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Hemispheric Lateralization For Processing Emotional Stroop-Like Task Among Right And Non-Right Handers

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Abstract:

This study investigates the Stroop-like incongruency effect when emotional face and emotional words, are presented as paired stimuli in the form of image and word in the split and parallel visual fields to right-handed and non-right-handed individuals. It was hypothesized that the lateralization pattern and ability of visual perception would differ of a person in terms of their handedness. The sample comprised 80 right-handers and 69 non-right handers males of 17-25 years of age. Self-report 10-items questionnaire were administered to determining handedness. To access the incongruency effect reaction time and accuracy were measured based on Stroop-like task with the help of JAVA based program in which pair of stimuli presented for 180 milliseconds on the computer screen in the form of images (five emotional faces) and words (five emotional words) under experiment 40 trials (20 split visual field and 20 parallel visual field) in congruent and incongruent conditions. Results reveal that in both visual field presentations i.e. split visual field and parallel visual field, non-right handers were faster in reaction and greater accuracy compared to right-handers. So, the results demonstrated that non-right handers had a less incongruence effect in both types of stimuli words and images as compared to right-handers.

Keywords: Lateralization, Handedness, Emotional Stroop task.

Introduction:

The brain is a very complex organ in human body in terms of its function and structure. It has been studied extensively during the last 150 years in various aspects through different tools, technique and methodologies (Dax, 1836). Human brain is a single structure but it comprises two halves that are known as hemispheres. Right side of the brain is known as right hemisphere and left side of brain is called left hemisphere. A variety of researches have suggested that these two hemispheres look almost similar in structure but their functions are quite different. The functions of two hemispheres are defined in a number of ways in which level of information processing within the hemisphere as well as between the hemispheres to make them understandable. To explore the functional speciality of both the hemispheres researcher are still engaged in the study of this area (Bogen, 1979; Bradshaw & Nettleton, 1981; Chall & Mirsky, 1978; Lennon, 1984; Thompson, Bogen & Marsh, 1979; Uzzaman, 2017). Hemispheric asymmetry got significant attention after sixties and it has supported Hippocrates' observation that "the human brain, as in the case of all other animals, is double" (Bogen, 1969, p.137). The history related to asymmetry of hemispheric functions is well addressed by Corballis and Beals (1976) and Bogen (1969).

In the human brain both the hemispheres have their specified functions but in some way one hemisphere is more passive or less cognitive than other. This concept is known as cerebral dominance. Majority of researches in the area of hemispheric specialization propose that in majority of the people left hemisphere is considered dominant for verbal task as right hemisphere dominates in performance on visuo-

spetial task (Dimond, 1971; Gazzaniga, 1970; Klatzky, 1970;Levy & Reid, 1976; Sperry 1973). Apart from verbal ability left hemisphere is also specialized for manual skills (Corballis, 1980) and an excellent performer of motor activities in common population (Zangwill, 1976). Past researches were dedicated to explore left hemisphere more in detail as compared to right hemisphere. The reason for exploring left hemisphere was its relationship with language ability that has direct relation with human intelligence is reflected in an argument by Sperry (1973) as modern society focuses on the development and greater use of intelligence took more attention to explore left hemisphere and to neglect right hemisphere. Right hemisphere had explained in past studies as silent, non-dominant and minor hemisphere. In the last forty-years attention shifted to language dominant hemisphere to non-dominant language hemisphere, the right hemisphere, and the interaction between these two to understand different cognitive abilities (Wexler, 1980).

Lateralization concepts explain as the particular function of our body regulate preferentially by one hemisphere or one side of body. Some functions that are recognized as lateralized functions in human beings comprise language, handednes, facial expression, visual skills as well as face recognition sometimes spontaneous shifting of sideward. Studies and assumption about dominance of cerebral hemispheres and its structure as well as function have been the core area among the researches almost from last 150 years (Dax, 1836) and still it has taken considerable attention and interest (Bogen, 1977; Bogen and Marsh, 1979; Bradshaw and Nettleton, 1981; Chall and Mirsky, 1978; Tandanobu, 1978; Thompson, Tandanobu, 1978). Research, theory and assumptions about hemispheric differences in terms of functions or cerebral dominance have been explored (Dax, 1836) and these are still interesting topics among researchers (Bogen, 1977; Bradshaw & Nettleton, 1981; Chall & Mirsky, 1978). Human brain has unique ability for expressing, perceiving and processing information with the help of different highly specialized cells or neurons that facilitate these functions of brain by different neural communications. Indeed, Human brain prepared in such a way it's two half established and functioned as a two different independent capable mental systems located in both sides i.e. right and left sides (Gazzaniga & LeDoux, 1978; Joseph, 1982, 1988a,b; Levy, 1983; Sperry, 1966, 1982).

Traditionally hand preference or handedness has been associated with the indicator of brain lateralization. However, this kind of approach is relevant to specialized certain kind of complex task and not for simple ones. Hand preference is a marker of brain lateralization and preference indicates the hemisphere which is most likely to undertake the task determines which hand to be used by an individual. Within the brain and behaviour research handedness is frequently analyzed as a by-product of brain lateralization in human beings. However, what remains unclear is the fact that why these things do not affect all human beings universally. Nearly about five to fifteen percent people are found as left handers (Bosman, 2004).

The Stroop Effect

In the year of 1935, J.R. Stroop was published a very popular article on interference in attention and perceptual task. This article was not so popular on that period of time but now in the current days it influenced to the scholar in more extent. So there is question why Stroop task consistently attract attention of researcher? "Perhaps the task is seen as tapping into the primitive operations of cognition, offering clues to the fundamental process of attention. Perhaps the robustness of the phenomenon provides a special challenge to decipher; together these are powerful attractions in a field of complex phenomena, where the subtlest variation may exert a dramatic effect" (McLeod, 1991, p. 163). Stroop and Stroop-like effects (where incongruent stimuli are measured against a congruent condition) have proved to be robust

and replicable (Dyer, 1973; Schmit& Davis, 1974; Ehri, 1976; Rosinski, Golinkoff, & Kukish, 1975; Smith & Magee, 1980; Goolkasian, 1981; Glaser & Glaser, 1982; David, 1992; Brega& Healy, 1999). The major theoretical difficulty regarding the Stroop effect revolves around the fundamental source of the observable fact. The two core explanations presented to describe the Stroop effect are automaticity and relative speed of processing. The automaticity explanation is that both automatic and controlled processes are involved in the Stroop task. Automatic cognitive processing occurs from long-termpractice, such as in the case of reading. Controlled processes (Andrade, Henderson, & Kamiar, 1996) refer to those that are voluntary, requiring more attention, and relatively slow; therefore, novel tasks generally rely on controlled processing. Automatic processes, on the other hand, are fast, occur without direct intention, and are generally unconscious (Shiffrin & Schneider, 1977). Automaticity includes both interference and facilitation (Cohen, McClelland, & Dunbar, 1990). Interference refers to the extent to which one process encumbers performance of another, whereas facilitation indicates the extent to which one process assists performance of another (David, 1992). Through practice and maturation, reading progresses from controlled process to one that is automatic, lessening its demands on attention resources and attention shift against memory averaging (Uddin, Kawabe & Nakawizo, 2005). In an early work Cattell (1886) reported one of the first studies that provided support for automatic processing during reading. He found that people were faster in reading words than in naming the corresponding objects or their properties, including their color. Forty-nine years later, Stroop (1935) furthered Cattell's research by creating tasks involving color naming and reading. According to the automaticity explanation, the Stroop effect results from difficulty ignoring the word when asked to name the color of the word because reading has become an automatic process.

Literature review stated that there is no clear and conclusive picture about laterlization pattern among different handed persons. A verity of researchers examined in the same thing by using different methods in which Stroop task experiment is also widely accepted by the researches from good period of time. Above mentioned literature review moreover focused on two things, one is related with differences that has been widely accepted among different handed persons in terms of their cognitive functions and hemispheric lateralization for different tasks, second about Stroop task is the one of the technique through lateralization pattern can be drown by execution of different stimuli in different ways. Therefore It was hypothesized that, the lateralization pattern and ability of visual perception would be differ of a person in terms of their handedness.

The Present Study:

In view of the review of past research and theory, this study was planned to investigate the effect of lateralization on the experience of incongruity in cognitive field. In this context this study used handedness as an index of laterality and examined the differences in performance on Stroop-like task. In classical Stroop task only color words were used in different color inks. The present study attempted to investigate if Stroop like interference in some familiar thing like emotional faces of human beings with their respective word labels. However, the participant had to recognize both the word and image simultaneously. The reason to design experiment in this way, was to assess, how much the participant was able to recognize words and images quickly and accurately, when the same are presented under incongruent condition (e.g., HAPPY emotional face paired with SAD emotional word). Apart from incongruence manipulation this experiment was also designed to see the differential effectiveness of the visual field. It would tell which visual field yields better recognition of the stimuli. Through visual field (right visual

field and left visual field) presentations, the present experiment can also draw assumption about the nature of perception of an individual in terms of hemispheric lateralization. Handedness is linked through cerebral organization. However, its association with cognition remains unclear. Since the Stroop task is supposed to measure aspects of executive control, this study aims to investigate the role of handedness in interference in visual perception in Stroop like task.

Method:

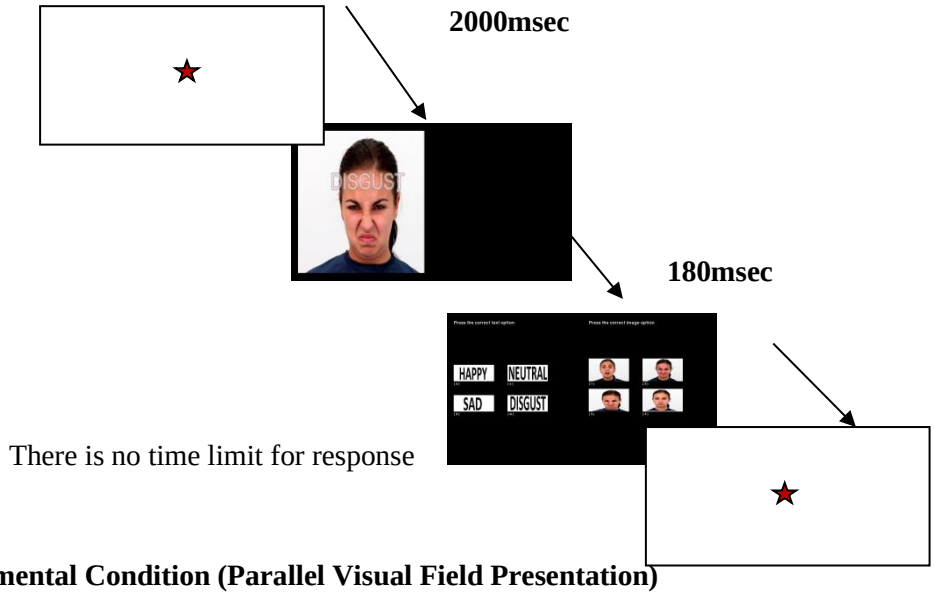
In the present study experiment was designed with some changes on traditional Stroop task procedure. Firstly, emotion faces/emotional words (HAPPY, SAD, ANGER, DISGUST & NEUTRAL) stimuli used in place of colour inks and colour name. Secondly, stimuli were presented in two different visual fields i.e. right visual field (RVF) and left visual field (LVF) and in addition reaction times and, accuracy was recorded. The measure purpose of this study was to investigate Stroop-like incongruency effect when emotional faces are presented in pair of stimuli in the form of image and word in split visual field to right-handed and non-right-handed individuals. And to investigate Stroop-like incongruency effect when emotional faces are presented in pair of stimuli in the form of image and word in parallel visual field to right-handed and non-right-handed individuals.

Experiment was designed on the base of Weekes and Zaidel's (1996) Stroop-like task. This study was examined with the help of self-developed JAVA based program for Stroop like task in which five different emotional faces and five emotional word (HAPPY, SAD, ANGER, DISGUST & NEUTRAL) used in the form of stimuli. We presented stimuli with the help of JAVA based program and recorded Reaction time and Accuracy. Stimuli were displayed on 39.62 cm diagonal screen and response recorded in milliseconds. Subject's handedness was defined with help of 10-item self-report questionnaire. In this questionnaire ten items measure hand preference (using a knife, combing hair, picking up a book, writing on paper etc.). These items have appeared in earlier studies (Coren, 1989; Mandal et.al. 2001; Porac, Coren, & Duncan, 1980; Suar at. Al., 2007). Five different kinds of emotional faces (happy, sad, neutral, disgust and fear) and their names were used as stimuli. All stimuli were displayed in proper size so that subject can easily perceive it. There was a fixation point presented in the centre of screen prior to every stimulus and it was in the form of circle with the radius of 1 cm. Stimuli presented in two different visual field i.e. Right visual field (RVF) and Left visual field (LVF) in two different conditions i.e. split visual field and parallel visual field, were shown 10 cm from fixation point.

After taking consents from subjects, self-report 10-items questionnaire were administered to determined handedness level. After defining their handedness level subject's eye sight were verified by performing some visual task by using one eye and both. We allowed participant to use their spectacles if needed. All procedure of experiment was explained to participants and answered their doubts. Five trials had given to every subject in the beginning of the experiment.

These were the instruction given to subject: In the experiment pair of stimuli (one image and one word) will be display in two different visual fields i.e. in left visual field and/or in right visual field preceded and followed by a fixation point for 2000msec. Stimuli will be present on screen only for 180msec preceded by four alternative response separately for each image and word. You have to respond one out of four alternatives for each stimulus (shapes and word) with the help of keyboard on the basis of your perception as soon as possible with accuracy. You can stop only after the END screen appears on your monitor. It will take five to ten minutes for completion.

Experimental Condition (Split Visual Field Presentation)



Experimental Condition (Parallel Visual Field Presentation)

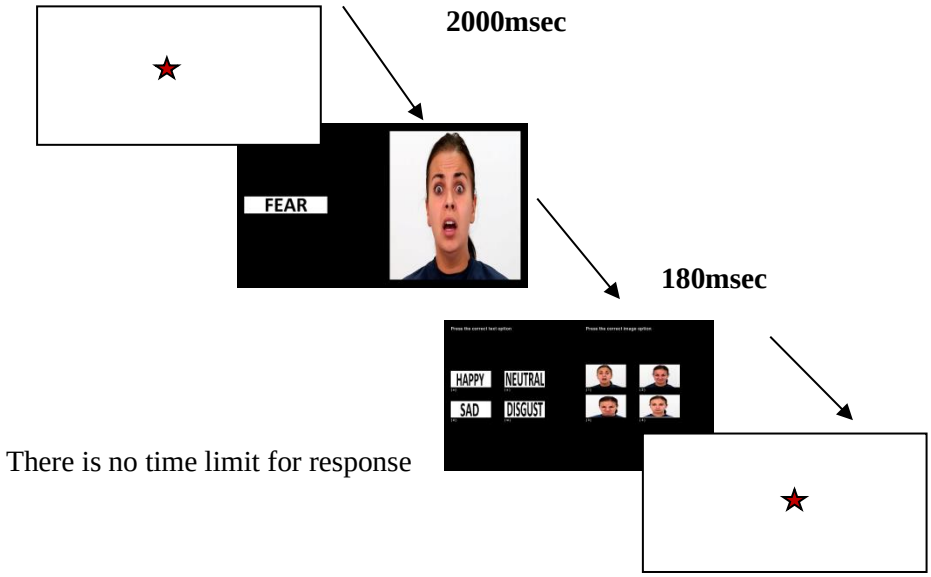


Fig: 1.1: Presentation of Experimental Conditions

Experiment was run in noise free environment and subject sited in the level of monitor and two fit far from display. Subject responded to all trials with help of key board by using key A,S, D and W for word and 1,2,3, and 4 for image. Reaction times (in milliseconds) of all one hundred twenty trials were recorded with accuracy by the program in MS-excell and further data were used for analysis. In total 40 trials were given to each participant in which 20 for each visual field presentation. Reaction time in and accuracy data were recorded by software in MS office excel sheet. The reaction time was recorded in milliseconds and accuracy recorded in the form of "true" and "false".

The sample of this study consisted of 149 male participants in which 80 predominantly Right handed and 69 non-right handed. Subjects were voluntary participated in this study; predominantly left and mixed handed participant were included in non-right handed subjects. All participants were undergraduate

and post graduate students from different streams between 17-25 years of the age had a basic knowledge of computer operating and their eye sight was also normal. Subjects were comfortable with English language and they knew all English words and their meanings of stimuli.

Experimental Design:

The study involved a 2 x 2 x 2, Handedness (right, non-right) x Congruency (congruent, incongruent) x Visual Field (left visual field, right visual field) factorial design with repeated measures on the last two factors.

Result Analysis:

The analysis was undertaken for all correct responses following a 2x2x2 factorial mixed model ANOVA with repeated measures on the last two factors. Thus there were following factors two types of handedness (Right handers/non-right handers), two levels of congruence (congruent/incongruent), and two types of visual field (left visual field/right visual field) separately for two kinds of stimuli (Image/Word). The first factor was between factor while the other two were within factors and required repeated measures analysis. With a view to have clarity in presentation the results obtained are presented in two major sections i.e. split visual field and parallel visual fields. Within each of these there are two major subsections pertaining to response latency and accuracy of recognition. Mean scores were computed for each subject of each treatment condition; i.e. congruent, incongruent presented in right or left visual fields.

Split Visual Field Analysis:

There was significant main effect of congruence found for emotional faces stimuli, $F(1, 147) = 12.089$, $p<.01$ Mean reaction times were faster in congruent condition in all three experiments for image stimuli as compared to incongruent condition for the both groups i.e. right-handers and non-right handers. In regard to the effect of visual field on reaction time the F values were significant as $F(1, 147) = 47.080$, $p<.01$. The mean reaction time (milliseconds) for left visual field ($M=5728.05$, $SD=4595.61$) was faster than the right visual field ($M=6582.49$, $SD=1551.35$).

Table 1.1 Summaries of ANOVAs separately performed on score of reaction time for Emotional Stroop-like task (Image & Word) in Split Visual Field Presentation:

Split Visual Field Presentation		**Reaction Time Emotional Stroop-like task**			
		Emotional Faces		**Emotional Words**	
Variables	**df**	**MS**	**F**	**MS**	**F**
Handedness (A)	1	24067429.089	9.558*	75560967.79	35.32**
Congruency (B)	1	33900370.858	12.089*	323845525.11	128.17**
Visual Field (C)	1	108188959.014	47.08*	739589643.6	422.83**
AxB	1	59575156.535	5.925*	2254599.077	.892
AxC	1	281584666.838	7.00*	1767811.579	1.01
BxC	1	62577565.446	28.09**	8888495.75	4.19*
AxBxC	1	71993333.129	32.32**	4581406.223	2.163
Within	147	2227457.365		2117646.615	

*p<0.05, **p<0.01

In emotional words stimuli the main effect of congruency was significant F (1, 147) = 128.179, p<.01similarly Visual field had also significant effect F (1, 147) = 422.83, p<.01. It was found that subjects took more time in incongruent condition (M=7907.06, SD=1491.03) as compare to congruent condition (M=6428.76, SD=1464.73). In regard to visual field participants were quicker when the stimuli were in right visual field (M=6810.88, SD=1382.35) as compared to left visual field (M=7524.95, SD=1537.41). Interaction effect of Handedness x Visual field and Handedness x Congruency were not significant the F values were F (1, 147) = 1.011, p>.05,F (1, 147) = 0.892, p>.05 respectively (see table 1.1).

Parallel Visual Field Analysis:

As per the between group analysis for image stimuli was shown significant differences in Right hander and Non-right hander group of samples as F (1, 147) = 4.062, p<.01. As per result, non-right handers (M=6056.20, SD=1830.98) were faster in recognition of image stimuli than the right handers (M=6307.17, SD=1227.69). Main effect of congruency and visual field were found significant as Congruency F (1, 147) = 10.861, p<.01, Visual Field F (1,147) = 181.15, p<.01, as per mean score of reaction time in Left Visual Field (M=5807.94, SD=1495.96) is lower than the Right Visual Field (M=6555.44, SD=1562.74). Further analysis was also carried out to see interaction effect between Handedness x Visual Field and Handedness x Congruency in the experiments of parallel visual field observation for image stimuli. Interaction effect was found significant as for Handedness x Congruency F (1, 147) = 181.151, p<.01 and for Handedness x Visual Field F (1, 147) = 56.001, p<.01(see table 1.2)

Table 1.2 Summaries of ANOVAs separately performed on score of reaction time for Emotional Stroop-like task (Image & Word) in Parallel Visual Field Presentation:

Parallel Visual Field Presentation		**Reaction Time Emotional Stroop-like task**			
		Emotional Faces		**Emotional Words**	
Variables	**df**	**MS**	**F**	**MS**	**F**
Handedness (A)	1	9333891.63	4.062**	9701513.15	3.845*
Congruency (B)	1	15092744.89	10.861**	441104803.46	169.03**
Visual Field (C)	1	82800685.36	181.15**	263446442.67	111.01**
AxB	1	251720271.77	181.15**	25946545.29	9.94**
AxC	1	71054404.38	65.25**	153319.33	.065
BxC	1	59133258.93	56.00**	10963263.49	5.001*
AxBxC	1	71707676.77	65.85**	11464113.91	5.23*
Within	147	1088828.66		2192158.642	

*p<0.05, **p<0.01

Between group analysis was found significant in all three experiments as F (1, 147) = 3.845, p<.05, foe emotional word stimuli in parallel visual field presentation. Mean reaction time of Right hander (M=7118, SD=1516) were faster than the non- right hander (M=7118, SD=1547). Main effect of Congruency was seen significant in all this experimental condition as F (1, 147)=169.038, p<.01. Handedness x Congruency interaction found significant as F

(1, 147) = 9.943, p<.01 it shows Non right hander perceived stimuli faster in incongruent condition than Right hander and Right hander performed well as compare to Non right hander in congruent condition but Handedness x Visual Field interaction was not found significant as F (1, 147) = .065, p>.05 (see table 1.2).

Discussion:

The result of this study on the basis of Stroop-like experiment give us enough findings in support of hypothesis that, the ability of visual perception can be differ of a person in terms of their handedness. The findings of current study indicate that congruency effect in both of the groups. Right handed and non-right handed individuals have faced difficulties to respond stimuli in the incongruent conditions for emotional face stimuli and their names. Among these groups of participants, non-right handers were more accurate and faster in terms of reaction time than the right handers. The findings of this study related to congruency in line with the study of Simon, Paullin, Overmyer and Berbaum (1985). They found among different handed individuals reactions to incongruent stimuli were slower than to congruent stimuli in Stroop task. But in this study stimuli were not used as classical experiment of Stroop task. So, we can say that incongruency interference can also occur across the visual field and across the different intensity of emotional driven stimuli.

This study also demonstrated that non-righthanded individuals perform better as compare to right handed individuals in terms of their reaction times for word and image stimuli in parallel visual field presentations and similar pattern of results were seen in split visual field presentations. In split visual field presentations non-right handers had overall better performance as compared to right handers. These results were showing because of unilateral or bilateral hemispheric dominance in an individual. Study suggests that right handers show high level of unilateral dominance as compare to non-right handers so that right hander can outperform in split visual field and non-right hander performed better in parallel visual field presentations. Benbow (1986, 1988), Beratis et al. (2010) and O'Boyle et al. (1995) documented that the non-right handed subjects were perceived the stimuli in a lesser amount of time as compare to right handed subjects in the visual perception of Stroop task.

There were enough results found in the favour of right hemisphere advantage for images of emotional faces stimuli as well as left hemisphere advantage was found for word stimuli. However, Right hemisphere advantage documented by Barnett (2008), Beratis et al. (2010) and numerous of previous studies. It should be noted that, in this study stimuli were taken in the form of different images like emotional faces, in place different color ink words as we generally take in traditional Stroop task and stimuli were presented in two different visual field presentations like split and parallel visual field. In addition to the findings of current research supports left hemisphere advantage for verbal task as we can see in the various previous results like Goldenberg & Arnet (1991) and others.

Conclusion:

The study was concentred upon the different handed especially right and non-right- handed samples. The results of the current study deliver sufficient support to proposed two hypothesis, as well as it also supports different findings and theories that discussing an interaction of handedness and perception or cognitive functions. Further this study also gives different insight to understand the effect of handedness on Stroop like task as well as hemispheric dominance on perception of verbal and nonverbal materials. Apart from handedness, visual field is also a factor that effects visual perception that was also explained in this study.

References:

1. Andrade. J., Henderson. L. &Kamiar. A.

(1996). Automaticityin Relation to the Stroop Interference Effect as a Consequence of MisspelledColor WordsRetrieved April 3. 2014 from the World Wide Web: hypertext transfer protocol: //www. psych. ufl. edu/~levy/96_5. htm.

2. Barnett, K. J. (2008). Colour knowledge: The role of the right hemisphere in colour processing and object colour knowledge. Laterality, 13, 456-467, doi: 10.1080/13576500802146387
3. Benbow, C. P. (1986). Physiological correlates of extreme intellectual precocity. Neuropsychologia, 24, 719-725. doi: 10.1016/0028-3932(86)90011-4.
4. Benbow, C. P. (1988). Sex differences in mathematical reasoning ability in intellectually talented preadolescents: Their nature, effects and possible causes. Behavioral and Brain Sciences, 11, 169_232.
5. Beratis, I. N., Rabavilas, A. D., Kyprianou, M., Papadimitriou, G. N., and Papageorgiou, C. (2013). Investigation of the link between higher order cognitive functions and handedness. J. Clin. Exp. Neuropsychol. 35, 393–403. doi: 10.1080/13803395.2013.778231.
6. Beratis, I. N., Rabavilas, A. D., Papadimitriou, G. N., and Papageorgiou, C. (2010). Effect of handedness on the Stroop colour word task. Laterality 15, 597–609. https://doi.org/10.1080/13576500903071104
7. Bogen, J. E. (1969). The other side of the brain II: An appositional mind. Bull. Los Angelesneurol. Sec. 34. 135-162.
8. Bogen, J. E. (1979). The calosal syndrome. In K. M. Heilman & E. Valenstein (Eds.), Clinical neuropsychology. (pp. 308-358). New York: Oxford University Press.
9. Bosman, F., Van Der Bilt, A., Abbink, J.H. And Van Der Glas, H.W. (2004), Neuromuscular Control Mechanisms In Human Mastication. Journal of Texture Studies, 35: 201-221. DOI:10.1111/j.1745-4603.2004.tb00833.x
10. Bradshaw, J. L., & Nettleton, N. C. (1981). The nature of bemispherie specialization in man, Behavioral and Brain Sciences, 4, 51-91.
11. Bradshaw, J. L., & Nettleton, N. C. (1981). The nature of hemispheric specialization in man. Behavioral and Brain Sciences, 4(1), 51–63.
12. Brega, A. G., & Healy, A. F. (1999). Sentence interference in the Stroop task. Memory & Cognition, 27, 768-778.
13. Cattell, James M. (1896). Address of the president before the American Psychological Association, 1895, Psychological Review. 3(2), 1-15. https://doi.org/10.1037/h0071520
14. Cohen, G., (1977). Hemispheric differences in a letter classification task. Perception andPsychophysics, 11, 139-142.
15. Cohen, J. D., Dunbar, K., & McClelland, J. L. (1990). On the control of automatic processes: A parallel distributed processing account of the Stroop effect. Psychological Review, 97, 332-361.
16. Corballis, M. C. (1980). Laterality and myth. American Psychologist, 35(3), 284–295.
17. Corballis, M.C. and Beals, I.L. (1976) The Psychology of left and right, Hillsdale, NJ: Lawrence Erlbaum.
18. Coren, S. (1989). Left-handedness and accident-related injury risk. American Journal of Public Health, 79(8), 1040-41. DOI: 10.2105/ajph.79.8.1040
19. Coren, S., & Porac, C. (1980). Birth factors and laterality: Effects of birth order, parental age, and birth stress on four indices of lateral preference. Behavior Genetics,10(2), 123-138. DOI: 10.1007/BF01066263
20. David, H.P. (1992), Born Unwanted: Long-Term Developmental Effects of Denied Abortion. Journal of Social Issues, 48: 163-181.
21. Dax, M. (1836). Read at CongrèsMéridional at Montpelier Gaz. Hebdom. Méd. Chirurg. 11, 259–260
22. Dimond, S. (1971). Hemisphere function

and word registration. Journal of Experimental Psychology, 87, 183-186. https://doi.org/10.1037/h0030516

23. Dyer, F. N. (1973). The Stroop phenomenon and its use in the study of perceptual, cognitive, and response processes. Memory & Cognition,1(2), 106-120.
24. Ehri, L. C. (1976). Do words really interfere in naming pictures? Child Development, 44, 502 - 505.
25. Gazzaniga, M. S. (1970). The bisected brain, New York: Appleton-Century-Crofts.
26. Gazzaniga, M. S., & LeDoux, J. E. (1978). The integrated mind, New York: Plenum Press.
27. Glaser, M. O., & Glaser, W. R. (1982). Time course analysis of the Stroop phenomenon. Journal of Experimental Psychology: Human Perception and Performance, 8(6), 875–894.
28. Goldenberg, G., & Artner, C. (1991). Visual imagery and knowledge about the visual appearance of objects in patients with posterior cerebral artery lesions. Brain and Cognition, 15, 160-186.
29. Goolkasian, P. (1981). Retinal location and its effect on the processing of target and distractor information. Journal of Experimental Psychology: Human Perception and Performance, 7(6), 1247–1257.
30. Joseph, R. (1982). The neuropsychology of development: Hemispheric laterality, limbic language and the origin of thought. Journal of Clinical Psychology, 38, 4–33.
31. Joseph, R. (1988b). Reversal of cerebral dominance for language and emotion in a corpus callosotomy patient. Journal of Neurology, Neurosurgery, and Psychiatry, 49, 628-634.
32. Joseph,R. (1988a). Confabulation and delusional denial: Frontal lobe and lateralized influences. Journal of Clinical Psychology, 42, 845-860.
33. Klatkzy, R. L., & Atkinson, R. C. (1970). Memory seans based on alternative test stimulus.
34. Levy, J. (1983). Language, cognition and the right hemisphere. American Psychologist, 38, 538-541.
35. Levy, J., & Reid, M. (1976). Variations in writing posture and cerebral organization. Science, 194, 337–339.
36. MacLeod, C. M. (1991). Half a century of research on the Stroop effect: An integrative review. Psychological Bulletin, 109(2), 163-203.
37. Mandal, M.K. & Dutta, T. (2001). Left-handedness: Facts and figures across cultures. Psychology and Developing Societies, 13(2), 173-191 doi.org/10.1177/097133360101300204
38. Mandal, M.K., &Ambady, N. (2004). Laterality of facial expressions of emotion: Universal and culture-specific influences. Behavioural Neurology, 15, 23-34. DOI: 10.1155/2004/786529
39. O'Boyle, M. W., Benbow, C. P., & Alexander, J. E. (1995). Sex differences, hemispheric laterality, and associated brain activity in the intellectually gifted. Developmental Neuropsychology, 11, 415-443. https://doi.org/10.1080/87565649509540630
40. Rosinski, R. R., Golinkoff, R. M., & Kukish, K. S. (1975). Automatic semantic processing in a picture-word interference task. Child Development, 46(1), 247–253.
41. Schmit, V., & Davis, R. (1974). The role of hemispheric specialization in the analysis of Stroop stimuli. Acta Psychologica, 38(2), 149–158.
42. ShiffrinR. M., Schneider W. (1977). Controlled and automatic human information processing. II. perceptual learning, automatic attending, and a general theory. Psychol.Rev. 84, 127– 190.
43. Simon, J. R., Paulline, C., Overmyer, S. P., &Berbaum, K. (1985). Reaction time to word meaning and ink color of laterally-presented stroop stimuli: Effects of

handedness and sex. International Journal of Neuroscience, 28, 21-33.
44. Smith, M. C., & Magee, L. E. (1980). Tracing the time course of picture–word processing. Journal of Experimental Psychology: General, 109(4), 373–392.
45. Sperry, R. (1966). Brain bisection and the neurology of consciousness. In J. C. Eccles (Ed). Brain and conscious experience (pp. 298–313). New York: Springer-Verlag.
46. Sperry, R. (1973). Lateral specialization of cerebral function in the surgically separated hemispheres. In F. J. McGuigan and R. A. Schoonover (Eds.), The psychophysiology ofthinking: Studies of covert processing. New York: Academic Press.
47. Sperry, R. (1982). Some effects of disconnecting the cerebral hemispheres. Science, 217, 1223–1226.
48. Stroop, J. R. (1935). Studies of interference in serial verbal reactions. Journal of Experimental Psychology, 18, 643-662.
49. Suar, D., Mandal, M. K., Misra, I., & Suman, S. (2007). Lifespan trends of side bias in India. Laterality, 12 (4), 302-320.
50. Thompson, A. L., Bogen, J. E., & Marsh, J. F. (1979). Cultural Hemisphericity: Evidence from Cognitive Tests. International Journal of Neuroscience,9(1), 37-43.
51. Uddin, M. K., Kawabe, T., &Nakamizo, S. (2005). Attention shift not memory averaging reduces foveal bias. Vision Research,45(25-26), 3301-3306.
52. Uzzaman A, Karim A (2017), Emotional Intelligence Scale: Assessing its Psychometric Characteristics in Bangladeshi Culture, International Journal of Indian Psychology, Volume 4 (2) DOI: 10.25215/0402.032
53. Weekes N. Y., Zaidel E. (1996). The effects of procedural variations on lateralized Stroop effects. Brain Cogn. 31, 308–330 10.1006/brcg.1996.0049.
54. Wexler. B.E., (1980). Cerebral laterality and psychiatry: a review of the literature. American Journal of Psychiatry,137, 279-291.
55. Zangwill, O. L. (1976). Thought And The Brain. British Journal of Psychology,67(3), 301- 314.