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Re-Establishing concurrent validity & reliability of 'Multiple intelligence level-scale' to assess dominant thinking pattern

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Abstract
Students can learn better if they are imparted education in the way meant for them. There is growing evidence of the existence of a cognitive style, encompassing many areas of human performance that depends on the differential use of the capabilities of the two cerebral hemispheres. Left-brain scholastic subjects focus on logical thinking, analysis, and accuracy. Right-brained subjects, on the other hand, focus on aesthetics, feeling, and creativity. The present research was conducted to re-confirm and re-establish the concurrent validity and reliability of the Dominant Thinking Pattern as assessed through the standardized Multiple Intelligence Level Scale (MILS) purely based on the Howard Gardner's theory of Multiple Intelligences. The research was conducted in and around Chandigarh. The sample consisted of 120 school going students between 7-16 years of age from different schools. Random sampling was followed. It was established through results that the Scale is valid and reliable measure to find out the dominant thinking pattern of the subjects.

Keywords: Dominant Thinking Pattern, Cerebral Hemispheres, Cognitive Style, Multiple Intelligences

1. Introduction

Hemispheric dominance is a cognitive style based on the differential ability to use the capabilities of the right or the left hemisphere. While both hemispheres can be involved in the performance of all tasks (with the possible exception of language production, which is typically the province of the left hemisphere, at least in right-handed people), the left hemisphere seems to have more verbal and sequential abilities, while the right hemisphere excels in visual- spatial tasks. Individuals who are more efficient at using the parallel holistic processing style of the right hemisphere have been termed right-hemispheric dominant; those who are more efficient at using the sequential verbal abilities of the left hemisphere have been called left-hemispheric dominant. Most humans have left hemisphere specialization for language abilities. A child is born whole but due to survival needs he develops a preferred sense (visual, auditory or kinesthetic). These senses send information to the child's preferred side of the brain (left or right) where the information is processed before it is sent to the preferred hand for verbal or written feedback. Irrespective of the child's dominance, he should be encouraged to develop his non-dominant bits to function as a whole child who can listen (auditory) and respond just as well as learn by reading (visual) or hands-on (kinesthetic) experiences, focus on details or on the bigger picture when it is called for, and who can instinctively respond when an opportunity knocks, be flexible and adapt to any learning environment and communicate with ease and clarity. One of the earliest means of identifying these two thinking styles was through the use of eye movements in response to questions (e.g., Day, 1964; Duke, 1968; Teitelbaum, 1954). There was considerable controversy and lack of consistency, however, from experiment to experiment until Gur and Gur (1977), and Gur, Gur, and Harris (1975) clarified the issue by showing that the position of the questioner was a crucial variable. When the experimenter was not in face-to-face contact with the subject, the eye movements reflected laterality; that is, the eyes moved contra-laterally to the hemisphere most efficient at processing that kind of information. In the face-to-face situation, however, the eye movements reflected dominance; that is, the eyes moved consistently in one direction, independent of the type of question. Sackeim, Packer, and Gur (1977) have shown that susceptibility to subliminal perception depends on the adoption of an organizational set that is consistent with the cognitive style of the subjects, as measured by eye movements. Hellige (1975) differentiated subjects on the basis of the form of their classically conditioned eye blinks. The V-type individual has characteristics similar to those postulated for the left hemisphere, while the C-type individuals have characteristics more typically associated with the right hemisphere. Using a simultaneous same-different reaction time task for letters, the two conditioning types produced different laterality patterns (performance in the left as opposed to the right hemisphere), with the V type showing a greater differential performance between the two hemispheres. It should be noted, however, that the V-type subjects showed superior right-hemisphere performance for verbal material. Hellige (I975), found differential laterality patterns, but no differences in group performance. Cognitive tempo is the term used to describe performance on Kagan's (1965) matching familiar figure test. Impulsive are individuals who give fast but inaccurate responses; reflective are accurate, but slow. The subject's task is to determine which of the comparison stimuli is identical to a standard, with the differences among the

comparison stimuli based on comparatively minor differences in details among the figures. Zelniker and Jeffrey (1977) developed a new set of stimuli in which the differences among the comparison stimuli depended on overall global differences rather than on differences in detail. When this new test was administered to a previously determined group of impulsive and reflective, the errors of the impulsive decreased and the errors of the reflective increased, leading to a slight but non-significant difference in favor of the impulsive. These results are consistent with the hypothesis that impulsive process in the holistic style of right- dominant individuals and reflective process in the sequential style of left-dominant individuals. Torrance, Reynolds, Riegel, and Ball (1977) have developed a paper-and-pencil subjective report scale ("Your Style of Learning and Thinking") to measure a subject's preference for right-hemisphere as opposed to left-hemisphere functions. In terms of reliability, construct validity, and concurrent validity, the test shows considerable potential as a measure of hemispheric dominance. Zenhausern (1978) has proposed a model of hemispheric dominance based on the hypothesis that for a right-dominant individual, visual images are essential to thinking and deductive reasoning is the preferred mode; for left-dominant individuals, visual images play an ancillary role and inductive reasoning is preferred. Several studies have provided support for the model. Zenhausern and Repetti found that subjects who reported they thought in pictures scored higher on the right scale of the Torrance *et al*. (1977) test than subjects who reported they did not think in pictures. The reverse pattern was found on the test for those subjects who reported they did not think in pictures. Zenhausern and Gebhardt (1979) found differential memory performance for right- and left-hemispheric dominant subjects. While they found rather complex interaction effects, there was a consistent finding of greater retention of material under auditory rather than visual input for left-dominant individuals and the reverse effect for right-dominant individuals. The cerebral hemispheres, particularly in the large and redundant cerebral cortical mantle, are the anatomical substrates of the uniqueness of human being. The cortex of the cerebral hemispheres embodies the higher integrative or intellectual capacities of man and its expanse in area and neuronal numbers far outstrips the same parameters of our nearest phylogenetic cousin, the chimpanzee. The complexity of neuronal ramification and interconnection is astonishing. It is estimated that there are nine billion neurons in each cerebral hemisphere and each neuron has between five and ten thousand interconnections with other neurons neighboring and distant. The mathematical dimensions are staggering, little short of infinite. The latest generation of man-made brains, in all their circuit complexity cannot compare. The higher integrative functions can be divided into those functions having diffuse representation in the cortex and those with more focal representation. Some functions are in both hemispheres and some are unilaterally represented. Obviously, all of this affects the symptoms produced by damage to the brain. A student's learning style refers to the preferential way in which he grasps processes, comprehends and retains information. Assessment of style can drastically enhance the learning process. Howard Gardner of Harvard has identified nine distinct intelligences. This theory has emerged from recent cognitive research and "documents the extent to which students possess different kinds of minds and therefore learn, remember, perform, and understand in different ways," according to Gardner (1991). According to this theory, "we are all able to know the world through language, logical-mathematical analysis, spatial representation, musical thinking, and the use of the body to solve problems or to make things, an understanding of other individuals, and an understanding of ourselves. Where individuals differ is in the strength of these intelligences - the so-called profile of intelligences -and in the ways in which such intelligences are invoked and combined to carry out different tasks, solve diverse problems, and progress in various domains." Gardner says that these differences "challenge an educational system that assumes that everyone can learn the same materials in the same way and that a uniform, universal measure suffices to test student learning. Indeed, as currently constituted, our educational system is heavily biased toward linguistic modes of instruction and assessment and, to a somewhat lesser degree, toward logical-quantitative modes as well." Gardner argues that educational systems would be better served if disciplines could be presented in a numbers of ways and learning could be assessed through a variety of means." The Naturalist, Cosmic, Intrapersonal, Musical and Spatial Intelligence comprise of more of Creative thinking and thus categorized as Creative Intelligences: while the Interpersonal, Kinesthetic, Logical as well as the Linguistic Intelligence are categorized as Logical Intelligences and therefore make the bearer having more of Logical Thinking Pattern. "When the corpus callosum, or bundle of nerves connecting the two hemispheres, is severed the left hemisphere responds better to verbal, sequential, and linear processing while the right hemisphere is inclined toward nonverbal, spatial-visual, and simultaneous processing" (Campbell and Scott-Kassner, 2002). Left-hemisphere processes are emphasized in linguistic and logical-mathematical intelligences, while spatial intelligences reflect right-hemisphere excellence.

2. Method

The research was conducted in and around Chandigarh. The sample for the pilot study consisted of 120 school going students between 7-16 years of age from different schools. The MILS was developed after thorough research and collecting data from over 500 respondents. The initial format of the Scale contained 135 items, with 15 items in each of the nine categories. As the study advanced, the final format of the MILS contains 90 items, with 10 items in each of the nine categories. Each category consists of the statements related to a specific intelligence. The respondents had to tick the statement/statements that they feel or think is appropriate to their personality/character/behavior. The current MILS as developed by the researcher was termed as Test-1. The Test-2 refers to an already developed and widely used scale- 'Left Brain, Right Brain or Whole Brain' – Dominant Thinking Pattern Test, developed by Dr Melodie de Jager. All the tests were administered on all the respondents as per the set schedule. The MILS-Test-1 was re-administered after 30 days. The results were then compared and analysed.

2.1. Participants

Random sampling was undertaken to select subjects both males as well as females from different schools aging between 7-16 years.

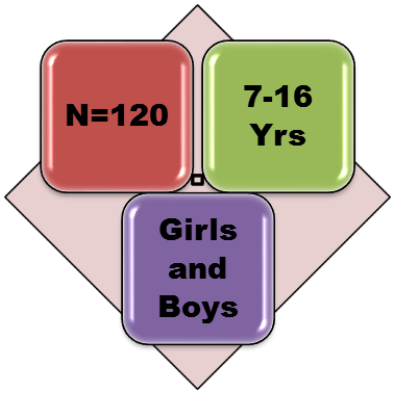

Fig 1: Sampling

The sample (N=120) was divided into four groups according to age.

Group-1	07 to 10 Years	n=30
Group-2	10 to 12 Years	n=30
Group-3	12 to 14 Years	n=30
Group-4	14 to 16 Years	n=30

2.2. Stages of Study

Rapport was built with the subjects. The study was conducted in three stages.

Stage-1 Multiple Intelligence Level Scale (Test-T-1) was administered.

Stage-2 'Left Brain, Right Brain or Whole Brain' – Dominant Thinking Pattern Test, developed by Dr Melodie de Jager (Test-T-2) was administered.

Stage-3 Multiple Intelligence Level –Scale (Test-T-1) was re-administered after 30 days, referred to as Test-3.

2.3. Phases of Analysis

Phase-1 Results of Test-1 and Test-3 were compared.

Phase-2 Results of Test 2 were analysed.

Phase-3 Results of Test-1, Test-2 and Test-3 were studied.

2.4. Statistical Analysis

Once the data was obtained, it was coded, tabulated and analyzed, keeping in mind the objectives of the study. Appropriate statistical tools were used to draw meaningful inferences.

Table 1: Statistical tools used for analysis of data

S. No.	Statistical tools	Formula	Purpose
1	Mean (x)	**X = ΣX/N** Where, X = Variable, N = No. of sample	To find out the average scores of variable used in the study.
2	Percentage	%=No of subjects in a category*100/No. of total subjects	To find out the percentage (out of 100) of the given category.
3	Standard Deviation (S.D.)	**$\overline{0}$ = ✓Σ x / N** Where, X = Deviation from actual mean, X = mean, X = variable, N = number of samples.	To find out deviation from the mean scores of the variables.
4	Standard error of mean (S.E)	**S.E = 0/n** Where, 0 = S.D., n= number of observations.	To find out the degree to which the mean is affected by the error of measurement and sampling.
5	't' test	**t = (x1-x2) / S** **✓n1n2/n1 + n2** Where, x1 = mean of 1st sample, x2 = mean of second sample, S = combine S.D., n1 = number of observations in 1st sample, n2 = number of observations in 2nd sample	To compare the average score of any two groups or to find out whether the mean of the two samples vary significantly from each other.

3. Results and Discussion

Comparing results of Test-1 and Test-3

Table 2: Mean of Multiple Intelligences assessed in Test-1 on Day-1 and Day-31 (n=120)

	Naturalist	Cosmic	Intrapersonal	Interpersonal	Kinesthetic	Musical	Spatial	Logical	Linguistic
Day-1	5.42	5.46	5.2	6.14	3.41	5.3	4.2	6.27	6.38
Day-31	5.43	5.36	5.095	6.32	3.34	5.29	4.21	5.27	5.75

Table 3: Mean, Standard deviation, standard error and t-values of MIL in Test-1 on Day-1 and Day-31

		Mean	SD	SEM	t-value	Lev of Sig.
Naturalist	Day-1	5.42	1.25	0.11	0.0622	Not statistically significant
	Day-31	5.43	1.24	0.113		
Cosmic	Day-1	5.46	1.45	0.132	0.54	Not statistically significant
	Day-31	5.36	1.41	0.126		
Intrapersonal	Day-1	5.2	0.65	0.059	0.105	Not statistically significant
	Day-31	5.095	0.69	0.06		
Interpersonal	Day-1	6.14	1.10	0.1	1.356	Not statistically significant
	Day-31	6.32	0.95	0.086		
Kinesthetic	Day-1	3.41	0.58	0.052	1.088	Not statistically significant
	Day-31	3.34	0.40	0.036		
Musical	Day-1	5.3	1.03	0.094	0.078	Not statistically significant
	Day-31	5.29	0.95	0.086		

Spatial	Day-1	4.2	0.84	0.07	0.09	Not statistically significant
	Day-31	4.21	0.85	0.077		
Logical	Day-1	6.27	0.41	0.037	0.533	Not statistically significant
	Day-31	6.24	0.46	0.042		
Linguistic	Day-1	6.38	0.65	0.059	0.349	Not statistically significant
	Day-31	6.35	0.68	0.062		

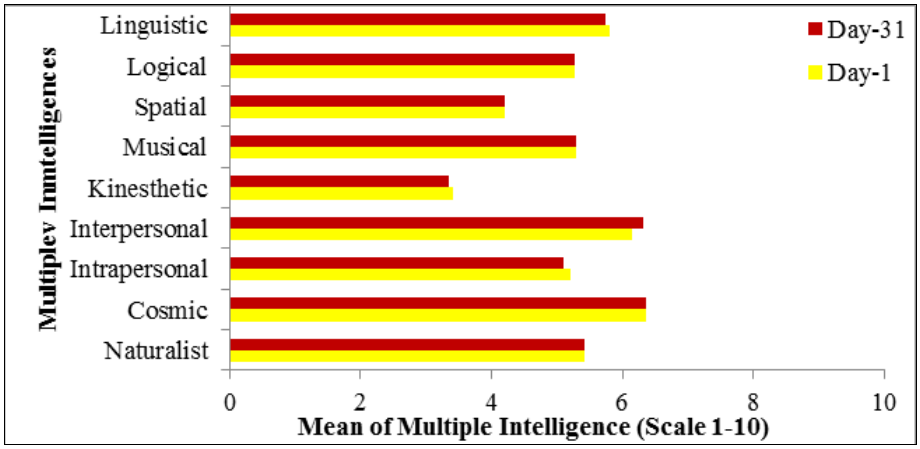

Fig 2: Mean of Multiple Intelligences assessed in Test-1 on Day-1 & Day-31

Table 4: Dominant Thinking Pattern of subjects assessed in Test-2 (n=120)

Dominant Thinking Pattern	Brain dominance	7 to 10	10 to 12	12 to 14	14 to 16
Logical	Left-brain dominance	78 %	80%	83%	87%
Creative	Right-brain dominance	22%	20%	17%	13%

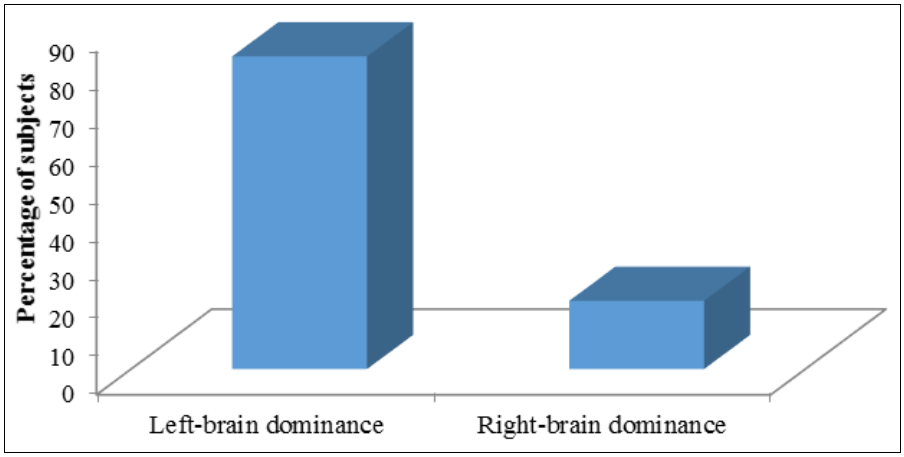

Fig 3: Dominant Thinking Pattern assessed in Test-1

There was inevitably no difference found in the Dominant thinking Pattern of respondents as assessed through Re-Test-1 administered on same respondents after a period of 30 days.

Results of Test-2

Table 5: Dominant Thinking Pattern of subjects assessed in Test-2 (n=120)

			7 to 10	10 to 12	12 to 14	14 to 16	Total
Score	**Brain dominance**	**Refined-Brain dominance**	**Percentage**	**Percentage**	**Percentage**	**Percentage**	**Percentage**
(-15 to -13)	Very strong left-brain dominance.	Left-brain dominance (Logical)	78	80	83	87	82
(-12 to -9)	Left-brain dominance.						
(-8 to -5)	Moderate preference for left-brain.						
(-4 to -1)	Slight preference for left-brain.						
0	Whole brain dominance (bilateral).	Bilateral	0	0	0	0	0
(+1 to +4)	Slight preference for right-brain.	Right-brain dominance (Creative)	22	20	17	13	18
(+5 to +8)	Moderate preference for right-brain.						
(+9 to +12)	Right-brain dominance.						
(+13 to +15)	Very strong right-brain dominance.						

Table 6: Cumulative Dominant Thinking Pattern of subjects assessed in Test-2 (n=120)

SCORE	Brain dominance	7 to 10	10 to 12	12 to 14	14 to 16
(-15 to -1)	Left-brain dominance	78 %	80%	83%	87%
(1 to 15)	Right-brain dominance	22%	20%	17%	13%

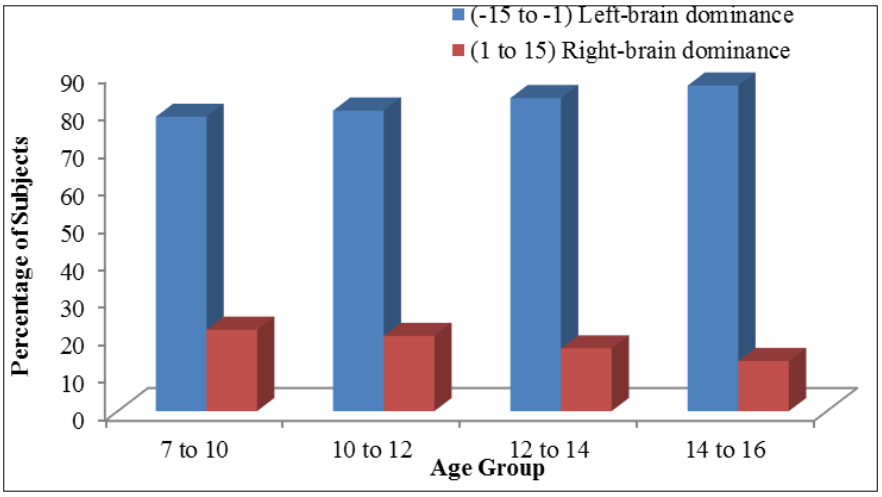

Fig 4: Brain Dominance of subjects assessed in Test-2

Comparing results of Test-1, Test-2 & Re-Test-1

Table 7: Dominant Thinking Pattern assessed in Test-1, Test-2 & Test-3 (n=120)

Dominant Thinking Pattern	Dominant Thinking Pattern	Test-1	Test-2	Re-Test-1
7-10 yrs	Logical	78	78	78
	Creative	22	22	22
10-12 yrs	Logical	80	80	80
	Creative	20	20	20
12-14 yrs	Logical	83	83	83
	Creative	17	17	17
14-16 yrs	Logical	87	87	87
	Creative	13	13	13

Table 8: Cumulative Dominant Thinking Pattern assessed in Test-1, Test-2 & Test-3 (n=120)

Dominant Thinking Pattern	Test-1	Test-2	Re-Test-1
Creative	18 %	18 %	18 %
Logical	82 %	82 %	82 %

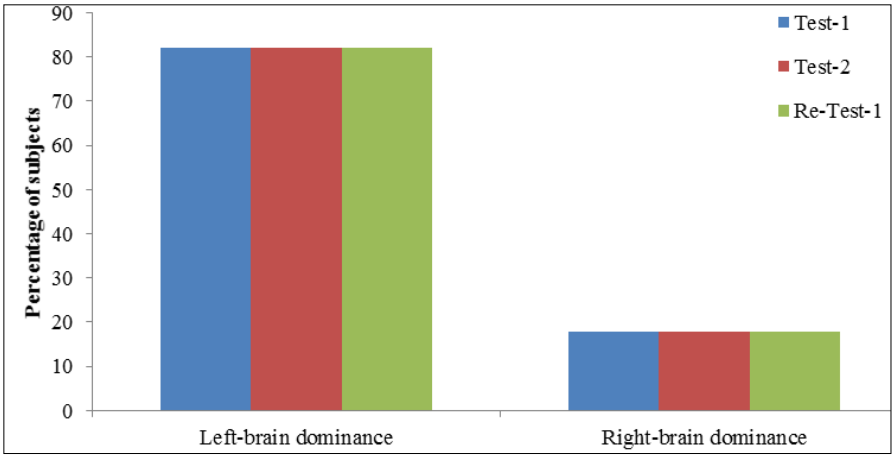

Fig 5: Dominant Thinking Pattern assessed in Test-1, Test-2 & Test-3

It is evidently clear that 18% respondents were found to have Creative bent of mind, while those having logical dominance in mind out-figured at 82% as assessed and re-assessed through all the Tests.

4. Conclusion

In a nutshell, there was inevitably no significant difference found in the Naturalist, Cosmic, Intrapersonal, Interpersonal, Kinesthetic, Musical, Spatial, Logical as well as the Linguistic Intelligence of respondents as assessed through Re-Test-1 administered on same subjects after a period of 30 days. The Naturalist, Cosmic, Intrapersonal, Musical and Spatial Intelligence comprise more of Creative thinking and thus categorized as Creative Intelligences: while the Interpersonal, Kinesthetic, Logical as well as the Linguistic Intelligence are categorized as Logical Intelligences and therefore make the bearer having more of Logical Thinking Pattern. There was no difference traced in the Dominant thinking Pattern of respondents as assessed through the three tests. Thus, it can be concluded that the said Scale is valid and reliable for the assessment of the Dominant Thinking Pattern of the subjects as assessed through the standardized Multiple Intelligence Level Scale (MILS) purely based on the Howard Gardner's theory of Multiple Intelligences.

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