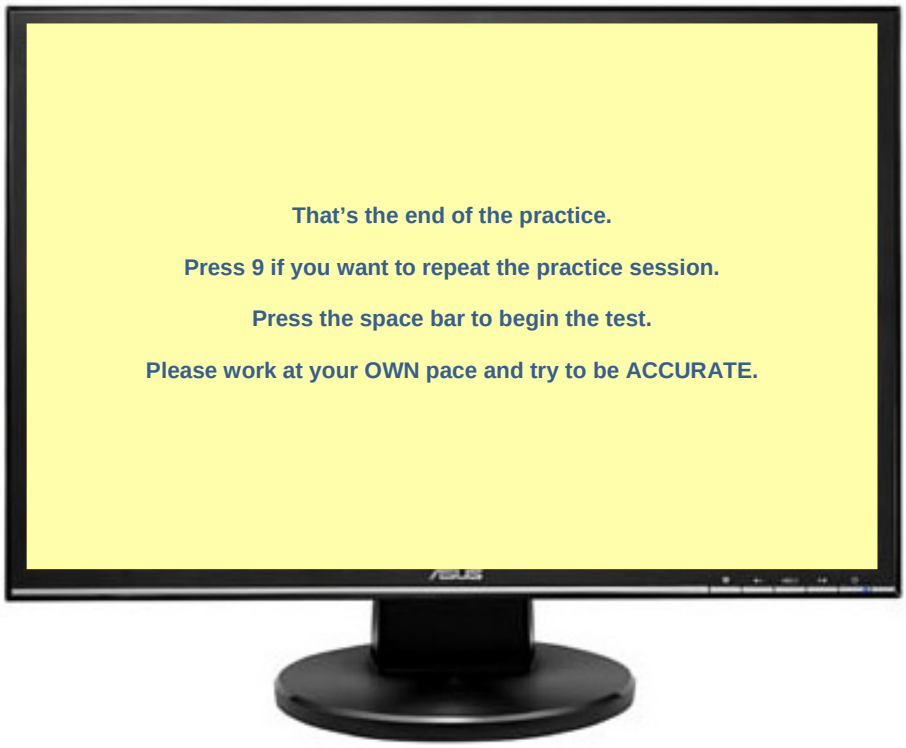
Then after pressing the space bar the next task appeared, which is an example of mixed stimuli in the form of pairs of pictures as shown in Figure.



(Source: Peterson, 2005)

Example of mixed item from the verbal section of the VICS test. In this example the correct response to this task is 'Mixed' because cycle is manmade and fly naturally exist in the environment.

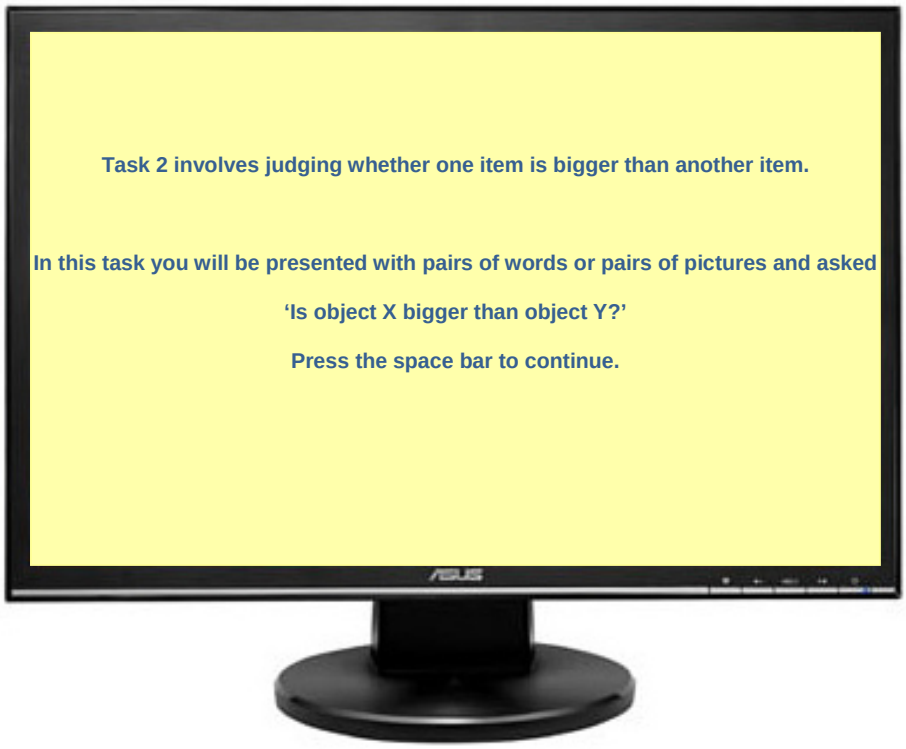
After giving examples about natural items, manmade items and mixture items, practice session ends and then after pressing the space bar the next information appeared as shown in Figure.



(Source: Peterson, 2005)

Describing that this is an end of practice session of the word tasks.

Task two describes the imagery stimuli. The participants have to judge whether “is object x bigger than object y” in real life.



(Source: Peterson, 2005)

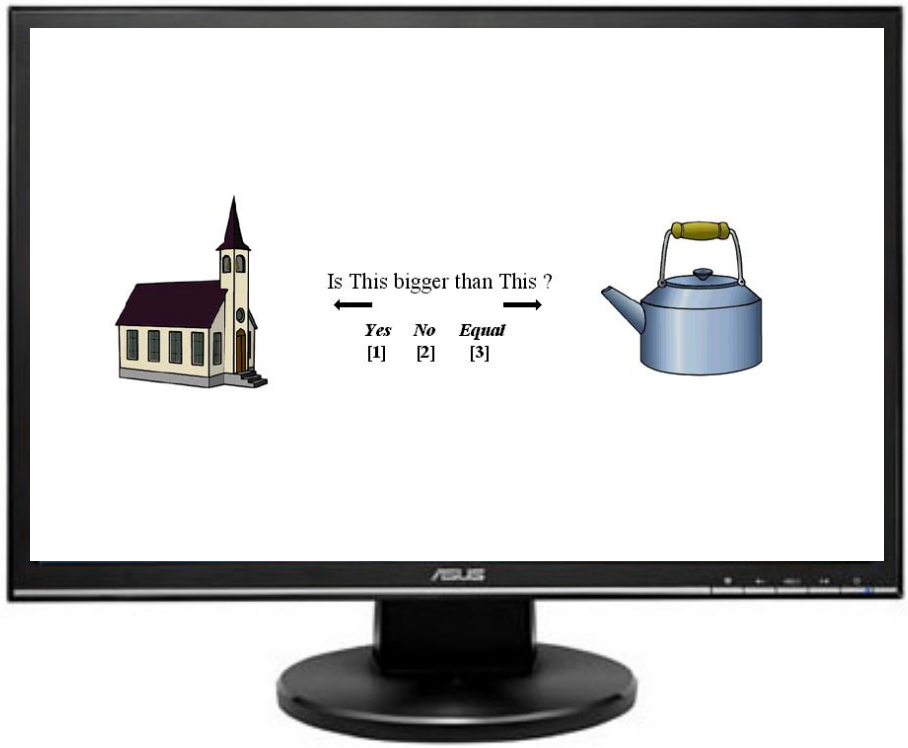
Describing instructions about imagery section.

Then after completing these tasks then next tasks appeared which explained about the bigger object in the real life, smaller object, and equal object in the real life was shown on the screen. After pressing the space bar the next information explains about ‘real’, ‘small’, and ‘equal’ items. The examples are shown in the Figure.

(Source: Peterson, 2005)

Example of imagery item (task) on the VICS test. In this example the correct answer is ‘Yes’ because in real life a cycle is bigger than a fly.

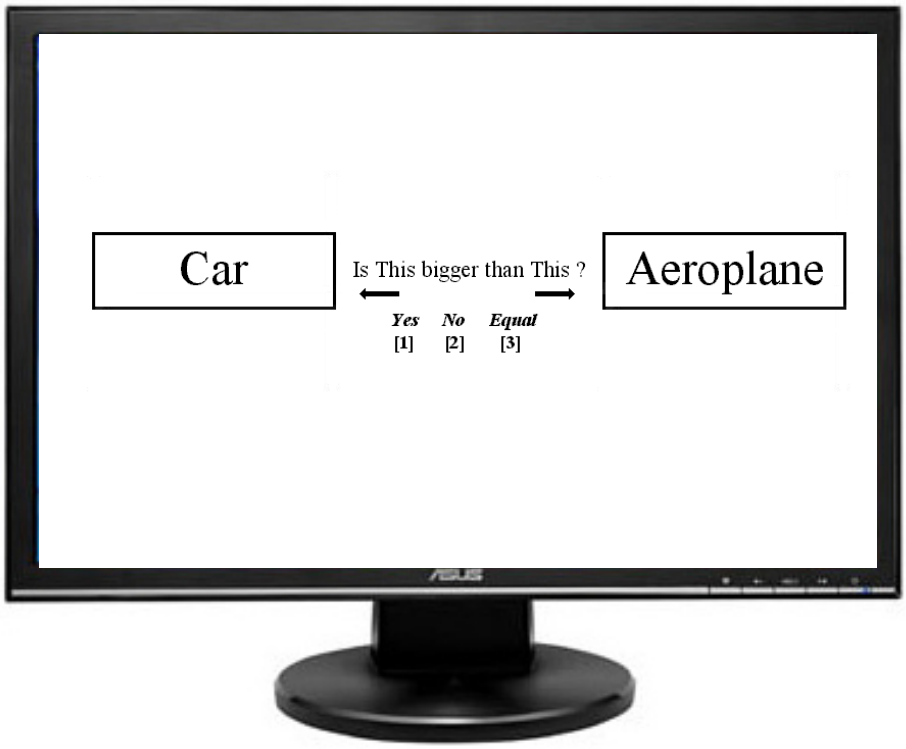
The following item describing an imagery item.



(Source: Peterson, 2005)

Example of imagery item (task) on the VICS test. In this example the correct answer is ‘Yes’.

This is an example of pairs of words.



(Source: Peterson, 2005)

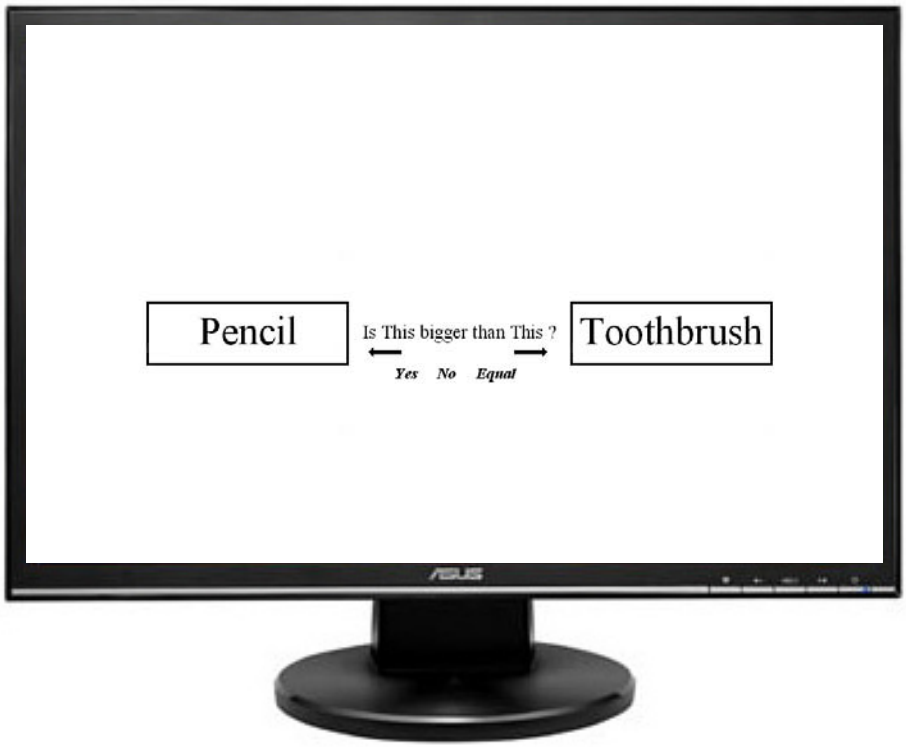
Example of imagery item (task) in the form of pairs of words. In this example the correct response is ‘No’ because a car is not bigger than an aeroplane in real life.

After completing these tasks then next tasks appeared which explained about the bigger object in the real life, smaller object, and equal object in the real life was shown on the screen. After pressing the space bar the next information explains about ‘real’, ‘small’, and ‘equal’ items. The examples are shown in the Figure.

(Source: Peterson, 2005)

Example of imagery item (task) on the VICS test. In this example the correct answer is ‘No’ because a thumb is not bigger than a pineapple in real life.

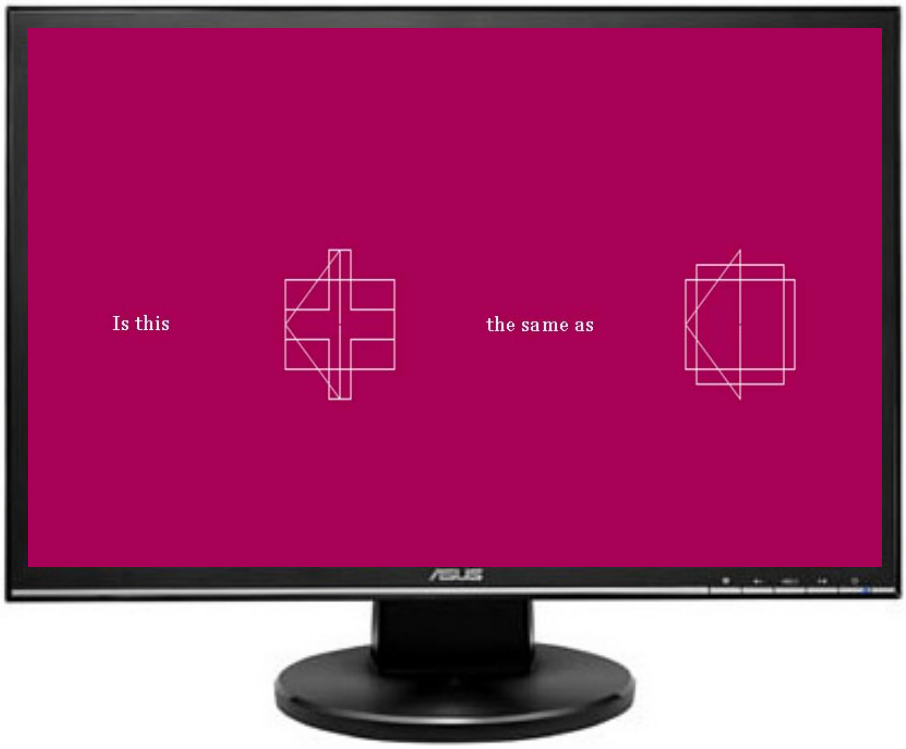
This is an example of pairs of words.



(Source: Peterson, 2005)

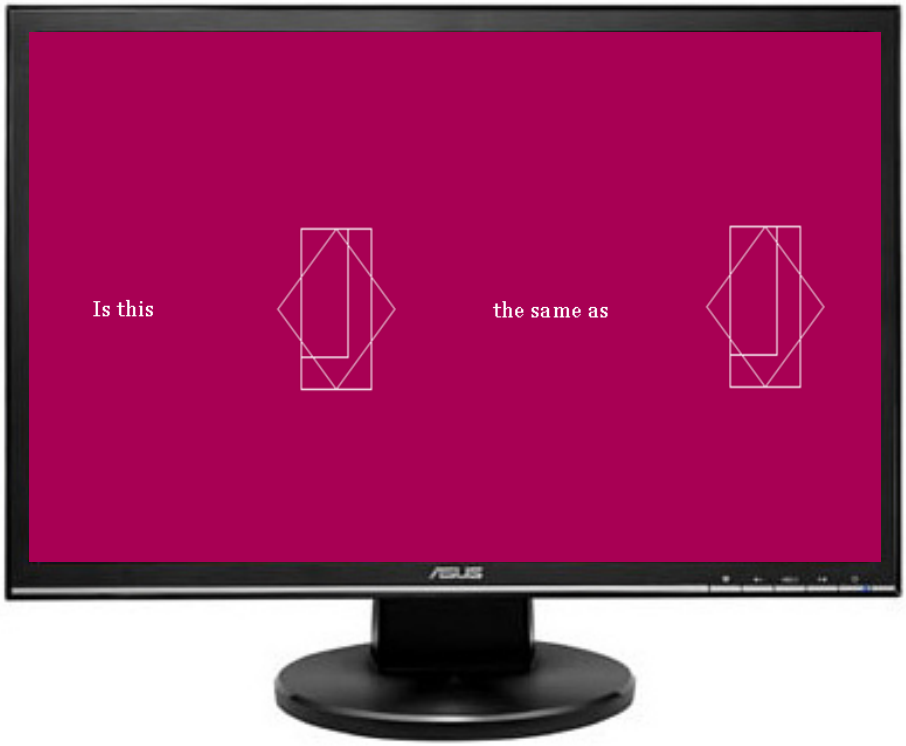
Example of an imagery item (task) on the VICS test. In this example the correct answer is ‘Equal’ because pencil and toothbrush are approximately equal in real life.

The following four figures are examples of Extended-CSA-WA test.



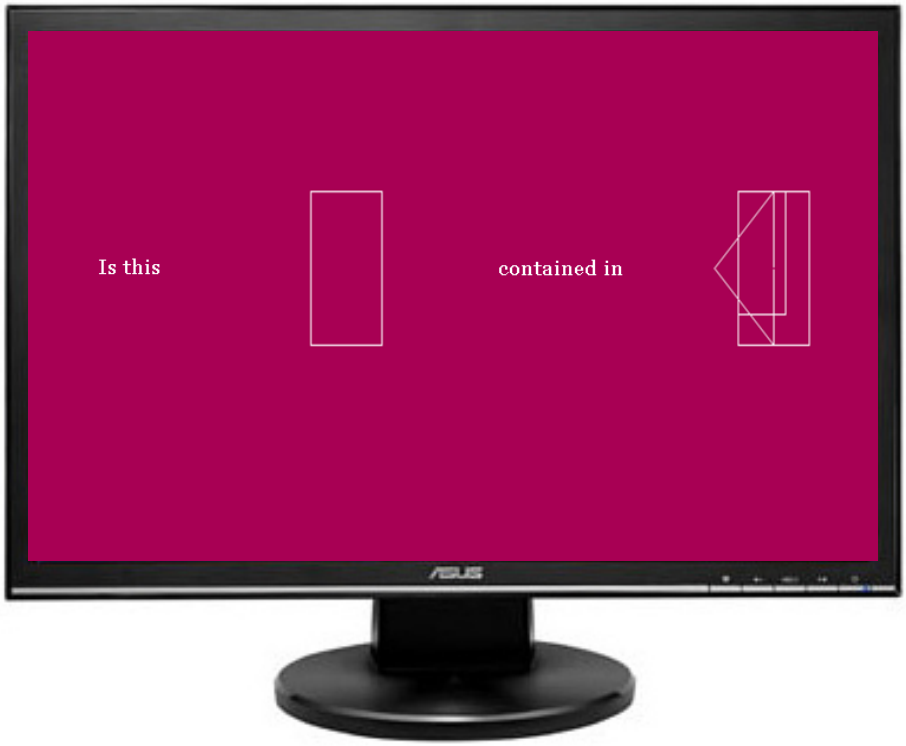
(Source: Peterson, 2005)

Example of Wholistic item (task) from Extended-CSA-EA. In this example the correct response is 'No' because the shape on the left side is not the same as the shape on the right side.



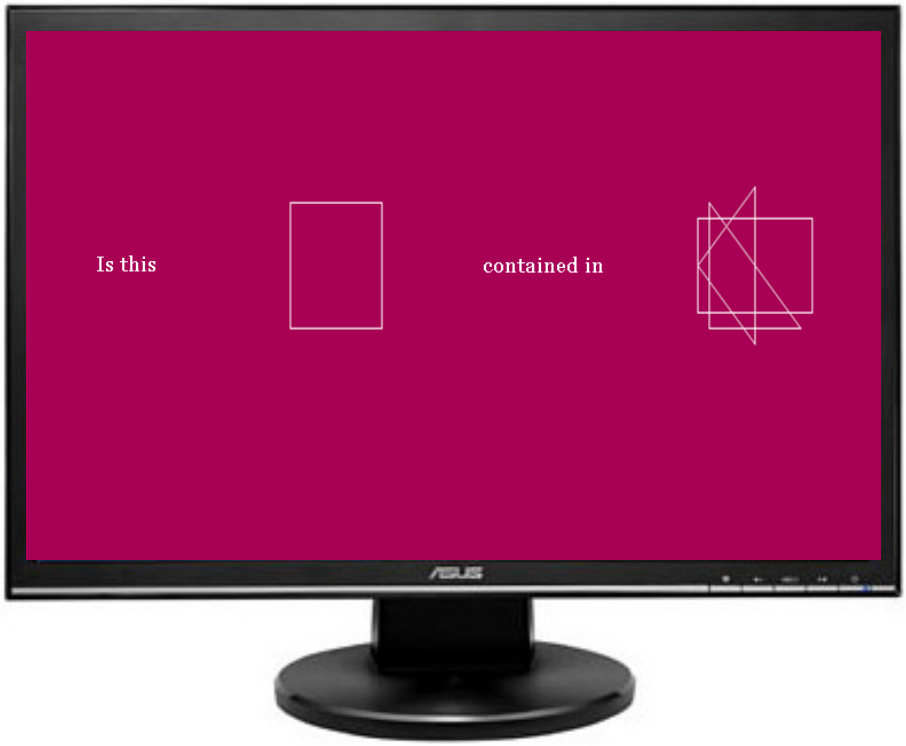
(Source: Peterson, 2005)

Example of Wholistic item (task) from Extended-CSA-EA. In this example the correct response is ‘Yes’ because the shape on the left side is the same as the shape on the right side.



(Source: Peterson, 2005)

Example of an analytic item (task) on the E-CSA-WA test. In this example the shape on the left side is contained in the shape on the right side, therefore the correct response is ‘Yes’.



(Source: Peterson, 2005)

Example of an analytic item (task) on the E-CSA-WA test. In this example the shape on the left side is not contained in the shape on the right side, because the shape cannot be rotated, therefore the correct response is ‘No’.

ANSWER SHEET (CONCRETE AND ABSTRACT SENTENCES)
FOR TRIAL 1

CONCRETE SENTENCES

Sentence 1

Trial 1:

Sentence 2

Trial 1:

Sentence 3

Trial 1:

Sentence 4

Trial 1:

Sentence 5

Trial 1:

Sentence 6

Trial 1:

ABSTRACT SENTENCES

Sentence 1

Trial 1:

Sentence 2

Trial 1:

Sentence 3

Trial 1:

Sentence 4

Trial 1:

Sentence 5

Trial 1:

Sentence 6

Trial 1:

Appendix-K

ANSWER SHEET (CONCRETE AND ABSTRACT SENTENCES) FOR TRIAL 2

CONCRETE SENTENCES

Sentence 1

Trial 2:

Sentence 2

Trial 2:

Sentence 3

Trial 2:

Sentence 4

Trial 2:

Sentence 5

Trial 2:

Sentence 6

Trial 2:

ABSTRACT SENTENCES

Sentence 1

Trial 2:

Sentence 2

Trial 2:

Sentence 3

Trial 2:

Sentence 4

Trial 2:

Sentence 5

Trial 2:

Sentence 6

Trial 2:

Appendix-L

Post hoc Analysis of Cognitive Styles

Post-Hoc Analysis for Cognitive Styles by using Bonferroni Test

Groups	Mean difference	*p*
Median RT on verbal task		
Visualizer - little style	.130	.300
Visualizer - verbalizer	.574	.001
Little style - verbalizer	.44	.001
Median RT on imagery task		
Visualizer - little style	.574	.001
Visualizer - verbalizer	.749	.001
Little style - verbalizer	.176	.313
Mean RT on verbal task		
Visualizer - little style	.779	.001
Visualizer - verbalizer	.959	.001
Little style - verbalizer	.179	.782
Mean RT on imagery task		
Visualizer - little style	.086	1.00
Visualizer - verbalizer	.687	.001
Little style - verbalizer	.601	.001
Mean RT on the picture items	Mean difference	*p*
Visualizer - little style	-.316	.002
Visualizer - verbalizer	-.091	1.00
Little style - verbalizer	.225	.236
Mean RT on the word items		
Visualizer - little style	.378	.016
Visualizer - verbalizer	.182	1.00
Little style - verbalizer	.196	.880
Mean RT on Exposure 1		
Visualizer - little style	.434	.002
Visualizer - verbalizer	.203	.769
Little style - verbalizer	.231	.571
Mean RT on Exposure 2		
Visualizer - little style	.259	.021
Visualizer - verbalizer	.069	1.00
Little style - verbalizer	.190	.457

Note. RT = reaction time

Appendix-M

Post hoc analysis of Individual differences

Post-Hoc Analysis for Discipline of Study by using Bonferroni Test

Groups	Mean difference	*p*
Management science – Social sciences	-.013	1.00
Management sciences – Natural sciences	-.287	.054
Social sciences – Natural sciences	-.274**	.011

Note. **$p < .01$